Communications
in Computer and Information Science 144

Gang Shen Xiong Huang (Eds.)

Advanced Research on Electronic Commerce, Web Application, and Communication

International Conference, ECWAC 2011
Guangzhou, China, April 16-17, 2011
Proceedings, Part II

Springer

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ISSN 1865-0929 e-ISSN 1865-0937
ISBN 978-3-642-20369-5 e-ISBN 978-3-642-20370-1
DOI 10.1007/978-3-642-20370-1
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: Applied for

CR Subject Classification (1998): H.3.3-5, H.4-5, H.2.4, J.1, I.2.6

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Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India

Printed on acid-free paper

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Preface

The International Science & Education Researcher Association (ISER) puts its focus on the study and exchange of academic achievements of international researchers, and it also promotes education reform in the world. In addition, it serves as an academic discussion and communication platform, which is beneficial for education and for scientific research, aiming to stimulate researchers in their work.

The ECWAC conference is an integrated event concentrating on electronic commerce, Web applications and communication. ECWAC 2011 was held during April 16–17, 2011, in Beijing, China, and was co-sponsored by the International Science & Education Researcher Association, Beijing Gireida Education Co. Ltd. The goal of the conference is to provide researchers working in the field of electronic commerce, Web applications and communication based on modern information technology with a free forum to share new ideas, innovations and solutions with each other. In addition, famous keynote speakers were invited to deliver talks and participants had the chance to discuss their work with the speakers face to face.

In these proceedings, you can learn more about the field of electronic commerce, Web applications and communication with contributions by researchers from around the world. The main role of the proceedings is to be used as a means of exchange of information, for those working in the field. The Organizing Committee did its best to meet the high standard of Springer's, Communications in Computer and Information Science series. Firstly, poor quality papers were rejected after being reviewed by anonymous referees. Secondly, meetings were held periodically for reviewers to exchange opinions and suggestions. Finally, the organizing team had several preliminary sessions before the conference. Thanks to the efforts of numerous individuals and departments, the conference was successful and fruitful.

In organizing the conference, we received help from different people, departments and institutions. Here, we would like to extend our sincere thanks to the publisher Springer, for their kind and enthusiastic assistance and support of our conference. Secondly, the authors should be thanked too for submitting their papers. Thirdly, all members of the Program Committee, the Program Chairs and the reviewers are appreciated for their hard work.

In conclusion, it was the team effort of all these people that made our conference successful. We welcome any suggestions from the participants that may help improve the conference in the future and we look forward to seeing all of you at ECWAC 2012.

January 2011 Gang Shen ISER Association

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Research on Modeling and Simulation for IR Image of Star&Sky Background

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Abstract. Background modeling is always a difficulty in generating infrared graphics with computer. This paper analyzed and contrasted two common methods in infrared background graphics simulation. Integrate with the characteristic that the star's imaging is relative simple, a new modeling and simulation method of star&sky background graphic modeling based on infrared star tableue data was raised after analyzing the infrared radiation characteristics of stars and sky.

Keywords: star&sky background; infrared imaging simulation; image generation; IR radiation.

1 Introduction

Space has become the key point of the high-tech war. The important role of space to war has reached an unprecedented status. Utilizing and control of space will directly affect the process of war in the future[1]. In view of the important role of space in the future war, the precise guidance weapons use in space war get a rapid development as the same time. The infrared imaging guidance weapon show unique advantages because of the cold and high vacuum conditions in space, so it has become the research focus in space precise guidance weapons.

The performance of infrared imaging guidance weapons could be test and evaluated by target practice and laboratory simulation. Data from target practice are the most authoritative data, which are most able to reflect the true performance of weapons. However, the defect is obvious, on the one hand, to get the data we must spend huge human, financial and material resources, and on the other side, the pressure is very big from the international community if we execute the target practice. In comparison, test and evaluation the performance of the infrared imaging guidance weapons through laboratory simulation approach is not only lower cost but also easier to simulate a variety of environmental conditions to test performance from a full range of view[2].

The supply of IR scene image signals is the key problem of laboratory simulation, and the rapid development of technology on IR imaging simulation provides a very effective way to solve this problem. The infrared image of space mainly consists of three elements, namely: space target, star background and various disturbances. Modeling of background is always the difficulty of the IR scene simulation. Generally speaking, there are two methods for IR background image simulation[1]. One method, which is as same as the target simulation in principle, uses CAD to generate the

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 1–6, 2011.
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geometric view of the background at first. And then the temperature distribution of the background is calculated by the model from experience method or basic model method. At last, the IR image is simulated in the basis of model. The advantage of this approach lies in that the simulated IR images of background show more realistic. However, because the background model is a three-dimensional model, the IR image generation requires a lot of time in rendering and other processing. So if the background model is too complex, it is difficult to meet the requirement of real-time. Another method is to obtain the real IR images of background, in which the useless targets are removed and the effect of atmosphere is calculated to equivalent value of zero distance from IR sensor. And after that, the target is inserted into the background by synthesizing the simulated background IR image and the simulated target IR image, which is generated by accurate three-dimensional target IR mode. In this way, the background is just look as a map, so the speed of processing gets a greatly increased. Obviously, a number of real IR image of background are required if we want to generate IR images by this method.

The simulation of star and sky background IR image has its own characteristics, such as the geometric shapes of the star in the IR image is very simple, and the IR radiation is very difficult to calculate in theory. We could not get the satisfactory star and sky background IR image if we use the previous two methods directly. So we present a new method for generating the star and sky background IR image based on IR star table.

Use italic for emphasizing a word or phrase. Do not use boldface typing or capital letters except for section headings (cf. remarks on section headings, below). Use a laser printer, not a matrix dot printer.

2 Modeling of Star and Sky Background

The background of space target is the star and sky background which is mainly consisted of deep space and the stars. In addition to various types of stars (stars and planets), the cosmic background radiation of deep space temperature is about 3.5K[2]. According to Wayne displacement theorem, the peak wavelength λ_m is about 827.9 μm when the temperature is 3.5K. At present, the peak wavelength of infrared sensors for military is generally less than 20 μm, so the infrared radiation of deep space can be neglected in the simulation.

2.1 Infrared Radiation Characteristics of Star

The calculated method of star irradiance on the top of atmosphere in theory is presented in the paper of [2], which requires the visual magnitude level and the temperature of the star. However, general speaking, it is very difficult for us to get those data of star, and the calculation is very large as the same time, so it is difficult to apply the method to the background infrared image simulation.

LRS star table, which is published by IRAS of NASA in 1978, is one of the many achievements on stars observing in the infrared band. This infrared star table is manufactured according to the spectral irradiance data from 1.4994~27.1275 μm band, corresponding to 200 sampling points. The star positions in the star table have all

been converted to the beginning of 1950, and are shown with the 1950.0 geocentric inertial coordinate system. Therefore, we can use the LRS infrared star table as our data sources of calculating the stars' irradiance on the top of atmosphere. The irradiance of stars in the specified band can be obtained as the following:

$$\int_{\lambda_1}^{\lambda_2} E_\lambda d\lambda = \sum_{\lambda_1 \le \lambda \le \lambda_2} E_\lambda \cdot \triangle \lambda_i \tag{1}$$

In above equation, E_λ is the irradiance of sampling points, and $\triangle \lambda_i$ is the wavelength between two sampling points. For any infrared sensor, as long as the work band of the sensor lies in wavelength of LRS star table, the irradiance of the stars in the sensor, which is as same as the irradiance on the top of atmosphere, can be calculated approximately through equation (1).

2.2 Modeling of Star Infrared Image

As the nearest star is about 4.2 light years from the earth[3], so we can look star as a point radiance sources in simulation. In ideal condition, a star in star and sky background image is shown as a bright spot of single pixel. The gray value can be calculated using the following method:

$$G_{\mathrm{i}} = G_{\min} + (E_{\mathrm{i}} - E_{\min}) \cdot \frac{G_{\max} - G_{\min}}{(E_{\max} - E_{\min})} \tag{2}$$

In above equation, $E_{\max}$ is the maximum infrared irradiance of the star in a band. $E_{\min}$ is the minimum infrared of the star in the band. The gray value of the star in the star and sky infrared background changes from $G_{\min}$ to $G_{\max}$. E_i is the infrared irradiance of any star and G_{i} is the gray value of the corresponding star.

In actual situation, because the diffraction effect of the infrared sensor the infrared image of a star always is a spot with a little area. Therefore, the diffraction effect of the infrared sensor should be considered for the need of generating the realistic star and sky background infrared image. In computer simulation, we can use the Gaussian distribution to a point to simulate the diffusion effect.

General speaking, if the center gray values of two stars are same, their star spot images are same too. Taking into account the gray levels of a image are always limited (generally less than 256) as the same time, we can generate the star infrared images with different center gray value before star and sky background infrared image simulation. And these star infrared images are stored as the file of bmp format. When we want to simulate the star and sky background infrared image, the star infrared image files are read into memory according to some rules at first, and then directly "paste" the specified star images to the background in the appropriate locations.

3 Simulation of Star and Sky Background Infrared Image

3.1 Preprocess of LRS Star Table

There are 5425 records in LRS star table, which are the result of observing and measuring to 5425 different stars and each record contains 960 bytes of data. In these data,

there are useful information included the star location, star infrared irradiance, and so on, and other useless information included noise, the average sample value and so on. As the same time, the star location in the star table is described in 1950.0 geocentric inertial coordinate system, while the location of the satellite target and the sensor in the simulation is described in geocentric inertial coordinate system of simulation time. So it is necessary to preprocess the LRS star table for generating the star and sky background infrared images. The whole preprocess include the selection and transformation of data in star table.

In this paper, we only retained the longitude, latitude, longitude self motion, latitude self motion and infrared irradiance of a star and discarded other data which have nothing to do with this paper. It is should be noted that we only retained the infrared irradiance data which lies in the band of sensor, and we can get a whole infrared irradiance by using the equation of (1).

The main aim of the transformation of the LRS star table is to transform the star location from 1950.0 geocentric inertial coordinate system to the geocentric inertial coordinate system in simulation time. The star location can be transformed by modifying the self motion and nutation[4] of star.

3.2 Judgment of Stars Entered in Field of Sensor

The stars in the star and sky background are those can be found in the view of sensor. So it is very important to find the stars that can appear in the view of sensor. The judging criteria are: suppose the view vector of a star is an unit vector pointing from the sensor to the star, and all stars those angle between their view vector and the view line of sensor is smaller than angle radius of the sensor both in horizon and pitch. If the field of view of the sensor is $FOV_x \times FOV_y$, the star's longitude is α_i,the star's latitude is δ_i, the longitude and latitude of sensor's view vector are α_{de} and δ_{de}, and if the star stay in the filed of view of the sensor, then the following relationship is founded:

$$\begin{cases} |\alpha_i - \alpha_{de}| \le (FOV_x / 2) \\ |\delta_i - \delta_{de}| \le (FOV_y / 2) \end{cases} \tag{3}$$

Any star meet the condition of (3) is visible star from the view of sensor.

3.3 Determination of the Relative Position Distribution of Stars in the Star and Sky Background Image

The sensor imaging is actually to project the three-dimensional scenes within the sensor field of view onto the image plane as the view axis of sensor, forming a two-dimensional image. The smaller is the angle between the star view vector and the view axis of the sensor, the closer is the distance between the star and the center of the background infrared image. It is a linear relationship. Suppose the longitude and latitude of the sensor view axis are α_{de} and δ_{de}, the longitude and latitude of a visible star are α_i and δ_i,the coordinate of the star image is (x_i', y_i'), the spatial resolution of the simulated image is $N_x \times N_y$, then we can get the equation as following:

$$\begin{cases} \dfrac{x'}{(N_x/2)} = \dfrac{\alpha_i - \alpha_{de}}{(FOV_x/2)} \Rightarrow x' = (\alpha_{de} - \alpha_i)\dfrac{N_x}{FOV_x} \\ \dfrac{y'}{(N_y/2)} = \dfrac{\delta_i - \delta_{de}}{(FOV_y/2)} \Rightarrow y' = (\delta_{de} - \delta_i)\dfrac{N_y}{FOV_y} \end{cases} \tag{4}$$

3.4 Generation of Star and Sky Background Infrared Image

After calculating the relative position distribution of stars in the star and sky background image, we can get the center gray value of the visible star by the infrared irradiance of visible star, and generate the star and sky background infrared image by copying the corresponding star image generated before to the corresponding location.

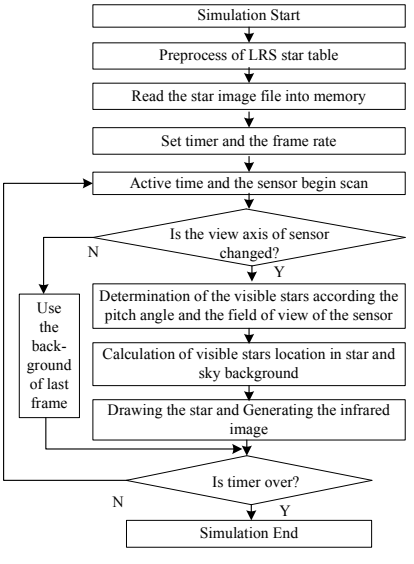


Fig. 1. The flow chart of dynamic generation of star and sky background infrared images

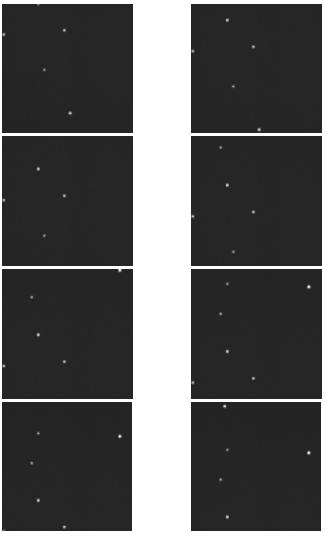


Fig. 2. Infrared sequence images of star and sky background

We designed the star and sky background dynamical infrared image generation program with VC++6.0 in Windows platform. Fig. 1 is it's flow chart. Fig. 2 is infrared sequence images of star and sky background. The frame rate is 25 frames every second, and the sensor is scanning in pitch direction with a speed of 15° every second.

4 Conclusions

For complex space targets such as satellites, space stations, their infrared images can use the method from the literature [5] to generate real-time infrared images. After

generation, according to the view axis of the sensor, we can generate the space scene infrared images by synthesizing the space target infrared image and star and sky background infrared image from gray normalization. These images can be used as infrared source to exanimate the performance of infrared imaging guidance weapon from a whole view.

Acknowledgments. This Paper is supported by the Youth Foundation of Naval Aeronautical and Astronautical University which number is 01D028.

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A Ray Casting Accelerated Method of Segmented Regular Volume Data

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Abstract. The size of volume data field which is constructed by large-scale war industry product ICT images is large, and empty voxels in the volume data field occupy little ratio. The effect of existing ray casting accelerated methods is not distinct. In 3D visualization fault diagnosis of large-scale war industry product, only some of the information in the volume data field can help surveyor check out fault inside it. Computational complexity will greatly increase if all volume data is 3D reconstructed. So a new ray casting accelerated method based on segmented volume data is put forward. Segmented information volume data field is built by use of segmented result. Consulting the conformation method of existing hierarchical volume data structures, hierarchical volume data structure on the base of segmented information is constructed. According to the structure, the construction parts defined by user are identified automatically in ray casting. The other parts are regarded as empty voxels, hence the sampling step is adjusted dynamically, the sampling point amount is decreased, and the volume rendering speed is improved. Experimental results finally reveal the high efficiency and good display performance of the proposed method.

Keywords: ICT, image segmentation, hierarchical volume data structure, volume rendering, ray casting.

1 Introduction

Visualization of 3D regular volume data can be classified into two kinds in terms of the difference of data description method during rendering[1]. One is called surface rendering, the other is called volume rendering. Volume rendering can display hair-like structure and imperceptible change inside object in different extent. It also can show texture attribute, shape characteristic and mutual level relation of each part in the reconstructed object. So volume rendering method is chosen to reconstruct large-scale war industry product in its 3D visualization fault diagnosis which based on ICT images.

Ray casting method has the highest rendering quality and is most widely used in volume rendering method at present[2]. But rendering speed of conventional ray casting method is slow. Sampling and image synthesis are calculated again if observe orientation is changed. Therefore the efficiency of conventional method is low. Data quantity of the 3D regular volume data field which is made up of large-scale war industry product ICT images is big. The disadvantage of conventional method is more obvious.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 7–12, 2011.
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Researchers at home and abroad put forward many improved algorithms of ray casting method in recent years. These algorithms can be classified into two kinds. One makes use of the relativity in image space to reduce the number of ray. The algorithms proposed by Zhao Jian[3] and M. Levoy[4] belong to this kind. They didn't cast ray from all pixels of image plane. They used the relativity of neighboring pixels to choose which ray to cast. But display result of this kind algorithm is not better, so it isn't main direction at present. The other kind makes use of the relativity in object space to reduce the number of sampling point which is needless. The algorithms proposed by Hong qi[5], R. Yagel[6], J. Willtelms[7], M. Agate[8], K. R. Subramanian[9] and C. Suneup[10] belong to this kind. Former five researchers of them adopted hierarchical volume data structure to reorder 3D regular volume data field. Then the empty voxels which made no difference to display result are jumped over. C. Suneup defined a valuation which indicated the distance between empty voxels and non-empty voxels. Empty voxels are overleaped in the process of volume rendering by the valuation. This kind of algorithms reduces computational complexity in different extent, and improves rendering speed on the premise of maintaining image quality.

The improved algorithms described above aim at medical 3D volume data field which empty voxels occupy higher ratio. Such as examinational human head CT data, it contains 73 percent[5] empty voxels through statistical analysis. However, in large-scale war industry product like solid motor, volume data filed is big and empty voxels ratio is finite. The accelerated effect of above accelerated algorithms is not distinct. Therefor, on the base of the segmented result which described in the national invention patent[11] applied by this paper authors, and consulting the hierarchical volume data structure accelerated methods expounded in papers [5-9], a new ray casting accelerated method based on segmented regular volume data is put forward in this paper.

2 Description of Accelerated Method

The design idea of the accelerated method in this paper is as follows: On the base of segmentation pre-processing, 3D regular volume data field which contains segmented information is constructed. Then consulting hierarchical volume data structure accelerated methods, a new ray casting accelerated method is designed. In the new method, user customs the parts needed to 3D reconstruct, and the other parts are regard as empty voxels and overleaped.

2.1 Construct Segmented Information Volume Data Field

2D serial tomography images of large-scale war industry product such as solid motor can be obtained from high energy ICT testing system. These images can be arranged into 3D regular volume data field. We commonly suppose the size of 3D regular volume data field is $L \times M \times N$. 3D regular volume data field is illustrated in Fig. 1.

Voxel coordinates is defined as (i, j, k) in data field where $i = 0,1,\cdots,L-1$, $j = 0,1,\cdots,M-1$, $k = 0,1,\cdots,N-1$. Recording value of each voxel is the gray value generated after ICT testing. In segmented 3D regular volume data field, each voxle

has its own sort. For an instance, there are six kinds components segmented in solid motor which described in paper [11]. They are background, air ring artifact, shell, propellant, star hole and inside defect. In a general way, we suppose there are K kind components in data field. Then we construct a data field which space coordinates structure is the same as the 3D regular volume date field illustrated in Figure 1. The difference in our data filed is recording value of each voxle is not the gray value but the sort value. The sort value is defined as $C(i, j, k)$, $C(i, j, k) = 1, 2, \cdots, K$。

2.2 Establish Hierarchical Volume Data Structure

In segmented information volume data field, not all of the data is significative. Such as in solid motor volume data field, reconstructed background and air ring artifact are useless. In a general way, we suppose the a and b part of object need to reconstruct, namely $C(\mathbf{i}) = a, C(\mathbf{i}) = b$ where $a, b = 1, \cdots, K$ and $a \neq b$. So the other parts are regarded as empty voxels.

To construct the hierarchical volume data structure, we do the following: If cell $V_0(\mathbf{i})$ in the original volume data field V_0 doesn't belong to the a or b part, the cell value is zero, otherwise it is one. Cell $V_m(\mathbf{i})$ in any volume data field V_m, m >0, contains a zero if all eight cells on level $m-1$ that form its octants contain zeros, otherwise $V_m(\mathbf{i}) = 1$. The formulas are as follows.

Cell value in level 0 volume data field V_0 :

$$V_0(\mathbf{i}) = \begin{cases} 1 & C(\mathbf{i}+\Delta\mathbf{i}) = a \text{ or } C(\mathbf{i}+\Delta\mathbf{i}) = b \\ & \text{for } \mathbf{i} \in \{1, 2, \cdots, N-1\}^3 \text{ and } \Delta\mathbf{i} \in \{0,1\}^3 \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

$$V_m(\mathbf{i}) = \begin{cases} 1 & V_{m-1}(2\mathbf{i}-\Delta\mathbf{i}) = 1 \\ & \text{for } \mathbf{i} \in \left\{1, 2, \cdots, \frac{N-1}{2^{m-1}}\right\}^3 \text{ and } \Delta\mathbf{i} \in \{0,1\}^3 \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

In formula (2), let $\{1, 2, \cdots, N-1\}^3$ be the set of all 3-vectors with entries $1, 2, \cdots, N-1$. In the same way, we can know the meanings of $\{0,1\}^3$ and $\left\{1, 2, \cdots, \frac{N-1}{2^{m-1}}\right\}^3$.

2.3 Realization Process of Accelerated Method

We reformulate ray casting method by use of hierarchical volume data structure constructed in previous section.We first compute the point where the ray enters the single cell at the level M volume data field V_M . When we enter a cell, we test its value. If it contains a zero, we don't sample in it and advance along the ray to the next cell on the same level. On the other hand, if the cell being tested contains a one, we move down

one level, and test the cell value sequentially. If the parent of adjacent cells is different, we move up to higher level volume data field to test cell value. Then operate on the whole volume data field use the same manner. Thus, in volume field, the more empty voxels contained the more computational time is saved. If we are already at the level 0 volume data field V_0, we know that one or more of the eight voxels at the vertices of the cell belong to *a* part or *b* part. We then draw samples at evenly spaced locations along that part of the ray falling within the cell, resample the data at these sample locations. Flow chart to show the process is illustrated in Fig. 2.

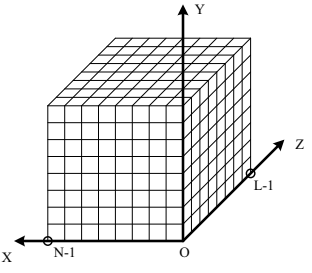


Fig. 1. 3D regulation volume data field

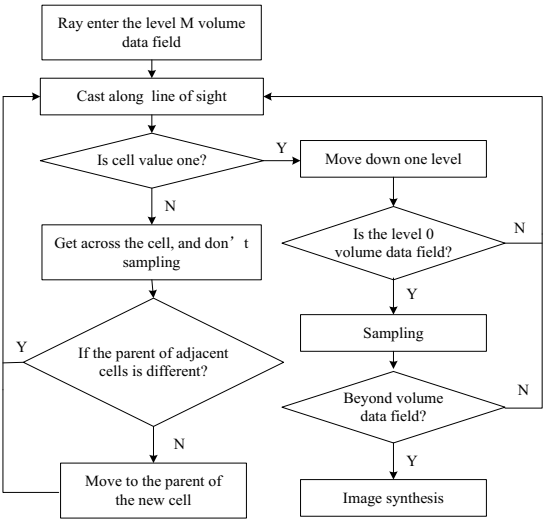


Fig. 2. Flow chart of accelerated method realization

2.4 The Example of Accelerated Method

In order to explain the accelerated method distinctly, we use the result of segmented solid motor which introduced in paper [11] to describe the construction of hierarchical volume data structure based on segmented information and the realization process of ray casting accelerated method in 2D space. The example is illustrated in Fig. 3.

Fig. 3(a) is a piece of original solid motor ICT image. It can be segmented into background, air ring artifact, shell, propellant, star hole and inside defect which is defined as 1, 2, 3, 4, 5 and 6. We choose partial region in Fig. 3(a) whose size is 16×16 pixels. Figure 3(b) shows the digital form of the selected region. On the base of Fig. 3(b), we render the interested defect part inside solid motor, so the other five parts can be regarded as empty voxels. Ray casting in 2D hierarchical volume data structure is illustrated in Fig. 3(c), and the blank blocks denote empty voxels which defined as 0, dark blocks denote defect part.

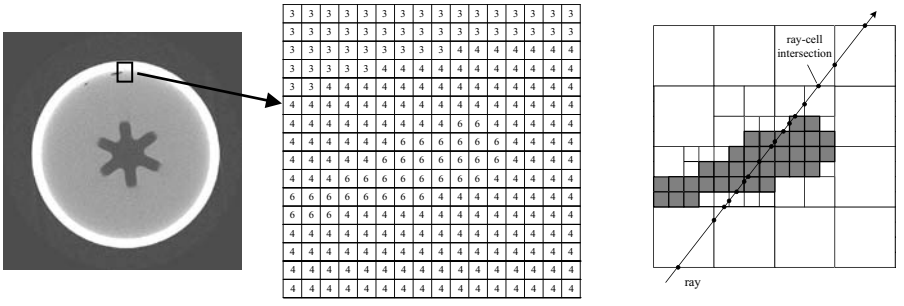


Fig. 3. Ray casting accelerated method of segmented solid motor

3 Experiment Result

We adopt C++ language and OpenGL to program. The computer configuration is Centrino II 2.20HZ CPU, 2GB memory, GeForce 8400GS 256M memory display card. Data source is the solid motor ICT series images supplied by naval nondestructive testing center. The size of data source is 1024×1024×120. After eight times magnified interpolation in Z axis, the size of volume data field is 1024×1024×960. Then we 3D reconstruct the solid motor by the ray casting accelerated method introduced in this paper. The reconstruct results are illustrated in Fig. 4.

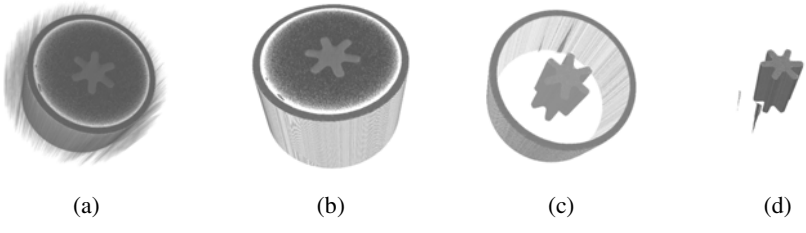


Fig. 4. Results of 3D reconstruction

Fig. 4(a) is reconstructed result of the original non-segmented ICT series images. It is obvious that there is air ring artifact around. Fig. 4(b) is reconstructed result of the volume data field whose air ring artifact is wiped off. Fig. 4(c) is reconstructed result of shell, defects and star hole. Fig. 4(d) is reconstructed result of defects and star hole. The amount of empty voxels in volume data field is increasing from Fig. 4(a) to Fig. 4(d), and the accelerated result of the method in this paper is more and more obvious.

4 Conclusion

We pay attention to the space position and size of insight defects in 3D visualization fault diagnosis of large-scale war industry product. In volume data field which formed

by ICT series images, not all of the voxels are significant in defects testing. Ray casting accelerated method based on segmented volume data field is put forward in this paper. The essential of the accelerated method is the parts which not need to reconstruct after segmented are regarded as empty voxles. Then hierarchical volume data structure on the base of segmented information is constructed. So the sampling step is adjusted dynamically, and the sampling point amount is decreased. Experimental results reveal that solid motor is reconstructed rationally on the base of segmented result by this paper method. Volume rendering speed is improved obviously and at the same time veracity and accuracy of defects testing are ensured in solid motor 3D visualization fault diagnosis.

Acknowledgments. This Paper is supported by the National Natural Science Foundation of China which number is 51005242.

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Design and Implementation of Service-Oriented Learning Resource Grid Demonstration System

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Abstract. Combined the technology of service-oriented with learning resource grid, this paper proposed its solution of demonstration system. Firstly, the architecture of learning demonstration system was given, and the services in the system were discussed. Then the learning resource grid demonstration system was designed from the data supporting layer and visualization layer in detail. Finally, the implemented system not only showed the service invocation process visually, but also let learners or users get a deeper understanding about grid.

Keywords: Learning Resource Grid (LRG); Grid Demonstration System; Grid Visualization; Service.

1 Introduction

In the initial stage of grid development, "Data Grid" and "Computing Grid" achieves success firstly. Along with the progress of research and practice, grid is evolving from computing for central to resources sharing. Foster presents that resources sharing in virtual organization is grid essence in paper "The Anatomy of the Grid: Enabling Scalable Virtual Organizations"[1]. All sharing resources in grid are described as services, grid is transforming from computing science to commercial field, and service-oriented grid research is becoming a hotspot gradually.

The demonstration system, visualization software, provides the visual demo for service-oriented learning resource grid which has been constructed. Designing and researching the demonstration system promotes understanding the concept, the way of working and the service invocation process in grid.

2 LRG Demonstration System

2.1 Architecture

In LRG demonstration system, physical resources were described uniformly and packed to services distributed on grid service platform, such as downloading service and searching service. All advanced applications invoke needed services by using grid middleware and application software. The architecture is shown in Fig. 1.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 13–19, 2011.
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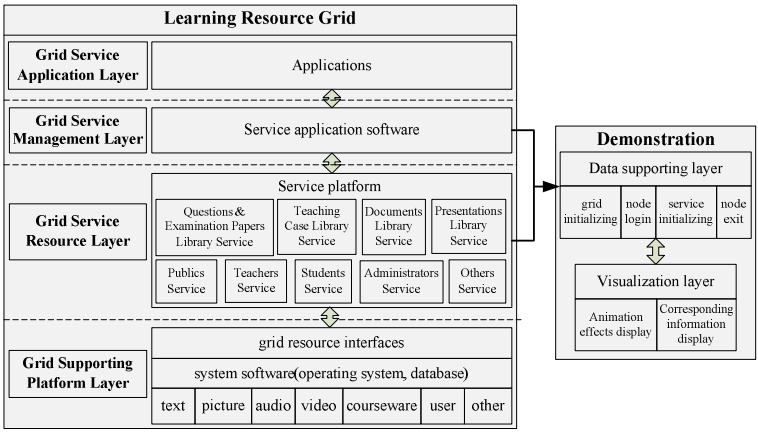


Fig. 1. Architecture of LRG demonstration system

LRG demonstration system includes two parts: LRG and the demonstration of LRG. The architecture of LRG, based on the Open Grid Service Architecture[2], has four layers:

(1) Grid Supporting Platform Layer. The layer is comprised of grid resources, system software and grid resource interfaces. System software which includes operating system and database system reflects the heterogeneous and dynamic characteristic of LRG. Grid resources include kinds of resources. Grid resource interfaces provide corresponding interfaces to access and operate grid resource service software for different users and applications.

(2) Grid Service Resource Layer. It is based on the Grid Supporting Platform Layer, and in this layer learning resources are packed to services which are managed and shared by unified standard interfaces. Focusing on Services is good for concealing the heterogeneity of grid resources.

(3) Grid Service Management Layer. It is the bridge between the upper level applications and the lower level services. It manages all distributed grid services, provides efficient, securing and credible service for grid applications and coordinates operation of whole grid system effectively. It is the crucial layer of the architecture.

(4) Grid Service Application Layer. It mainly includes kinds of grid applications.

The LRG demonstration system gets data from LRG and displays the characteristics of grid friendly by using visualization technology.

(1) Data Supporting Layer. It provides data support for LRG demonstration system and realizes grid and service initializing; node login and exit.

(2) Visualization Layer. The LRG is demonstrated dynamically about process and information.

2.2 Service Design

There are two types of users on LRG service platform, including service providers and service consumers[3]. Service providers register the newly added services to the

Table 1. Service description label

Name	Function	Attribute
portType label	describe the range of service, all labels express the operation of service between <portType> and <portType/>	service name
element label	define the variable of service, including basic and complex variables (data type)	variable name/type
types label	describe the range of variable definition, between <types> and <types/>	null
complex type label	define complex variable (data type), as sub-label of element label	null
operation label	define a method in service	operation name
message label	define a message in service	message name
message PDU label	define a PDU(Protocol Data Unit) of message as sub-label of message label	PDU name
input of operation	define the input of operation as sub-label of operation label	message
output of operation	define the output of operation as sub-label of operation label	message
binding label	describe the access protocol of service	service name

service platform of LRG demonstration system. Service consumers get service information and invoke correlative services from there. Service providers pack the lower level resources to services though service description and registry. Service consumers subscribe, distribute and invoke the required services by use of the upper service application software. The terms are that:

(1) Service Description. It is the foundation of service access and the important content of service subscription and distribution. Service description describes attributes and characteristics of various services in detail. Structural Markup Language is used to describe service, the label defined as shown in Table 1.

(2) Service Registry. When new services are increased, service providers send register information including service ID, URL and type to the registration server. Registration server receives the register information and puts it into the database to facilitate the query. The format of service register message is designed as six PDUs: message type, service ID, node ID of service, service type, node type of service, service URL.

(3) Service Subscription and Distribution. The client process sends service description request message to the server, the server receives the message, extracts information of service ID and sends service description response message to the client process. The format of service description request message includes three PDUs: message type, destination node of message, service ID.

(4) Service Invocation. The client process sends the service call message to the server, and the server receives the message, extracts the service interface and the parameter information, calls the appropriate service function, and returns the service return message to the client. The format of service call message is designed as shown in Fig. 2.

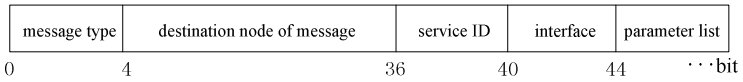


Fig. 2. Format of service call message

According to different learning resource types and served objects, the services of LRG were designed and parted into nine service classes: Questions & Examination Papers Library, Teaching Case Library, Documents Library, Presentations Library, Publics, Teachers, Students, Administrators, Others.

3 LRG Demonstration System Design

LRG demonstration system is visualization software which is based on the LRG. Resources are distributed, dynamic, heterogeneous and autonomous in LRG[4], so LRG demonstration system design principles should have Dynamics, Transparency, Scalability and Operability and so on.

3.2 Data Supporting Layer

Data supporting layer is divided into four modules, grid initialization, node login, service initialization and node exit. Real-time data is get from the service platform and application software of LRG and modules are initialized.

(1) Grid Initialization Module. Data supporting layer get the resource information on the grid from the registration node, including geographical position, attributes of node and registered services. The grid initialization module contains two classes, MapInfor and Gridshow. Class "MapInfor" is used to initialize and operate the logical position of node; Class "Gridshow" is the nucleus of whole grid demonstration.

(2) Node Login Module. It acquires real-time plug and play node information, which is mainly about node geographical position; node attributes (ID, Name etc.) and registered services. The key to this module focused on the time control.

(3) Service Initialization Module. Demonstration service process design is read including the information about service type, service name, service ID, service initial ID and terminal ID. According to service initial ID and terminal ID, actual position is converted to logical position in grid in order to demonstrate the service invocation process.

(4) Node Exit Module. It acquires registered node information periodically, finds the exiting node, deletes them, simulates the real-time situation and shows related information.

3.3 Visualization Layer

The visualization layer is responsible for demonstrating the acquired data from data supporting layer visually, including animation effects display and corresponding information display.

(1) Animation Effects Display Module. The whole process, for example, grid generation, service invocation and node exit, can be displayed with the methods of

Table 2. Function descriptions of Animation Effects Display Module

Function name	Descriptions
public void drawOnlineImage()	display the login node in the animation area parameter: Graphics2D g2d, double x, double y, String ID, int a
public void getid_from_servicexy()	get service initial and terminal ID from logical initial and terminal position parameter: double x, double y
public void drawServiceImage()	show the specific service pictures parameter: Graphics2D g2d, double from_x ,double from_y, double to_x, double to_y, String servicType, String type, double speed_x
public void Self_call_line()	the animation of service self-call parameter: Graphics2D g2d, double x, double y, int chang, String type, int a
public void actionPerformed()	"Timer" event parameter: ActionEvent e
public void Change_Reservic_inc()	change the disply position of service icon no parameter

animation, time control and logic control. The "Timer" mechanism is used to control the nodes twinkling effects and the animation effects of service invocation. The function descriptions are shown in Table 2.

The use of interactive ideas between human and computer, such as the suspension of animation, the prompt of system current time and state, is easy to understand the concept of grid and the whole animation process clearly. The function descriptions of suspension and instruction were designed.

(2) Corresponding Information Display Module. It interprets aforementioned animation effects and gives related information, including service subscription, information publishing display and information refreshment. When information in LRG demonstration system information display area is full, it refreshes and goes on displaying.

LRG demonstration system interacts with users by use of grid service application software whose functions mainly include task submit, result display, service management and service invocation.

4 Implementation

"LRG demonstration system" window pops up with running the LRG demonstration system application. The initial interface is shown in Fig. 3. The animation effects display is located on the left side and the corresponding information display is located on the right side.

The animation effects display were shown on the left in Fig. 4.

(1) Node login and exit grid. Registration server, the initial node of grid, is in the middle of animation area. Other nodes login grid by registration server. Animation area can dynamically display the login and exit of grid nodes. In different are of

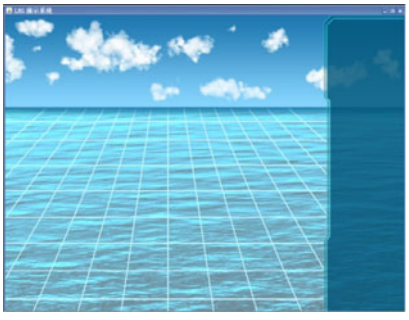


Fig. 3. The initial interface



Fig. 4. LRG demonstration system

animation area the login nodes of grid are shown in different user, flag and color of ID. For example, the login nodes as students are shown in top-left corner with red node ID. In addition, background picture in animation area can be shown and refreshed dynamically.

(2) Time prompt. The prompt of time is located at the upper right quadrant of animation display area. Its function is to show the current stage of demonstration system and what the users can do. For example, animation can be suspended by double-clicking the animation display area and recovered by double-clicking again. The trends of demonstration system can be mastered conveniently.

(3) Service invocation. The process of service invocation is demonstrated. The students subscribe searching learning resource service. The registered node calls the service and return address or results to students. The whole service invocation process is displayed in animation area.

The corresponding information was shown on the right in the same Fig. 4.

(1) Node login and exit grid. The state information of nodes is shown, such as node ID, type, attributes, interface, components and so on.

(2) Service invocation. The name, interface and components of the subscribed and invoked service are shown in synchronism according to the contents of animation display area.

(3) Refreshment. When the corresponding information area is full, the area can be cleared, be refreshed and continue to show the information.

5 Conclusion

Service-oriented grid research has become a future tendency with a particular focus on grid application. The learning resource is taken as the background. The service-oriented LRG was designed, in which kinds of resources were packaged as services so as to conceal their heterogeneity. The characters of plug and play and extensively share were embodied. The LRG demonstration system, which visually demonstrates the concept, principle and service invocation in LRG, was proposed and implemented, and the abstract grid technology was visualized for learning application.

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The Backup Battle of DTD and DTT in Digital Library

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Abstract. The backup of the digital library resources has its unique characteristics, the work can be done both by disk to tape (DTT) or disk to disk (DTD), according to the backup data is static data or dynamic data. This paper produced a conclusion after comparing the advantages and disadvantages of the two backup methods.

Keywords: digital library; DTD (disk to tape); DTT (disk to disk); Long-term protection.

1 Introduction

Digital Library has a large amount of data, especially in today's information explosion. Now, digital documents are gradually replacing paper documents, the library has the responsibility which long-term preservation of human civilization, and the focus of responsibility, from the paper documents to the digital resources. And unfortunately, digital literature is very fragile and need to data backup may be lost to compensate for their losses.

As we explore the DTD (disk to disk backup) and DTT (disk to tape backup), we should understand what data to back up in digital libraries. Digital library data are varied, including the WEB resources, electronic publications, scientific data, multimedia resources and electronic dissertations, etc., and all the data to carry out Internet-based resource services, in addition to backup the full-text database, the need to backup server, which the backup server to be involved in SUN Solaris, LINUX, Windows NT, Windows 2000 and other operating system platforms, and multiple machines running Microsoft SQL Server 2000 database and ORICAL.

2 DTT Challenges

Tape is the main media of save and restore the backup in the beginning. With the rising volume and speed, the tape allows the user to lower the cost of storing multiple backups or version. Because it is a removable media, tape can be used as a remote disaster recovery backup. Currently, most of the Digital Library use tape to backup data.

Unfortunately, the tape automatically backup also has some disadvantages, its stronger recovery than the backup. Weak recovery is the biggest problem on the tape.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 20–24, 2011.
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The tape drive to increase the transmission speed, so the backup should be particularly careful to adjust the flow of data written to tape to avoid tape at the beginning, in progress, and positioning have a " shoe shine" effect [1]. When using incremental backup, because there is no backup of all data, so this problem will worsen. In addition, the data stream written to tape, basically to be able to support the backup data to multiple users simultaneously, This feature is known as multitasking. In order to fully use the maximum tape drive performance, multi-task processing can increase the speed of the backup, but it will reduce the relative speed of recovery, because the recovery, the system needs to spend more time reading the backup image, and skip backup data of other users.

The biggest challenge of DTT backup is that it's back up the quality is not stable. During the operation, it is possible all the backup data has been successful, but it is difficult to verify whether all the data within the tape can be restored. The tape of poor quality will resume operation failed, and this error is usually not aware of it, we must wait until the restore operation will be found, until then it was too late.

In addition, today data is massive, tape backup is also facing another problem. So many of the tapes, will increase investment in artificial management, such as special storage environment, with a service management, particularly the staff of management changes in the positions, how to accurately find a tape, in the phase of the system environment is recovery form the backup tape, secure and right to read the data of tapes. From this view, data security and readable with tape backup, is not easy to achieve.

2.1 DTD Backup

Advantages

First of all, it is different with the tape drive, disk array does not require a stable flow of data. Even with only a small amount of data stored in the incremental backup, there is no "friction" effect. Second, the disk array allows managers to do more infrequent “Full Backup”, rather than endure the consequences of the implementation of slow recovery or increase the risk of data recovery, you can simplify and speed up the overall backup speed.

In addition to reducing backup time outside, often carried out for a full backup, you can also reduce the number of tapes required for recovery, simplifying the recovery process. To tape backup point of view, the number of tapes required for recovery will be by increasing the number of incremental backups. The disk array allows manager to simplify the backup process. Recovery in the production of remote backup, the disk is easier and more effective. Using the "disk to tape" copy the data, do not need to be dealt with simultaneously by a tape backup of the recovery of multiple users; it can be copied for each user to restore the backup, thus speeding up the recovery process.

In addition, the "disk to tape" than "tape to tape" copy mode is more flexible. When being "tape to tape" copy, the main source of the tape and to backup tape, do the other two have no means of backup or restore operation. Conversely, when data is being copied to tape, disk allows users to simultaneously access the data, accept the backup and recovery operations.

The most important thing is to recover data disk is very good, both in reliability or execution speed. The disk drive interface specification-based techniques, such as disk

arrays, so the disk becomes more reliable than tape media. As previously mentioned earlier, poor quality of the tape makes the whole recovery operation failed. With RAID protection, even if the disk is damaged, you can continue to successfully restore data.

The shortcomings of disk backup

Although the disk is a backup has some advantages, but disk-based backup strategy also has drawbacks. Some backup software applications adjust them according to the backup disk data structure, most of the disk device as a file system to be backed up, and the file system is destined can not avoid the interference of debris disks, backup and recovery performance will lead to a sharp decline. Therefore, if you use disk backup, the disk file system must be regularly finishing.

Second, a low-cost disk array for backup, it can only persist in a few weeks to accommodate the backup data. It can not accommodate a large number of data for long-term retention. Most of the digital library data needs long-term preservation, which will result, practical and technical personnel will force the library will eventually move the backup data transferred to the medium.

In addition, starting from the security of data from viruses, hackers, security threats and natural disasters, also needs to be considered. File system is easy to be attacked, but the tape is a no-file system format, it determine born with immunity.

Disk array is generally used to store in-use-status data, if the backup data and in-use-status data are placed on the same disk array, you must take into account the single point of failure. That occur in response to a site, the power or the threat of communications infrastructure, Library technicians have a copy of the entity's data is stored in a place away from the base site, repair the fault can be used, and this will increase the disk backup costs.

Finally, in terms of filing requirements, the life of the disk than tape media to be much shorter life span. The idle disk may loss of data or degaussing after one or two years, unless turn on once of every thirty days.

The other, there isn't uniform standard disk backup, and backup software must only be tightly integrated. For example, the LAN Free backup DTD in UNIX SAN, if the data set should be stored in a unified volume, you need software to support the shared volume, would increase the cost. Backup software program implementation in terms of disk backup and tape backup is not as perfect as it is mainly because the high price of disk storage. Compared with the tape, the disk has high cost relatively, which makes the disk uneconomical in most cases.

High compression ratio Increase competitiveness

Full use of the advantages of disk backup, combined with unique high-compression technology, such as the deduplication technology can improve the cost-effective disk backup. For example, EMC offers a superb DTD backup solution-Data Domain [3][4]. The overall compression algorithm technology is mainly stored in the backup disk of all data within it and the data independent of format and arrangement. The amount of data stored in the more efficient compression of the more obvious. Within four weeks, if you set a full backup weekly and daily run the file-level incremental backup, compression ratio of about 10:1. In the eight weeks, the compression ratio of

about 14:1. After about 20 weeks after the 20:1 compression efficiency will be achieved. EMC Corporation is the compression ratio in many data processing centers and after the test confirmed the results.

Data Domain use a overall data compression algorithms of zero lost technology, an advanced disk as a backup device, no matter what kind of backup file format, have greatly improved the efficiency of backup and recovery.

2.2 Comparison of DTT and DTD

In order to clearly compare two types of backup mode, please see the following table: "Comparison of DTT and DTD backup". Several key items in the table on the tape and disk backup compared [2].

Table 1. Comparison of DTT and DTD backup

Table Head	DTD	DTT
Portability	*Even if it can backup to a remote SAN, cloud application or use RDX (removable disk technology) to store off-line backup, but it is importable.*	*Portable*
Capacity	*Limited (On the SAN, it is true. Each storage array has a maximum limit of capacity, even if this capacity is not reached.)*	*Each tape has a limited capacity, but the backup can span multiple tapes.*
Speed	*Because the disk supports random access，so the speed is very fast .*	*Because of the tape has the linear characteristics, so much slower than disk.*
Availability	*Most recent backup can be obtained.*	*The tape must be loaded before recovery data. Once the tape is offline storage, it may lead to problems.*
Reliability	*More reliable, but, because the disk backup applications is that block-level incremental backup, a single point of failure could cause all backup disks are not available.*	*More reliable than the original tape, but still vulnerable to demagnetization or "eat" by tape drive.*
Management burden	*Multiple versions of files are normally stored on the Internet, users can restore their own files.*	*Users must submit a help desk request, and then wait for the administrator to restore the backup.*
Backup frequency	*Many disk-based solution to back up the whole day in a row, to ensure the latest data backed up.*	*Tape-based backup is usually carried out at night. If an error occurs before the backups, it is likely to cause large amounts of data loss.*
Backup window	*If the disk-based backup support continuous data protection (CDP), then the backup window is not a problem.*	*Any support for Volume Shadow Copy (or snapshots) of resources in terms of backup, the backup window is not a problem, but if you do not support the VSS, then the backup window must be allocated.*

3 Conclusion

The data backup management strategies of digital library: static and dynamic data. The data of digital library have their own unique needs, but in general management strategy is based on data backup will be backed up that is static or dynamic. Disk-based backup is perfect for those large data changes, such as server backup, but to store the backup volumes are generally limited space. Therefore, if you know some data will never change, such as the digital literature data. Then you can use these static data write to the tape, to free up some disk space.

We often used a DTT backup the DTD backup data provide security. However, if the application for storage array backup fails, the backup is actually a very serious failure. On the one hand, the failure make you can not make any backup until this issue is resolved. On the other hand, the history of your backup will be lost. Assume that a user ask you to restore files from the request last Thursday. File server is still at work, this paper there have been, but because there is no backup, and will never be able to restore the previous version of this document. This obviously does not meet the needs of long-term preservation.

Technology updates too fast, new technology may not always be able to support all the files before the normal reading, so each time a system backup should be properly preserved, and are able to recovery safely, otherwise, only God knows which data will be the "death data" during we have the backed-up data.

One way to solve this problem is to backup the backup server. We can make Disk to Disk to disk (D2D2D) backup, or the disk to disk to tape (D2D2T) backup. In this way, the backup server is backup to removable media. This offline backup was created to send, and even if the device is struck by lightning, the disk backup will not be destroyed.

Disk and tape are two types of backup media. Because the two media have their advantages and disadvantages, so we can combine these two media to create a more efficient backup architecture of digital library.

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An Analysis Research about Accuracy and Efficiency of Grid DEM Interpolation

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Abstract. Grid DEM is the main presentation of DEM and is applied widely. The quality of DEM interpolation lies on accuracy and efficiency, in which way the Grid DEM is generated. The interpolation method used to generate grid DEM from TIN based on Delaunay conflict area is presented in this paper. The method's using in production is analyzed and proved correctly through experiments, which can promise the accuracy and efficiency simultaneously.

Keywords: TIN; Delaunay triangulation; Grid; DEM.

1 Introduction

The regular grid DEM is the main representation of DEM, which can be obtained by format transformation of TIN and contours, or be obtained by interpolation of terrain characteristic data. Thus the correlation studies belong to surface modeling which holds three main methods—interpolation, fitting and extrapolation.

Whatever which method is putted to use, the essence is to get unknown value by the known sample values. In order to obtained high quality Grid DEM the prerequisite is to determine the most contributive subset in the sample data sets. How quick to find the subset is the efficiency problem and which subset is the accuracy problem. We discuss the efficiency and accuracy about the Delaunay TIN (triangulated irregular networks) DEM to be transformed to grid DEM. Delaunay TIN is provided with optimal spatial structure and easily to find the neighbor object.

The software package is developed to confirm which method is the best. The experiment process contains triangulated networks generated by scattered 3D points, grid DEM transformation, efficiency and accuracy analysis.

2 Interpolation Method

The developed software package is compared with the GOLDEN SURFER in grid DEM interpolation. The statistics RMS is through bilinear interpolation method.

2.1 The Methods [1]

The methods about SURFER and the improved interpolation method about Delaunay TIN are:

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 25–30, 2011.
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(1)Inverse Distance to a Power

The principle of this method is: to suppose there are many scattered 3D points, the corresponding coordinates (x_i, y_i) and property value $z_i (i = 1,2,\cdots,n)$, $p(x, y)$ is any grid point. The grid point $p(x, y)$'s property value is determined by the property values around p.

$$Z_p(x, y) = \sum_{i=1}^{n} \frac{z_i}{[d_i(x, y)]^u} \Big/ \sum_{i=1}^{n} \frac{1}{[d_i(x, y)]^u} \quad (1)$$

Which $d_i(x, y) = \sqrt{(x - x_i)^2 + (y - y_i)^2}$ is the distance from (x_i, y_i) to $p(x, y)$. $Z_p(x, y)$ is the property value of the grid point. The weight function is $W_i = 1/[d_i(x, y)]^u$, u is ordinarily equal 2.

(2)Kriging method

The word "kriging" is synonymous with "optimal prediction"[3]. It is a method of interpolation which predicts unknown values from data observed at known locations. This method uses variogram to express the spatial variation, and it minimizes the error of predicted values which are estimated by spatial distribution of the predicted values.

The third to eighth method is simply described as:

(3)Minimum Curvature: Minimum curvature, one of two principle curvatures, is a curvature of a normal section with the smallest value of curvature among all normal sections at a given point of the land surface.

(4)Modified Quadratic Shepard: There are many variations on Shepard's original interpolation method, which is essentially the standard inverse distance (IDW) procedure. One variant introduced by Shepard involves the use of two separate powers: a lower value (generally 2) for nearby data points and a higher value (generally 4) for points further away. Another variant, implemented in some packages, adjusts the weights based on how far away the furthest point (in the entire set or within a given radius) is to be found.

(5)Natural Neighbor: Natural neighbor interpolation is based on the Thiessen polygon network of the scatter point set. The Thiessen polygon network can be constructed from the Delaunay triangulation of a scatter point set. A Delaunay triangulation is a TIN that has been constructed so that the Delauney criterion has been satisfied.

(6)Nearest Neighbor: Nearest-neighbor interpolation (also known as proximal interpolation or point sampling in some contexts) is a simple method of multivariate interpolation in 1 or more dimensions. Interpolation is the problem of approximating the value for a non-given point in some space, when given some values of points around that point. The nearest neighbor algorithm simply selects the value of the nearest point, and does not consider the values of other neighboring points at all, yielding a piecewise-constant interpolant. The algorithm is very simple to implement, and is commonly used (usually along with mipmapping) in real-time 3D rendering to select color values for a textured surface.

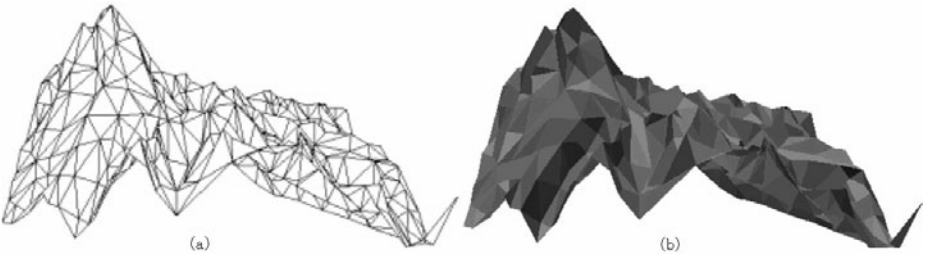


Fig. 1. Paragraphing surface: (a) a mesh drawing; (b) a surface drawing

(7)Multivariate Polynomial Regression: using the Least Squares method and determines the coefficients of the polynomial, the generalized correlation coefficient and the standard error of estimate.

(8)Radial Basis Function: The Radial Basis Function (RBF) method is one of the primary tools for interpolating multidimensional scattered data. The methods' ability to handle arbitrarily scattered data, to easily generalize to several space dimensions, and to provide spectral accuracy have made it particularly popular in several different types of applications.

(9)Triangulation with Linear Interpolation (Fig. 1): The standard form of interpolation using triangulation of the data points is a widely available exact method. The Delaunay triangulation of the point set is first computed with the z-values of the vertices determining the tilt of the triangles. Interpolation is then simply a matter of identifying the value at each grid node by linearly interpolating within the relevant triangle.

2.2 Triangulation with No-Linear Interpolation

There are many interpolation methods based on Delaunay TIN [2], we improved the triangulation with linear interpolation method by Delaunay empty cavity character. First, find the conflict area of the grid point. Secondly, determine the quadratic

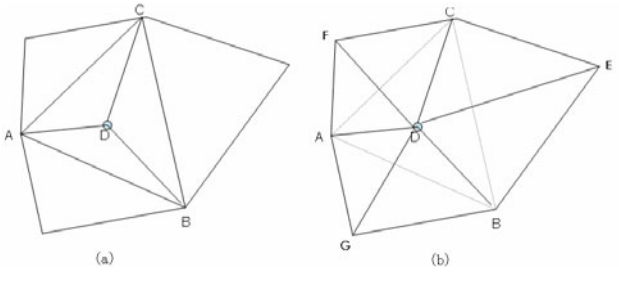


Fig. 2. Interpolation methods base on Delaunay TIN:(a) grid point effected by the triangle;(b) grid point effected by the Delaunay conflict area

surface value by the vertexes of the conflict area (Fig. 2). Thus, the smoothness is guaranteed.

3 Experiment Test

In the experiment test, the terrain characteristic data is gathered by RPS(A Remote photogrammetry System developed by ourselves).The Work Zone is some region in Jilin province. The range is (xmin,ymin) = (856601.404, 4298107.967),(xmax, ymax)=(876948.685,4320489.851), (zmin,zmax) = (240.000,713.650). The number of scattered 3D points is almost 300,000, and 409 points are randomly selected as check points. The region area is 20×20=400 square kilometers (Fig. 3). The grid distance is 100 meter.

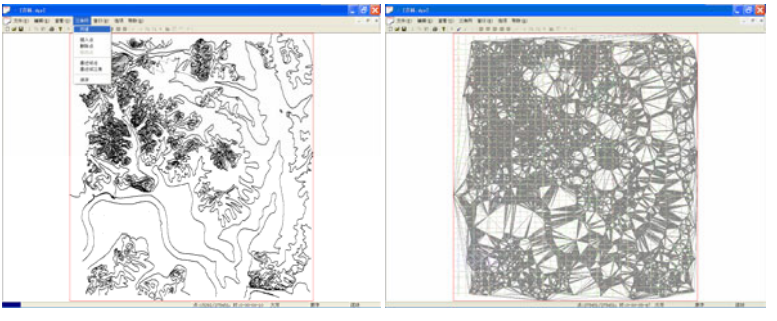


Fig. 3. Terrain characteristic data of some region in Jilin province and transformation of TIN DEM to GRID DEM

The 1st to 9th method is tested through SURFER software. The 10th no-linear improved interpolation method is tested through our software package.

4 Analysis and Result

Fig. 4 shows the 1st to 9th method's results, and Table **1** shows all the 10 methods' results. The last two interpolation methods are based on Delaunay TIN, and the last one is the improved method by us (**Fig. 5**).

Table **1** about time cost contains two parts, one is index time of the grid point, and one is determining the value of the grid point. The mainly time cost is the index time. Any a method has its disadvantage and advantage. It is difficult to estimate which one is the best, and it is important what subject is suitable for use. For instance, Fig. 4 shows easily that the Polynomial Regression is not suitable for terrain modeling. In generally, the more accuracy the more time cost, and vice versa. And the accuracy of grid DEM is related to the distribution and density of terrain characteristic data. We can draw a conclusion from Table **1** that the methods related to Delaunay are a good trade off for efficiency and accuracy.

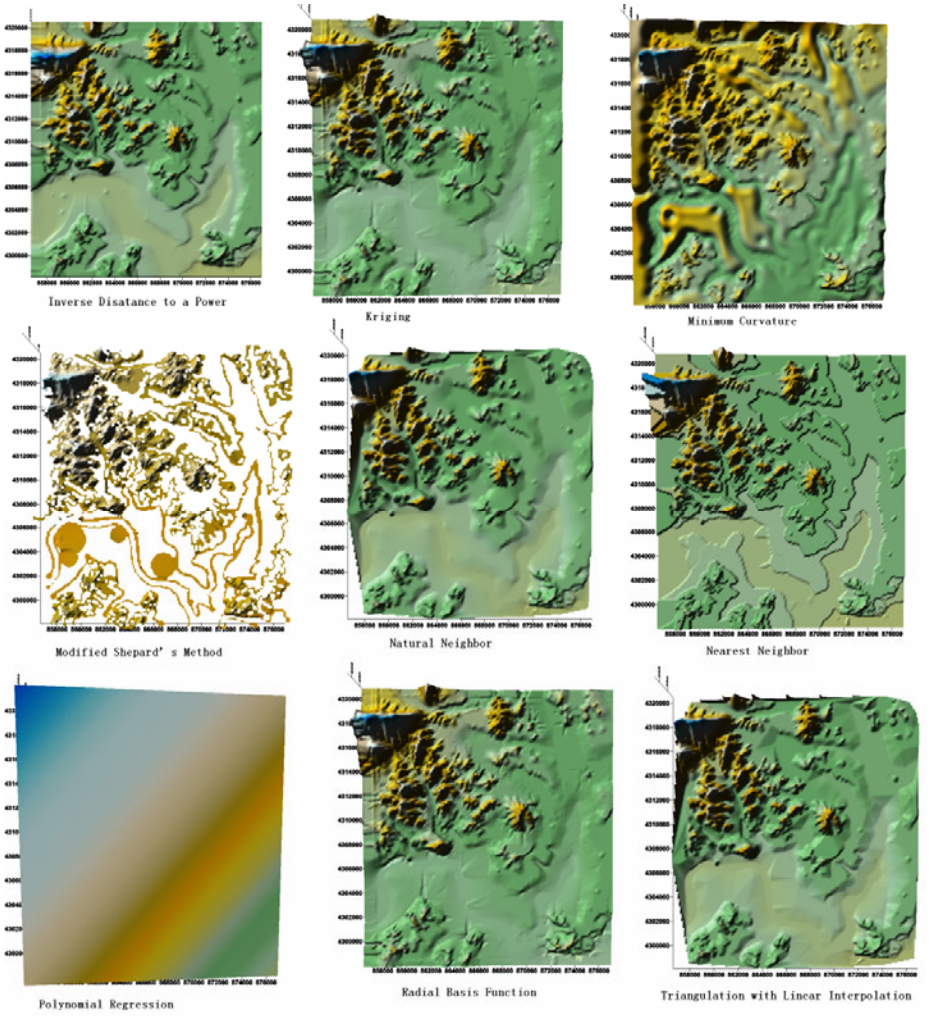


Fig. 4. Interpolation results(layer colors)

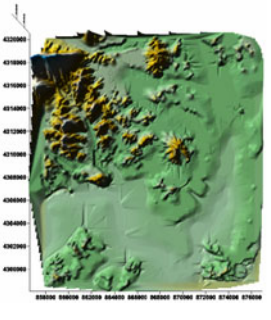


Fig. 5. Delaunay TIN empty cavity interpolation

Table 1. Efficiency and accuracy of the interpolation methods

(Z,|ΔZ|) / Interpolation methods	time (sec)	Min.	Max.	Mean.	STD. Dev
Inverse Distance to a Power	79.7	240.231	682.128	299.465	56.754
		0.001	19.050	4.067	5.753
Kriging	119.4	225.394	703.549	298.663	56.326
		0.001	16.856	2.846	4.149
Minimum Curvature	1.4	179.625	713.339	307.997	56.501
		0.003	18.473	3.522	5.100
Modified Shepard's Method	12.9	-85.473	859.372	311.271	62.861
		0.001	17.320	3.867	4.252
Natural Neighbor	48.8	239.997	703.404	297.137	52.350
		0.001	17.308	3.461	4.764
Nearest Neighbor	1.7	240.000	713.650	299.024	57.297
		0.000	17.400	2.237	4.006
Polynomial Regression	0.1	192.808	453.492	323.150	53.474
		0.045	261.672	87.844	125.196
Radial Basis Function	523.5	217.713	706.190	298.582	56.364
		0.002	16.793	2.735	4.002
Triangulation with Linear Interpolation	3.6	240.000	704.845	297.260	52.497
		0.000	17.346	3.361	4.667
Delaunay Cavity Triangulation	4.2	241.243	704.328	297.250	51.763
		0.000	12.645	1.154	1.973

Acknowledgments. This is supported by the National Science Foundation for Distinguished Young Scholars of China (Grant No. 40901199).

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Analysis of Human Resources Management Strategy in China Electronic Commerce Enterprises

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Abstract. The paper discussed electronic-commerce's influence on enterprise human resources management, proposed and proved the human resources management strategy which electronic commerce enterprise should adopt from recruitment strategy to training strategy, keeping talent strategy and other ways.

Keywords: electronic-commerce; electronic commerce enterprise; human resources management.

1 Introduction

Based on internet, electronic-commerce used different information technology methods including electronic data transfer and other technologies, has provided customer the advanced transaction pattern and equal transaction opportunities, reduced the transaction time greatly, saved transaction expenses, and broke transaction region limits, provided us unprecedented big transaction platform. In recent years, each kind of electronic-commerce website emerged one after another incessantly; spread in the real life nearly all domains. According to the announcement research data display from the world internet media evaluation organization "Nielsen online" at January 29, 2008, the global on-line shopping net citizen already achieved 85%. Up to March 13, 2008, according to the user quantity computation, China has already surpassed US to become the global biggest internet market, its handset web net citizen number is ultra 5,0400,000 people, the network market shopping volume of business have amounted to 59,000,000,000 Yuan. The essence of electronic commerce is the informatization process of business management's each aspect. The informatization process is the process to carry on the transformation through new methods and measures to the old work process. An enterprise's electronic commerce development is one sustained and unceasing improvement process. The typical electronic commerce developing process constituted electronic commerce enterprise frame, the basic essential factor mainly include: constructing network infrastructure; realizing office automation; constructing enterprise core business management and application system, such as enterprise resources planning and net web gateway; developing customer relations management; supply chain management; implementing new business management, such as knowledge management; consummating support environment, such as physical logistic distribution and delivery system, electronic payment system, social environment, legal environment and so on.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 31–36, 2011.
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Electronic commerce is attacking traditional management pattern intensively both from depth and breadth, has brought stern challenge both for traditional management theory and methods, simultaneously also produced many new management problems. The appearance of electronic commerce also emerged various aspects influences on business management system and the methods, which requesting enterprise management transform, including enterprise strategy, enterprise organizing, enterprise internal operation and management pattern, market management and so on. Because of the close relationship with enterprise strategy execution, human resource management also has to be carried on suitable adjustment to guarantee the electronic commerce enterprise management achievements.

Confronting the new competition environment and challenge, managing human resources effectively becomes the important origin and way for enterprise to gain and maintain the competitive advantage. Carrying on strategic management to enterprise's most important property: 'the personnel' becomes the electronic commerce enterprise's important mission. In order to gain and maintain competitive advantages under the globalization background, electronic commerce enterprises must reconsider human resources role and value increment problem by one brand-new whole world thinking mode, establish new pattern and flow to raise global keen sense and core ability. Just like principles 'thought globalization, motion localization' which many multinational corporations persist, which is the effective tactic to reply the challenges which globalization brings to the enterprise. International competition deepening will impel enterprise to allocate resources in global scope inevitably, including human resources disposition in global scope. It can be said that, in the E-age, human resources guidance will become the basic guidance for electronic commerce enterprise to success.

2 China Electronic Commerce Enterprise's Human Resource Management Characteristics

2.1 Human Resources Competition becomes the Focus for Electronic Commerce Enterprises Competence

The appearance of electronic commerce initiated the competition which enterprises to establish it's own competitive advantage, but the focal point of the competition is to seize talented person. The electronic commerce's fast development makes people to start to realize: enters the electronic commerce period of expansion, the enterprise need multi-skill and predictive talented person, especially higher level and interdisciplinary E business talented person and IT professionals are most marketable. In recent years, various countries generally found the talented person's shortage is more and more serious, especially the developed countries. For example, US has more than 300,000 IT occupation vacancy, will provide 200,000 work visas in the next 3 years to attract overseas talented person; Germany implemented 'Green Card' project in global scope to attract IT talented person, and has established China and Germany on line in Beijing, to provide service for IT talented person who go to Germany. We can say, in the electronic commerce time, the most fiercest competition among enterprise is not fund, advanced equipment, also not the market share, but talented person. Who owe high quality human resources, who will obtain the richest return.

2.2 Talented Person's Localization That China Electronic Commerce Enterprises Need

Electronic commerce time is an age admiring knowledge, staff's intelligence and ability manifest higher value compared to any former time, knowledge staff become enterprise's main resources, their creativity is fountainhead of company's value appreciation, they provide creative work, high quota additional value for products or services through their own creativity, analysis judgment and design. Administrator, professionals and marketing personnel are all belong to knowledge staff. These professionals are not only need to be skilled in their own special field, but also need to understand and familiar with electronic technology operating law and regulation, have keen insight to network market. They all have good educational background and abundant specialized knowledge generally, have original opinion, active thoughts and formidable creative desire, and hope to reveal their individuality widely, unfold individual self-value. Specifically, it means the talented person whom China electronic commerce enterprise development needs is such kind of inter-disciplinary talent: has force of penetration to scan information, is good at communicating, has expand strength to fight market, has persuasive power with multitude innovative thinking, meanwhile must familiar with IT profession 's situation and characteristics, understand China cultural context deeply, quite familiar with domestic and foreign management environment and pattern, moreover must certainly has the international field of vision.

2.3 Staff's Working Space becomes Large, which Is More Suitable to Self-control

Under electronic commerce environment, enterprise can use network, communication technology, and virtual cooperation to produce and develop products. Simultaneously, enterprise staffs may have more time and space to control through actualizing migration work, family work based on network. It is propitious for staff to absorb new knowledge, new skill, to increase human capital inventory, to create bigger benefits for enterprise.

2.4 Challenges and Opportunities Faced by Enterprises

According to different links from enterprise's electronic commerce objectives establishing, expanding, to its organizational structure, business processes confirming and all rules and regulations formulating, are all completed by all aspects of electronic commerce professionals in appropriate conditions. Without makers of E-commerce objectives, organization and planning, or lack of this kind of management and technical personnel, the enterprise is unlikely implement electronic commerce. China current status about electronic commerce professionals are: first, insufficient total talents, there are large gap in major specialty, which has become development bottleneck restricting our enterprise to disseminate electronic commerce. Secondly, talents structure is unreasonable, talents need to update knowledge structure, particularly in terms of practicality, at present many university graduates of electronic commerce professionals can't meet actual needs of enterprise. Third, talent supply structure is unreasonable, high level technical talents are scarcely.

3 China Electronic Commerce Enterprise's Human Resource Management Policy Analysis

In the face of growing competition home and abroad at present, China electronic commerce enterprises must face the reality, pay attention to human resources management, take appropriate strategies and measures to enhance human resources management ability and level, make sure people can bring their potential into full play, and develop with enterprise.

3.1 Personnel Recruitment

Attracting varieties electronic commerce talents flow to enterprise, bringing in high level E-commerce talent actively, injecting fresh vitality unceasingly, make sure enterprise can make benefits from electronic commerce development, which is the first step that electronic commerce enterprise to develop talents. When selecting personnel, enterprise should consider in conjunction with electronic commerce developing stage, to judge the developing stage which enterprise is, the initial stage, application stage or high speed developing stage, according to the need to recruit senior technology professionals or choice ordinary people by application of practice. Personnel recruitment policy is primarily reflected in two aspects, recruitment and selection. Electronic commerce development provides enterprise a convenient, fast, global, all day, low cost selection mode of recruitment and selection, which can be said a recruitment revolution. Online recruitment and talent selection offers enterprises more wide selection and space, and make information asymmetry reversed on a certain extent. Enterprise's talent performance appraisal method has undergone a series of changes, such as in computerized interview, video conference, video chats mode levels to verify.

3.2 Personnel Training

Actively developing electronic commerce talents is an urgent task of our education, and the corporation responsibility of all enterprises. In recent years China colleges and universities' electronic commerce professional have trained a large amount of students, to met society needs on a certain extent. However, due to the lack of rationality of guidance, personnel training direction and structure are out of order. Our electronic commerce training problems are remarkable, the major problems are: A large number of low level talent supplies exceed demands, high-level talents supply falls to meet the demand. Unequal distribution, training disorder and unreasonable personnel structure are the most drawbacks to provide electronic commerce talents. Therefore, when enterprise is training talents, should clearly indicate electronic business talent orientation and training direction, specifically from two respects: first, to innovate talents training pattern, promote inter-disciplinary talent reserves; second, to strengthen international exchange and cooperation, promote electronic commerce international talents construction, build a sustainable training and support system for electronic commerce talents.

Training and learning under electronic commerce environment, mainly rely on network to train staff, and self-learning. Information technology developments enable knowledge dissemination and diffusion become extremely fast, efficient, and low-cost.

Staff can inquiry their own concerns and the need for additional knowledge through internet by convenient, fast, low cost way. Enterprise can publish simple training materials through intranet, provide centralized training through multimedia or remote training through online video platform. Business learning contents established by department is accessible by the platform, instead of traditional training which collect all staff, select appropriate time, location to complete. At the same time, different staff can select contents according to their own needs. Because knowledge updating is very fast, web-based learning will be a trend. And to combine training and business goals, can evaluate training program effectiveness in time.

3.3 Retaining Talents

Enterprises should foster staff, but the more important point is to retain talents. In recent years, many electronic commerce enterprises have felt the great risk that brain drain brought to enterprise management. Generally speaking, most electronic commerce talents are young people, this kind of people think active, energetic, change fast, like stimulation, often consider themselves technology advanced, not very good at dealing with interpersonal relationships, and eager for attention, poor interpersonal environment around, once have any dissatisfaction, they will vote with their feet no matter anything, at this time enterprise will suffer the largest damage. Therefore, enterprise should enhance this portion of talent management; establish risk prevention system for the outflow of talent, make electronic commerce talent irregular flows occur hardly or minimize the incidence of the potential, while at the same time should establish drain risk control mechanisms. When enterprise defense electronic commerce talent drain, should focus on 'keep', pay close attention to internal and external talent development, establish risk control system for talent drain, and do everything possible to retain staff enterprise needs, in order to prevent accidents. In addition, enterprise should improve effective incentive for electronic commerce talents who have special contribution, like pay system, reward system, stock option plan and other respects, to perfect electronic commerce talent incentive system.

In information age, when enterprise retain talents, except considering from a traditional perspective, should also follow next points: ① applying informational human resources management system, strengthening E-commerce talents' dynamic management, setting up detailed personal documents, paying attention to their trends, communicating with the staff to fully understand their satisfaction with the work environment, based on employees self will, in combine with enterprise development, developing reasonable career planning, and carrying out adjustments regularly, which can mobilize the enthusiasm of staff; ② using intranet to recognize employee's excellent performance reasonable; ③ using intranet and other information tools to train staff on different levels, so that they can receive required knowledge timely. As information technology continues to advance, human resource department will play increasing important role in business management. Therefore, internal human resources management system's building is related to enterprise's survival and development, which should arouse attention of enterprises.

4 Conclusion

Electronic commerce enterprise development in China has entered a strong period, but as one of enterprise management's important link—human resource management, should follow the trend closely. Under the e-business environment, scientific management of human resource has become the key and restrict factor for business operation and benefits increasing. Human resources' importance for enterprise development has been gradually over material resources and financial resources, and, in some cases, human resources even can replace material resources and take advantage of the unprecedented potential. Electronic commerce enterprise's human resource management is a development activity need future develop and perfect. This article is just making tentative discussion and study from several specific aspects; hope to play a catalyst role.

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Analysis Model of Cooperatively Technical Innovation Risk

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Abstract. In this paper, the seeking method of enterprise cooperatively technical innovation risk has been analyzed, and the method of calculating risk regulation gradient is expatiated in detail. The wavelet transformation of the decomposition displays the good time frequency localization characteristic and the multi-criteria function, therefore the wavelet nerve network based on the wavelet decomposition and the nerve network has the good fault-tolerant ability and the non-linearity approaching performance. And based on this, a complete controlling risk model of cooperatively technical innovation is brought forward, and the algorithm of risk control model is discussed.

Keywords: Analysis Model; Risk Control; Cooperatively Technical Innovation; Nerve Network.

1 Introduction

By mean of seeking the risk unusual link and carrying on the adjustment to remarkable risk, the risk condition may be transfer from the serious risk condition to the lower risk condition in the comparatively quick manner. We can use the risk gradually inspection method of seeking the risk unusual link, and the steps is as following:

1. Establishing a series of risk controlling point in the entire process, just as the figure 1 showing.

2. Calculating the risk of various risk controlling point R_t.

3. Calculating the risk increment $\Delta_t = R_{t+1} - R_t$ between the risk control point and carrying on the comparison, finding the maximal Δ_t, therefore, the innovation unit between the risk controlling point t and the risk controlling point $t+1$ is the risk unusual link.

2 Basic Concept

There does exist the complex non-linear function mechanism between the risk factors of cooperatively technical innovation, so we can use the non-linear method to research the keeping way and controlling mechanism of cooperatively technical innovation. Regarding every link of figure 1, inspecting from the system angle, must

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 37–43, 2011.
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keep the investment plan of controlling risk of the link between the head and tail risk optimization and adjustment control, and obtains the most superior risk, and achieves the goal of controlling risk. This kind of coordination control pursues the smallest controlling cost of the complex system, and get the best controlling effect. Therefore, a convenient and external expression method is necessary to reflect the coordinated degree and take it for the basis of harmoniously controlling.

And now, we define the risk regulation elasticity of the investment:

$$E_{x_i(t)} = \frac{\Delta r_i(t)}{r_i(t)} \Big/ \frac{\Delta x_i(t)}{x_i(t)} = \frac{\partial r_i(t)}{\partial x_i(t)} \cdot \frac{x_i(t)}{r_i(t)}, \text{ i=1,2,……,6, t=1,2,……,n} \tag{1}$$

In the formula, $r_i(t)$: The risk size of the No. i risk species when the risk control investment quantity increases to $x_i(t)$ at the link t. $x_i(t)$: The total quantity of risk control investment of the No. i risk species at the link t.

And we define $c_i(t)$, that expresses the influencing coefficient of risk state variable $r_i(t)$, $r_i(t)$ is the No. i risk species at the link t, and it can be obtained by the following formula.

$$c_i(t) = \frac{a_i(t)}{\sum_{t=1}^{n}\sum_{i=1}^{6} a_i(t)}, \; a_i(t) = \sum_{q \neq i} a_{iq}^{t} r_q \tag{2}$$

In the formula, r_q: The risk state variable of No. q. a_{iq}^{t}: The influencing factor of the risk state variable $r_i(t)$ of No. i is to influence the risk state variable r_q of No. q at the link t, can be obtained by the history data and experience of the experts and the related personnel who enjoying the cooperatively technical innovation. $a_i(t)$: The influencing variable of the risk state variable $r_i(t)$ of the No. i risk species at the phase of t. And we know coordination coefficient $c_i(t)$ is express the totally influencing degree of $r_i(t)$ to the others risk state variable, and reflects the influencing degree of $r_i(t)$, and embodies the basis of harmoniously controlling.

By the synthetically risk regulation elasticity and its influencing coefficient, we can obtain the controlling risk regulation gradient of cooperatively technical innovation.

$$H_i(t) = c_i(t) \cdot E_{x_i(t)} \; (i = 1, 2, \cdots, 6, \quad t = 1, 2, \cdots, n) \tag{3}$$

Thus the risk regulation matrix $H(t)$ of cooperatively technical innovation is following, and the regulation matrix $H(t)$ is the basis of harmoniously controlling risk that includes in all the links between the head and tail risk control point.

$$H(t)=\begin{bmatrix} H_1(1) & H_2(1) & \cdots & H_6(1) \\ H_1(2) & H_2(2) & \cdots & H_6(2) \\ \cdots & \cdots & \cdots & \cdots \\ H_1(n) & H_2(n) & \cdots & H_6(n) \end{bmatrix} \tag{4}$$

If the risk regulation investment total quantity is x, the risk regulation investment quantity $x_i(t)$ of the No. i risk species at the link t is following:

$$x_i(t)=\frac{H_i(t)}{\sum_{t=1}^{n}\sum_{i=1}^{6}H_i(t)}\cdot x,\ i=1,2,\cdots,6,\quad t=1,2,\cdots,n \tag{5}$$

3 Model of Coordinating and Controlling Risk

The nerve network is suitable for recognizing and simulating nonlinear system, and the wavelet transformation or the decomposition displays the good time frequency localization characteristic and the multi-criteria function, therefore the wavelet nerve network based on the wavelet decomposition and the nerve network has the good fault-tolerant ability and the non-linearity approaching performance. Based on this and uniting control theory viewpoint, here we bring forward a complete controlling risk model of cooperatively technical innovation, and this controlling risk model is based on the wavelet and nerve network, just as the figure 1 showing.

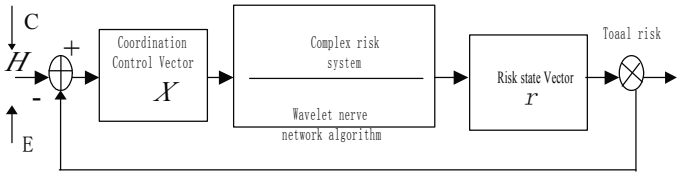


Fig. 1. Overall Risk Regulation Sketch-map

Coordination coefficient is $C=(c_1(1),c_2(1),\cdots,c_5(n),c_6(n))$, regulation elasticity is $E=(E_{x_1(1)},E_{x_2(1)},\cdots,E_{x_5(n)},E_{x_6(n)})$, coordination control vector is $X=(x_1(1),x_2(1),\cdots,x_5(n),x_6(n))$, risk state vector is $r=(r_1,r_2,r_3,r_4,r_5,r_6)$, r_i $(i=1,2,\cdots,6)$, and respectively expresses the size of environment risk, IT risk, market risk, fund risk, cooperation risk and performance risk, the total risk is $R=\sum_{i=1}^{6}r_i$, so the coordination control problem can be described, regarding the coordination matrix H, defines the total risk expected value R, chooses the wavelet nerve network algorithm, obtains the coordination optimization value of system control

input X by unceasingly optimization. The characteristic of this kind of regulative algorithm is to preparatory confirm the system input data by regulation degree, and calculate by the educated wavelet nerve network, but not possess the process all to entrust with the wavelet nerve network, like this will be able greatly to enhance the computation speed and accuracy.

In the essence, wavelet transformation is a kind of integral transformation of different parameter space:

$$W(\vec{p}) = \int_{-\infty}^{+\infty} f(\vec{x}) h(\vec{p}, \vec{x}) d\vec{x}, \qquad f(\vec{x}) \in L^2(R^n) \tag{6}$$

In the formula, $f(\vec{x})$: The function that has the tight collection. $h(\vec{p}, \vec{x})$: The wavelet base. $\vec{p} = (P_1, P_2, ..., P_n)$: The coordinate of n dimensional parameter space. $\vec{x} = (x_1, x_2, ..., x_m)$: The coordinate of m dimensional parameter space

Under the situation of the uni-dimensional signal $f(x)$, the wavelet base $h(\vec{p}, \vec{x})$ and $h(a,b,x)$ (here, $\vec{p} = (a,b)$) may be deduced by the following formula,

$$h(a,b,x) = \frac{1}{\sqrt{|a|}} h(\frac{x-b}{a}) \tag{7}$$

In the formula, $h(x)$ is the basic wavelet or the female wavelet, $|a|^{-1/2}$ is the normalized coefficient, a,b is respectively be the contraction and translation factor of $h(a,b,x)$, and the factor, regarding the signal $f(x)$, its partial structure differentiation can be realized by adjusting parameter a,b and the window size and position of wavelet base.

The wavelet nerve network is a kind of front nerve network based on the wavelet analysis to the nerve network, may regard as a new function of joining nerve network which takes the wavelet as the base. For calculating the overall risk regulation input of cooperatively technical innovation, and supposes the total quantity of inputting the training sample is P, the network output pitch point has 6, the input pitch point has 6n, and then to the p sample, the i pitch point, the output may be indicate by the following formula.

In the formula, $\sigma(x) = 1/[1+\exp(-x)]$ is a Sigmoid function. Figure 2 is the corresponding framework sketch-map of wavelet nerve network. And the significance of hiding level summation is that its signal indication will be realized by linearly summing the selecting wavelet base, the parameter of needing study has ω_{ik}、b_k、a_k（$i = 1,2,\cdots,6$, $k = 1,2,\cdots,K$）, and K is wavelet element which need to select, and can be optimized by the following energy function with smallest mean error.

$$\tilde{r}_i^p = \sigma(u_i) = \sigma\left[\sum_{k=1}^{K} \omega_{ik} \sum_{m=1}^{6n} x_m h(\frac{x_m - b_k}{a_k})\right] \quad (i = 1,2,\cdots,6) \tag{8}$$

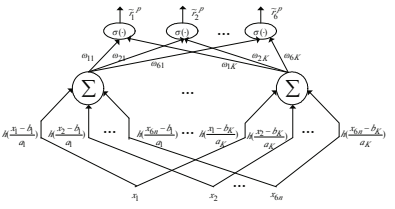


Fig. 2. Risk Regulation Wavelet Nerve Network Framework Sketch-map

$$E = \frac{1}{2}\sum_{p=1}^{P}\sum_{i=1}^{6}(r_i^p - \tilde{r}_i^{\,p})^2 \tag{9}$$

Here, r_i^p is the ideal output of the No. P sample and the No. i pitch point.

The adoptive wavelet function has many kinds of, here wavelet base may use Morlet female wavelet, namely:

$$h(x) = \cos(1.75x)\exp(-x^2/2) \tag{10}$$

This wavelet is the Gauss wave of cosine modulation, the time domain function and the corresponding frequency range function resolution is higher.

If supposes $x'_m = (x_m - b_k)/a_k$, $\sigma'(u) = \partial\sigma(u)/\partial u = \sigma(u)\left[1-\sigma(u)\right]$, and the gradient of E respectively is:

$$\frac{\partial E}{\partial \omega_{ik}} = -\sum_{p=1}^{P}\sum_{m=1}^{6n}(r_i^p - \tilde{r}_i^{\,p})\sigma'(u_i)x_m\cos(1.75x'_m)\exp(-x'^2_m/2) \tag{11}$$

$$\begin{aligned}\frac{\partial E}{\partial b_k} = &-\sum_{p=1}^{P}\sum_{i=1}^{6}\sum_{m=1}^{6n}(r_i^p - \tilde{r}_i^{\,p})\sigma'(u_i)x_m\omega_{ik}[1.75\sin(1.75x'_m)\exp(-x'^2_m/2)\\ &+\cos(1.75x'_m)\exp(-x'^2_m/2)x'_m]/a_k\end{aligned} \tag{12}$$

$$\begin{aligned}\frac{\partial E}{\partial a_k} = &-\sum_{p=1}^{P}\sum_{i=1}^{6}\sum_{m=1}^{6n}(r_i^p - \tilde{r}_i^{\,p})\sigma'(u_i)x_m\omega_{ik}[1.75\sin(1.75x'_m)\exp(-x'^2_m/2)\\ &+\cos(1.75x'_m)\exp(-x'^2_m/2)x'_m]x'_m/a_k^2\end{aligned} \tag{13}$$

And $i = 1,2,\cdots,6$, $k = 1,2,\cdots,K$

Taking the conjugate grads method to optimizing network parameter ω_{ik} 、 b_k 、 a_k , and supposes $\omega = (\omega_{11},\omega_{12},\cdots,\omega_{6K})$ and $\partial E/\partial\omega = (\partial E/\partial\omega_{11},\partial E/\partial\omega_{12},\cdots,\partial E/\partial\omega_{6K})$, and $s(\omega^j)$ is the circulation search vector of the No. j searching direction, and ω^j is the connecting vectors from the hiding level to outputting level of the No. j for circulation search.

$$s(\omega^j)=\begin{cases}-\dfrac{\partial E}{\partial \omega^j} & j=1\\ -\dfrac{\partial E}{\partial \omega^j}+\dfrac{-\dfrac{\partial E}{\partial \omega^j}\left[-\dfrac{\partial E}{\partial \omega^j}\right]^T}{-\dfrac{\partial E}{\partial \omega^{j-1}}\left[-\dfrac{\partial E}{\partial \omega^{j-1}}\right]^T}s(\omega^{j-1}) & j\neq 1\end{cases} \tag{13}$$

The same principle, definite $s(b^j)$ and $s(a^j)$. Therefore the network parameter vector may be adjusted according to the following formula.

$$\omega^{j+1}=\omega^j+\alpha_{\omega j}s(\omega^j),\ b^{j+1}=b^j+\alpha_{bj}s(b^j),\ a^{j+1}=a^j+\alpha_{aj}s(a^j) \tag{14}$$

And $\alpha_{\omega j}$、 α_{bj} and α_{aj} are the fixing value between the $(0,1)$.

According to the wavelet nerve network analog model and regulation matrix model, and seeking the nature law of regulating risk of cooperatively technical innovation. And definite the regulation error is $e=\widetilde{R}-R$, and R is the expecting total risk. The regulation rate goal is $J=\min e^2/2$.

The Partial derivatives of system output to regulating input is $\partial R/\partial X=C\partial r_i/\partial X$ ($i=1,2,\cdots,6$). And $\partial R/\partial X=(\partial R/\partial x_1,\partial R/\partial x_2,\cdots,\partial R/\partial x_{6n})$, $C=(1,1,\cdots,1)$.

$$\frac{\partial r}{\partial X}=\begin{bmatrix}\partial r_1/\partial x_1 & \partial r_1/\partial x_2 & \cdots & \partial r_1/\partial x_{6n}\\ \partial r_2/\partial x_1 & \partial r_2/\partial x_2 & \cdots & \partial r_2/\partial x_{6n}\\ \cdots & \cdots & \cdots & \cdots\\ \partial r_6/\partial x_1 & \partial r_6/\partial x_2 & \cdots & \partial r_6/\partial x_{6n}\end{bmatrix} \tag{15}$$

$$\begin{aligned}\frac{\partial r_i}{\partial x_m}=&\sum_{k=1}^{K}\sigma'(u_i)\omega_{ik}[\cos(1.75x'_m)\exp(-x'^2_m/2)-1.75x_m\sin(1.75x'_m)\exp(-x'^2_m/2)\cdot\frac{1}{a_k}\\ &-x_m\cos(1.75x'_m)\exp(-x'^2_m/2)x'_m\cdot\frac{1}{a_k}]\end{aligned} \tag{16}$$

The process of regulating algorithm is as following:

1. $j_{\max}$ is the biggest iteration number of times, $e_{\max}$ is the expecting precision
2. $X^{j+1}=X^j+\alpha_{Xj}Cs(X^j)$, and $0<\alpha_{Xj}<0$.

$$X^0=\left[\frac{H_1(1)}{\sum_{t=1}^{n}\sum_{i=1}^{6}H_i(t)}\cdot x,\frac{H_2(1)}{\sum_{t=1}^{n}\sum_{i=1}^{6}H_i(t)}\cdot x,\cdots,\frac{H_6(n)}{\sum_{t=1}^{n}\sum_{i=1}^{6}H_i(t)}\cdot x\right],\quad s(X^j)=\begin{cases}-\dfrac{\partial r_i}{\partial X^j} & j=1\\ -\dfrac{\partial r_i}{\partial X^j}+\dfrac{-\dfrac{\partial r_i}{\partial X^j}\left[-\dfrac{\partial r_i}{\partial X^j}\right]^T}{-\dfrac{\partial r_i}{\partial X^{j-1}}\left[-\dfrac{\partial r_i}{\partial X^{j-1}}\right]^T}s(X^{j-1}) & j\neq 1\end{cases}$$

3. If $j=j_{\max}$ or $e_j\le e_{\max}$, and then stopping the calculation, otherwise, turn to the steps

Finally, X, the optimized regulation input value of satisfying the total risk demand.

4 Conclusions

In this paper, we analyzed the seeking risk method of cooperatively technical innovation. And then we put forward the concept of risk control and regulation gradient of cooperatively technical innovation. At last, a complete controlling risk model of cooperatively technical innovation is brought forward, and this controlling risk model is based on the wavelet and nerve network.

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A Fast Antenna Selection Algorithm Based on Dissimilarity Coefficient in MIMO System

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Abstract. MIMO system can offer considerable capacity. But as the antenna's number increasing, the costs of hardware such as RF chains are very expensive, and limit the using of MIMO system. The traditional antenna selection algorithms based on correlation can give a low complexity but capacity performance loss is large. In this paper, a fast antenna selection algorithm is proposed for MIMO system based on dissimilarity coefficient criteria. The proposed algorithm can be used to calculate the correlation of antennas better, supplies more efficient capacity performance, and has the lower complexity. The simulation results verify the conclusions.

Keywords: MIMO, antenna selection, dissimilarity coefficient.

1 Introduction

Early studies prove that MIMO technology can enhances the system performance dramatically. But the setback of hardware cost motivated by increased number of antenna limits its' applying, the approach of selecting reduced number of antennas to transmit or receive overcomes the drawback of MIMO.

The exhaustive search over all possible subsets performs the optimal property, but has the huge computation complexity so that this algorithm can't be applied [1]. In following researches, some suboptimal algorithms were explored. Gorokhov proposed a detrimental selection algorithm [2]. An approximate algorithm is presented by Gharavi known as incremental selection algorithm [3]. The discrete stochastic optimization antenna selection is showed in [4]. Literature [5] presented a geometric approach named G-circles, which achieve some advantages. In [6], a priority-based genetic algorithm is studied for joint transmit and receive antenna selection. In [7], it is shown that antenna selection techniques based on DWT in correlated channel. The [8] and [9] developed an algorithm based on mutual coupling in closely-space.

Literature [10] and [11] show a Correlation based method. The method reduces complexity largely, but loses performance substantially. In this paper, we offer an alternative fast approach to decrease the capacity loss. The proposed method adopts dissimilarity coefficient to measure the dissimilarity between antennas. The selection criterion has simply mathematical expression, contains no matrix computation, reduces the computational complexity and supplies better capacity performance.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 44–50, 2011.
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2 System Model

In this section, we consider a MIMO system with n_r antennas in receiver and n_t antennas in transmitter, with the channel is flat fading, and noise is complex Gaussian random variables, channel state information is assumed receiver can renew the channel information through channel estimation. When all the antennas are put into use, the $n_r \times 1$ received signal can be described as follows

$$\mathbf{y}(t) = \sqrt{\frac{\rho}{n_t}}\mathbf{H}\mathbf{x}(t) + \mathbf{n}(t) \tag{1}$$

where $\mathbf{x}(t)$ is $n_t \times 1$ transmitted signal, $\mathbf{n}(t)$ denotes the $n_r \times 1$ noise that zero mean complex Gaussian random variable with variance is one. The ρ is average noise-signal ratio. The Channel matrix $\mathbf{H}$ is $n_r \times n_t$ matrix. We assume receiver uses L RF chains and transmitter uses n_t RF chains. When $L = n_t$, the MIMO system can get a good performance found in literature [11], so we suppose $L = n_t$ in this scheme, then the capacity can be further described:

$$C = \log_2 \det(\mathbf{I}_L + \frac{\rho}{n_t}\tilde{\mathbf{H}}\tilde{\mathbf{H}}^H) \tag{2}$$

3 Antenna Selection Algorithms

The algorithm of exhaustive search has a very high complexity, so a number of suboptimal methods are published recently. CBM aims at deleting the rows with the higher correlation and lower powers. It uses the correlation function is

$$R_{i,j} = \left|\left\langle \mathbf{h}_i, \mathbf{h}_j \right\rangle\right| \tag{3}$$

where $R_{i,j}$ is correlation of i-th and j-th row, $\mathbf{h}_i$ and $\mathbf{h}_j$ denote the i-th and j-th row of $\mathbf{H}$ respectively, and $\left\langle \mathbf{h}_i, \mathbf{h}_j \right\rangle$ represents the inner product of $\mathbf{h}_i$ and $\mathbf{h}_j$. According to the procedure in 9, this method reduces the complexity substantially, but a larger capacity loss is found. In this paper, we choose the dissimilar measure as the performance criterion, and offer an alternative approach which has lower complexity and better performance.

Let the absolute error of two row vectors is $\lambda_i = \left|\mathbf{x}_i - \mathbf{y}_i\right|$. Then based on the absolute error, we can get the dissimilarity coefficient of two rows as the following equation

$$z_c = \frac{\sum_{k=1}^{m}(m-k+1)\xi_k}{\sum_{k=1}^{n_t} k} \tag{4}$$

where m is the number of element of one row. Sorting the absolute error descended as $\xi = \{\lambda_1, \lambda_2, ...\lambda_n\}$, the weighted coefficient ξ_k is from the set. In equation (4), we consider the impact from absolute error in the dissimilarity coefficient, which larger absolute error corresponding to larger weighted coefficient. Therefore, the exact estimation of dissimilarity between rows can be obtained. For simplified calculation, we can modify (5) as follows

$$z_{i,j} = \sum_{k=1}^{n_t}(n_t - k + 1)\xi_k \tag{5}$$

The cost function of selection Fd can be written as

$$Fd = \min_{j<i<=n_r} \sum_{k=1}^{n_t}(n_t - k + 1)\xi_k \tag{6}$$

where i and j denote the arbitrary two rows in channel matrix, and $i \neq j$. We assume Ud is the full set of row index, and Us is the set of selected row index, and it begins with an empty set. The analysis leads to procedure as table 1.

Table 1. The antenna selection algorithm flow

1.	$Ud = \{1,2,...n_r\}, Us = \{\}$	10.	*if* $\|\mathbf{h}_i\|^2 > \|\mathbf{h}_j\|^2$
2.	*for* $k = 1 : n_r - L$	11.	$Ud[j] = [\ ]$
3.	*for* $all\, i, j \in Ud$	12.	*else* $Ud[i] = [\ ]$
4.	*if* $i \neq j$	13.	*end*
5.	$\lambda_k = \|\mathbf{h}_i - \mathbf{h}_j\|$	14.	$Us = Ud$
6.	$sort(\lambda_k, descending)$	15.	$n_r = n_r - 1$
7.	$\mathbf{h}_i, \mathbf{h}_j = \min_{j<i<=n_r} \sum_{k=1}^{n_t}(n_t - k + 1)\xi_k$	16.	*end*
8.	*end*	17.	*return* $subset = channel[Us,:]$
9.	*end*		

The total times of multiple of the dissimilarity coefficient computation is

$$f_{proposed} = 2n_t \sum_{k=1}^{L} (n_r - k + 1)(n_r - k) + (8n_t + 4)(n_r - L) \tag{7}$$

The CBM requires the times of multiple is

$$f_{CBM} = \frac{1}{2}(4n_t + 3)\sum_{k=1}^{L} (n_r - k + 1)(n_r - k) + \left(8n_t + 4\right)(n_r - L) \tag{8}$$

From the two formulas, we can see that the complexity of proposed algorithm is lower than CBM.

4 Simulation Results

In this section, the capacity and error performance of the new algorithm will be simulated and analyzed. In simulation, we support the channel is complex Gaussian random variables.

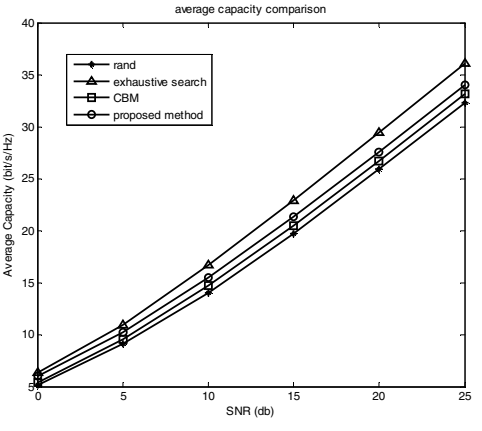


Fig. 1. Average capacity comparison with n_r =8, n_t =4, L =4

Figure 1 shows the results for n_r =8, n_t =4, L =4. It is the comparison of average capacity performance of the algorithm exhaustive search, CBM, random selection and the proposed method. For the exhaustive search, we use equation (3) to compute capacity of all possible channel subsets, and select the set with largest capacity. It can be seen that the random selection shows the worst capacity, the exhaustive search algorithm has the best performance, and the new method perform better average capacity than CBM, and is closer to the optimal algorithm.

Figure 2 shows the average capacity comparison in correlated channel. It is assumed that n_r =8, n_t =4, L =4. Clearly, the performance of proposed algorithm is better than CBM. Take SNR=15 for example, the capacity of the proposed method is

1bit/s/Hz higher than CBM. When SNR=0 to 10db, the proposed algorithm is very close to the optimal method. Comparing figure 1 and figure 2, we can find the average capacity property in complex Gaussian random channel is about 9 bit/s/Hz more than in correlated channel whatever algorithms are used.

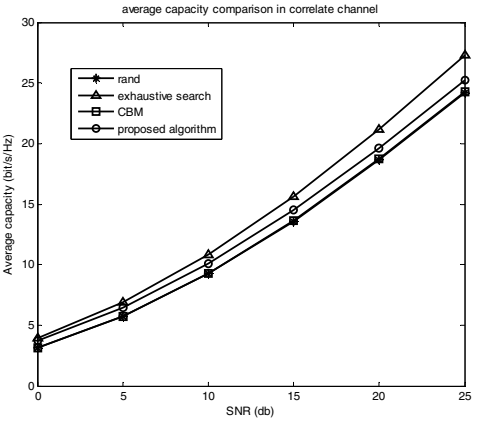


Fig. 2. Average capacity comparison with n_r =8, n_t =4, L =4 in correlated channel

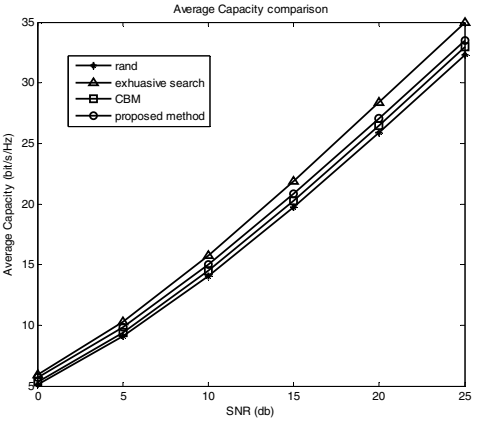


Fig. 3. Average capacity comparison with n_r =6, n_t =4 and L =4

Figure 3 shows the average capacity comparison when n_r =6, n_t =4 and L =4. The tendency of the methods is proximity with figure 1, we see that the capacity property of the proposed method is superior to CBM and random selection. Comparing figure 1 and figure 3, we can see that the average capacity is increased when the antenna number is more.

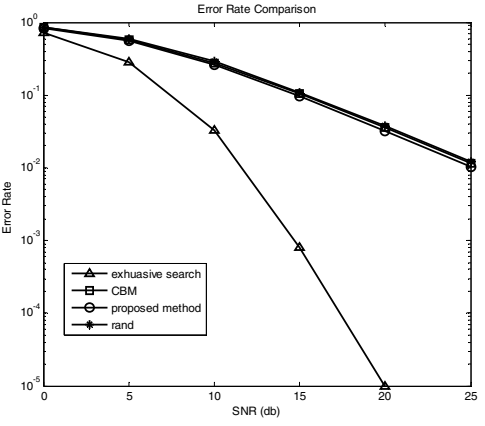


Fig. 4. Error rate comparison with n_r =8, n_t =4, L =4

Figure 4 presents the error rate comparison of the three algorithms, for the sake of exactness, 100000 channels are realized. It can be seen that the proposed method has slightly good error performance. The method of exhaustive search performs the lowest error rate and the random selection has the worst error property.

5 Conclusions

We propose a new MIMO antenna selection algorithm aims at enlarging the capacity. It is based on dissimilarity coefficient to select a subset with the lower similarity and higher power. From the simulation, it is found that the proposed method supplies better capacity property and slightly better error performance compared CBM. Furthermore, because it nearly doesn't contain matrix calculation, the complexity is lower than CBM, realizes the fast selection, and is suitable for Practical communication system.

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Non-coherent Underwater Communication Algorithm Based on CCK Coding

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Abstract. A non-coherent CCK-FSK algorithm used in fading channel such as underwater acoustic communication is proposed. In the proposed algorithm, complementary-code-key is used as spread spectrum code which can combat fading channel with less data rate loss. First, the binary dates are mapping to CCK codes to combat frequency selective fading. Then, the CCK codes are mapped by 1-of-4 FSK modulation method. The selected frequencies are orthogonal. Then the DFT/IDFT transforms can be used in order to decrease computational complexity. Performance simulation with realistic channel characters was done and the results show that the CCK-FSK algorithm has more than 5 dB SNR gain compared with FSK algorithm in the fading channel.

Keywords: non-coherent; underwater communication; CCK; FSK.

1 Introduction

A non-coherent CCK-FSK algorithm used in underwater (UWA) communication suffered by serious frequency selective fading is proposed. Complementary-code-keying (CCK) has been adopted in IEEE 802.11b Standard for 11Mbps DSSS baseband[5]. The CCK modulation performance in fading channel is demonstrated in [1]. In [3], [4], CCK was combined with OFDM. But these algorithms using coherent modulation methods, there performance decreased when the SNR is low. In this paper, we use complementary-code-key as spread spectrum code combined with FSK modulation to combat channel fading. Compared with other spread spectrum codes such as Gold sequence, using CCK code suffers less data rate loss. This character makes CCK spreading spectrum methods suit for band-limit channels.

First, every 8 bit binary dates are mapping to CCK code. Then, the CCK code is mapped by 1-of-4 FSK modulation method[2]. The selected frequencies are orthogonal in order to increase data rate and IDFT/DFT transform is used in modulation/demodulation to decrease computational complexity.

1.1 CCK-FSK

Non-coherent modulation methods such as FSK use energy detection methods, which are more robust than coherent modulation methods in low receiving SNR and do not

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 51–55, 2011.
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need channel estimation techniques. However, the frequency selective fading which always suffered in UWA communication seriously decrease the performance of FSK in these channels. In the proposed algorithm, CCK is used as spread spectrum code to combat fading channel.

CCK- FSK Modulation

CCK-FSK modulation algorithm is a series of mapping. These mappings are as follows.

The project was supported by the Natural Science Foundation of Fujian Province of China(No. 2010J05139)

First mapping:

The series binary source dates were transformed to paralyze as (1)

$$\mathbf{C} = \begin{bmatrix} c_0, c_8 \cdots \\ c_1, c_9 \cdots \\ \vdots \quad \vdots \\ c_7, c_{15} \cdots \end{bmatrix} = \left[\mathbf{c}_0, \mathbf{c}_1, \cdots \mathbf{c}_i, \cdots \right] \tag{1}$$

Then, the binary signal $c_{i,\ (k-1)^* 2+0}, c_{i,(k-1)^* 2+1}$ is mapped to $\varphi_k, i = 0,1,2,3$. Mapping method is shown in Table 1.

Table 1. $c_{i,\ (k-1)^* 2+0}, c_{i,(k-1)^* 2+1}$ to φ_k

source	φ_k
00	0
01	$\pi/2$
11	π
10	$-\pi/2$

Second mapping:

The phases $\boldsymbol{\theta}_{ik}$ of the CCK code are obtained by (2). $\boldsymbol{\theta}_{ik}, k = 0, \cdots, 7$. $\boldsymbol{\theta}_{ik}$ also contain 4 phases.

$$\begin{bmatrix} \theta_0 \\ \theta_1 \\ \theta_2 \\ \theta_3 \\ \theta_4 \\ \theta_5 \\ \theta_6 \\ \theta_7 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} \varphi_0 \\ \varphi_1 \\ \varphi_2 \\ \varphi_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ \pi \\ 0 \\ 0 \\ \pi \\ 0 \end{bmatrix} \tag{2}$$

Third mapping:

Then $\boldsymbol{\theta}_{ik}$ is mapped as Table 2.

Table 2. $\boldsymbol{\theta}_{ik}$ to b_{ik}

$\boldsymbol{\theta}_{ik}$	b_{ik}
0	1
$\pi/2$	2
π	3
$-\pi/2$	4

Then, we have $b_i = \left[b_{i0}, b_{i1}, \cdots, b_{ik}, \cdots, b_{i7}\right]^T$. And we define $a_i^{'} = \left[a_{01}, a_{11}, \cdots, a_{ik}, \cdots, a_{i,31}\right]^T$,

where $\begin{cases} a_{ik} = 1 \quad k = (n-1) \times b_{in} \quad n = 1, 2, \cdots, 8 \\ f_i = 0 \quad other \end{cases}$.

To reduce the RAPR, let $a_{ik} = a_{ik} \times e^{j\varphi_{ik}}$. Where φ_{ik} obey the uniform distribution in the range of $\{-\pi, \pi\}$.

Then, the length of the signal is increased to N by zero padding in order to increase SNR. We have $a_i = [a_i^{'}, 0, 0, \cdots, 0]^T$.

In order to improve bandwidth efficiency, we choose the orthogonal subcarriers and use IDFT to realize signal modulation.

$$s_{ik}^{'} = \sum_{n=0}^{N-1} \mathbf{a}_{in} e^{j\frac{2\pi nk}{N-1}} \quad k = 0, \cdots, N-1 \tag{3}$$

Normalization $s_{ik} = s_{ik}^{'} / \max(s_{ik}^{'})$.

The robustness can be increase by inserting zeros

$$\mathbf{a}_i = [0, \cdots, 0, a_{01}, 0, \cdots, 0, a_{11} \cdots, a_{i,31}, 0, 0, \cdots, 0]^T \tag{4}$$

In order to increase date rate, a set of CCK codes can be modulated in one FSK code. So the date rates of the flexible.

Demodulation of the CCK-FSK

Base-band complex samples can be written as

$$\mathbf{x}_i = [x_{i0}, x_{i1}, \cdots, x_{in}, \cdots x_{i,N-1}]^T \tag{5}$$

After DFT transform, we have

$$y_{ik} = \left| \sum_{n=0}^{N-1} x_{in} e^{-j\frac{2\pi nk}{N-1}} \right| \quad k = 0, \cdots, N-1. \tag{6}$$

Take the first 32 points

$$\mathbf{Y} = \begin{bmatrix} y_{i0}, y_{i1}, \cdots y_{i3} \\ y_{i4}, y_{i5}, \cdots y_{i7} \\ \vdots \\ y_{i,28}, y_{i,29}, \cdots y_{i,31} \end{bmatrix} \tag{7}$$

The subscript of the maximum point in each line is

$$\mathbf{b}_i = [b_{i0}, b_{i1}, \cdots, b_{in}, \cdots b_{i,7}]^T \quad . \tag{8}$$

Using the corresponding relationship showed in Table 2, we transform b_i to θ_i .

$$\mathbf{S} = \begin{bmatrix} s_{01}, \cdots, s_{i1}, \cdots, s_{I1} \\ s_{02}, \cdots, s_{i2}, \cdots, s_{I2} \\ \vdots \\ s_{07}, \cdots, s_{i7}, \cdots, s_{I7} \end{bmatrix} = \left[\mathbf{s}_0, \mathbf{s}_1, \cdots, \mathbf{s}_I \right] \tag{9}$$

Then a cross-correlation between $\mathbf{s}_i$ and the CCK code set is done. Where φ_i , $i = 1, 2, 3$ can be obtained by the maximum correlation peak. And φ_0 can be determined by the phase of peak.

1.2 Simulation Result

Performance simulation with realistic channel characters was done. Fig.1a shows the frequency response of the channel. The channel is seriously influenced by frequency selective fading. In the simulation, the chosen communication band is 1.5 kHz. The carrier is 6 kHz. We use 1024 points of IDFT and the guard signal is 50ms. The data rate is 86bits/s.

Fig.1b compares the bit errors between CCK-FSK and FSK while the date rate and communication band is similar. We can see that the bit error performance of FSK at 10dB is similar to the performance of the proposed CCK-FSK algorithm at 3dB. So, about 5 dB SNR gain is obtained. When the SNR is 5dB, the bit error of the CCK-FSK algorithm is 10-2, which can be solved by error correction.

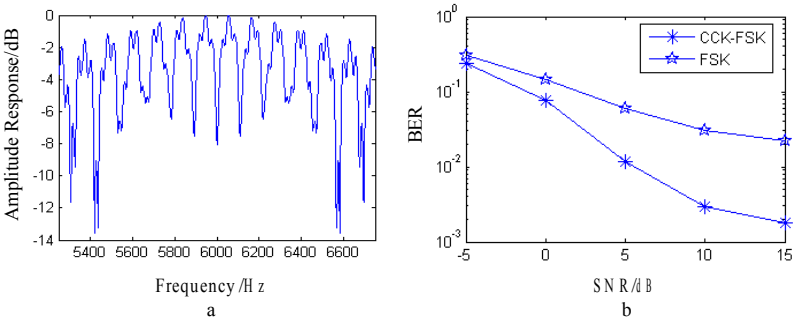


Fig. 1. Simulation results a. Frequency response of the channel b. bit error

2 Conclusion

In this paper, we use complementary-code-key as spread spectrum code combined with FSK modulation to combat channel fading. Compared with other spread spectrum codes such as Gold sequence, using CCK code suffers less data rate loss. This character makes CCK spreading spectrum methods suit for band-limit channels. Computer simulation was done with realistic channel characters obtained by sea test. The results show that the CCK-FSK algorithm has more than 5 dB SNR gate compared with FSK in the fading channel.

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An Improved MFAC Algorithm and Simulation Research Based on Generalized Pan-Model

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Abstract. In this paper, an adaptive control concept based on generalized Pan-model is presented according to an improved algorithm of model-free adaptive control; For the model, time-varying parameter of the a dynamic system are described as multi characteristic ones. Simulation is implemented for the two control strategies (algorithms).The simulation result indicates that the improved algorithm can effectively get over the instability of the dynamic process; the system control output signal has excellent performance involving trackability, robustness, anti-interference and so on; and the computation amount is relatively small so that the response is more rapid.

Keywords: MFAC; Nonlinear System; GUM; Robustness; Anti-interference.

1 Introduction

In general, an industrial process is characterized in nonlinearity, time variation, coupling and uncertainty and so on; even a constant model is obtained through a lot of simplification, it is also difficult for conventional control theories and methods to achieve expected effects in an implementation process. Model-Free Adaptive control---MFAC is a brand-new theory and technique, having advantages of both modern control theories and typical PID theories; neither accurate process quantitative knowledge nor design of a control for a certain process is required; it is characterized in analysis and criterion for stability of a loop system, wide application and excellent control effect[1]. However, there is a certain limit to MFAC; although a mathematical model of an object is not required, characteristics of an applied object shall be taken into consideration in practice; moreover, it is unable to adapt to a complex system by means of an integration approach based on simple identification and control. Therefore, MFAC shall be perfected according to main characteristics represented in a controlled process; thus, provided in this paper is an MFAC improved algorithm and simulation research based on generalized Pan-model, which solves the above problems more efficiently[1],[2].

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 56–62, 2011.
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2 Introduction for the Concept of Pan-Model

2.1 Principle of Model-Free Adaptive Control Algorithm

A general discrete time nonlinear system can be represented as follows[3]:

$$y(k+1) = f(y(k), y(k-1), \cdots, y(k-n_y), u(k), u(k-1), \cdots, u(k-n_u)) \tag{1}$$

Wherein $y(k), u(k)$ indicate output and input of the system respectively;

$u(k) \in R^1$ or $u(k) \in R^1$; n_y and n_u indicate system orders respectively.

For an SISO nonlinear system, follow the following assumptions:

- Assumption 1: system (1) is observable and controllable for input and output;
- Assumption 2: $f(\cdot)$ is a continuous partial derivative with respect to $u(k)$ which is current control input signal of the system.
- Assumption 3: system (1) is a generalized Lipschitz; namely, for any k and $\Delta u(k) \neq 0$, the following conditions are satisfied:

$$\left|\Delta y(k+1)\right| \leq b\left|\Delta u(k)\right|$$

Wherein $\Delta y(k+1) = y(k+1) - y(k), \Delta u(k) = u(k) - u(k-1), b$ is constant.

For a nonlinear system (1), if assumptions 1-3 are satisfied, there must be a $\phi(k)$ to satisfy the following condition when $\Delta y(k) \neq 0$:

$$\Delta y(k+1) = \phi(k)\Delta u(k) \tag{2}$$

Wherein $\left|\phi(k) \leq b\right|$, wherein b is a constant bigger than 0; equation(2) is a Pan-model of equation(1) of the system; $\phi(k)$ is a characteristic parameter. If both the sampling period and the value of $\Delta u(k)$ are small, $\phi(k)$ can be considered as a slow time-varying parameter; and the relation between $\phi(k)$ and $u(k)$ can be ignored; thus an adaptive control system can be designed theoretically.

For a discrete time system, a control law algorithm resulted by forward predicting an error criterion function by means of one step of minimization may produce an overgreat control input function so as to damage the system itself. However, a control law algorithm resulted by forward predicting an error criterion function by means of one step of minimized weighing may produce a stable tracking error[4]. For a nonlinear system (1), an overgreat control input variation irrationalizes replacement of the system(1) by a dynamic time-varying linear system(2), because an overlarge $\Delta u(k)$ means a possibility of an overlarge partial derivative variation; therefore, the relation between $\phi(k)$ and $u(k)$ cannot be ignored. In order to overcome defects of the above two control laws, the following control input criterion function is introduced:

$$J(u(k)) = [y^*(k+1) - y(k+1)]^2 + \lambda[u(k) - u(k-1)]^2 \tag{3}$$

Wherein λ is a penalty factor; $y^*(k+1)$ is a given value at the time $k+1$.

Substitute formula (2) into the criterion function (3), derivate $u(k)$ and set the value thereof to be 0 to result a solution:

$$u(k) = u(k-1) + \frac{\rho_k \phi(k)}{\lambda + |\phi(k)|^2}[y^*(k+1) - y(k)] \tag{4}$$

Wherein $\rho_k (0 < \rho_k < 1)$ is a learning step length. It can be concluded from the control law algorithm (4) that such control laws are unrelated to mathematical model structure and system order of a controlled system; I/O data of the system is used for the design only.

When a false partial derivative $\phi(k)$ is estimated by I/O data of the system, the system can be subjected to a feedback control by means of a control law so as to result a group of new observation data which is added into existed data; then characteristic parameters of next time are estimated. In such a manner, the whole control process can be realized. Compared with a traditional adaptive control scheme, the novel adaptive control scheme requires far fewer parameters for online adjustment; it is suitable for rapidity of the system and characterized in small computation amount and easy realization.

2.2 MFAC Based on Generalized Pan-Model

The Pan-model has the following disadvantages: firstly, the assumption that one-step time lag of the Pan-model is known and time-invariant is inconsistent with the uncertain lag present in a controlled object; time lag shall be firstly selected for large time lag present in the controlled object, which indicates that the selected sampling period is very large; output cannot be fed back effectively in time for the system is in an open loop state until the next sampling time; therefore, a large sampling period is infeasible; secondly, in the Pan-model, only a characteristic parameter $\phi(k)$ is applied to describing the nonlinear system dynamically, which is improper for a complex dynamic system. Thus, the following generalized Pan-model is provided.

Provided that assumptions 1-3 are satisfied, according to equation(2), when the time lag of the controlled object is 1,

$\Delta y(k+1) = \psi_1 \Delta u(k)$

When the time lag of the controlled object is 2,

$\Delta y(k+1) = \psi_2 \Delta u(k-1)$

$\vdots$

When the time lag of the controlled object is n,

$$\Delta y(k+1) = \psi_n \Delta u(k-n+1) \tag{5}$$

Add n equations above and set $\phi_i(k) = \frac{\psi_i(k)}{n}$ to result:

It can be resulted according to above formula that: when $\phi_n(k) \neq 0, \phi_1(k) = \phi_2(k) = \cdots = \phi_{n-1}(k)$, the time lag of the controlled object is just step n;

when $\phi_1(k) \neq 0, \phi_2(k) = \phi_3(k) = \cdots = \phi_n(k)$, time lag of the controlled object is just step 1 time lag. Time-varying parameter of the model varies from one to a plurality of characteristic parameters to describe a dynamic system, which is more suitable for a complex dynamic system for a controlled object with great inertia and strong nonlinearization. equation(5) is called as a Generalized Universal Model---GUM.

For the GUM of equation (5), the estimation method for a characteristic parameter is firstly provided; then a control law is derived according to the resulted estimation parameter in combination with a target function. In order to avoid rapid variation of the estimation value of the characteristic parameter, the following target function is provided:

$$\min J(\hat{\phi}(k)) = [\left| y^*(k+1) - y(k) - \hat{\phi}(k+1)\Delta U(k) \right|^2 + \mu \left| \hat{\phi}(k+1) - \phi(k) \right|^2] \tag{6}$$

Substitute equation(6) into formula (10); solve the derivative of $\phi(k)$; and set value thereof to be 0 to result:

$$\hat{\phi}(k+1) = \hat{\phi}(k) + \frac{\eta_k \Delta U(k-1)}{\mu + \Delta U^2(k)} (\Delta y(k+1) - \Delta U^T(k)\hat{\phi}(k)) \tag{7}$$

Wherein : $\hat{\phi}_1(k+1) = \hat{\phi}_1(1)$, η_k （$0 < \eta_k \leq 1$） is a learning step length. Following form of the control law is resulted by a similar method in a like manner:

$$u(k) = u(k-1) + \frac{\rho_k \hat{\phi}_1(k)}{\lambda + \left| \phi(k) \right|^2} [y^*(k+1) - y(k) - \sum_{i=2}^{n} \hat{\phi}_i(k) \Delta u(k-i+1)] \tag{8}$$

MFAC based on generalized Pan-model is formed by online interaction of equation (7) and equation (8).

3 Simulation Comparison and Research

During an aluminum powder atomization production, temperature and stability of aluminum liquid in an atomization furnace have direct influence on the quality of aluminum powder atomization; control thereof is key to the whole production process[5]. As the aluminum liquid is atomized continuously, the liquid level drops gradually; the atomization furnace shall be filled with the aluminum liquid from a melting furnace at variable intervals; low temperature of the aluminum liquid in the melting furnace will cause wide fluctuation of temperature of the aluminum liquid in the atomization furnace; the fluctuation amplitude is between +500℃ and -500℃; in addition, temperature of the atomization furnace is also influenced by variation of fuel gas heat value, variation of ambient temperature, interference factors such as deslagging operations and so on, characterized in strong nonlinearization and large time delay and so on; it is difficult to establish an exact mathematical model; good effects cannot be obtained by means of a regular PID control algorithm. However, MFAC has

excellent parameter adaptation, which can effectively control nonlinear objects with large time lag. Figure 1 is a structure principle diagram of an atomization furnace exit temperature control system in which MFAC serves as a regulator.

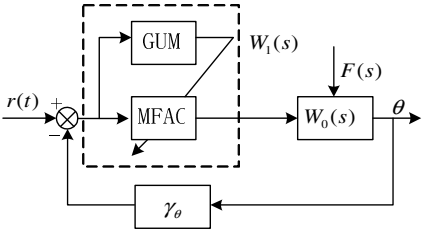


Fig. 1. The structure principle diagram of an atomization furnace exit temperature control system

In figure 1, r(t) is a given value; Wo(s) is an object of atomization furnace; F(s) is a disturbance transfer function; γ_θ is a transfer function of a temperature measurement element and a transducer. The following parameters of a controlled object are selected for simulation research:

$$W_o(s) = \frac{1.125}{(25s+1)^3}, \quad \gamma_\theta = 0.1$$

In the experiment, the model of a given system is only used for producing required I/O data; the system model is not involved in the design of the controller. The whole outside the dotted box in figure 1 is regarded as a generalized controlled object; two different controls such as MFAC and GUM-MFAC are applied for comparison respectively.

- Disturbance test

In an atomization furnace temperature control system, the external disturbance is very frequent; the designed control system shall have the ability to overcome various disturbances firstly. The disturbance test was carried out when the load is 100%. Select a sampling point $k >= 1000$; add a step response signal of $r(k) = 10$ at the input terminal; add 30% of constant measurement interference at the time of 1500s; and add 50% of constant measurement interference at the time of 2500s. In figure 2, GUM-MFAC control is obviously superior to MFAC control in response time. When 30% of constant

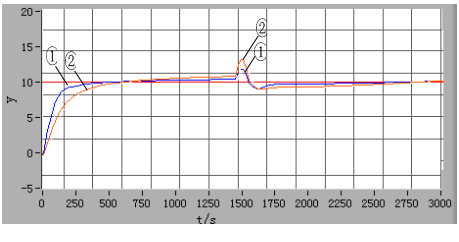
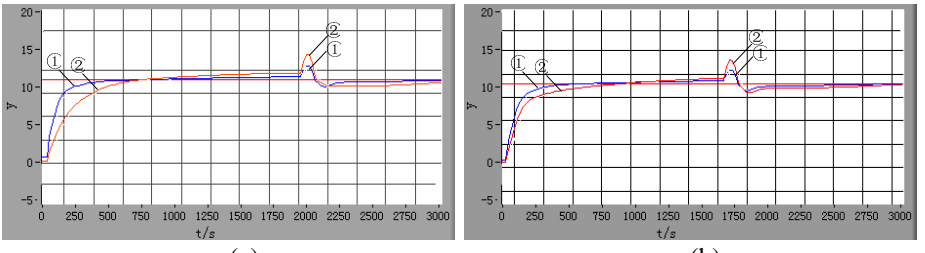


Fig. 2. Disturbance test

measurement interference is added, the response speed thereof is faster than the MFAC control, which indicates that GUM-MFA control has stronger disturbance resistant capacity.

- Robustness test

Fig. 3(a) is a simulation result comparison with addition of 30% time constant in a leading area and 20% time constant in an inert area; figure 3(b) is a simulation result comparison with reduced corresponding time constant.



(a) (b)

Fig. 3. Robustness test

Curve ① indicates a generalized MFAC simulation curve; curve ② indicates a Pan-model MFAC simulation curve; as shown in figure 3, characteristics of the controlled object vary, so that the essential MFAC gets slow response speed and large overshoot, but the control system is still stable; and the generalized MFAC still has excellent control effect, which indicates better robustness and adaptation.

4 Conclusion

An MFAC improved algorithm based on a generalized Pan-model is provided with respect to defects in the MFAC algorithm and applied to an exit temperature control system of a powder aluminum atomization furnace with strong nonlinearization and large time delay for simulation research. The result indicates that the MFAC improved algorithm based on a generalized Pan-model has faster response speed and stronger disturbance resistant capacity; it not only keeps stronger adaptation and robustness of the MFAC but also has simple parameter setting and small computation amount. In terms of application, there is no need of designing a control according to the model and it is characterized in excellent portability, simple setting, and wide application prospect.

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An Improving FSOA Optimization by Using Orthogonal Transform

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Abstract. After the shortcoming of the optimization algorithm on using fishing strategy (FSOA) being analyzed in this paper, an improving FSOA optimization is presented. The main approach of this optimization is that, about the aspect of the choice of detecting points, every fisherman selects his first detecting-point in his positive direction randomly, and then the others are determined through the orthogonal transform of the first detecting-point. And about the aspect of the searching strategy, that only the fisherman who is at the present optimal point that takes the strategy of constricted search, and the others make use of the strategy of moving search. It shows, from the experimental imitating study of some typical benchmark functions' optimization, that the improving FSOA is effective and feasible for solving the optimal solution of the complex functions.

Keywords: improving FSOA; orthogonal transform; random detection; optimization.

1 Introduction

Intelligent optimization approach or technology has been a research hotpoint for scholars both at home and abroad. Since 1960s, Holland[1] and Goldberg[2] have proposed genetic algorithm(GA), as well as Kennedy[3] with particle swarm optimization(POS), Dorigo[4,5] with ant colony algorithm, Chun[6] with immune algorithm, Castro[7] with clonal selection algorithm, Li[8] with artificial fish algorithm(AFSA) and so on. However, these optimization algorithms or technologies are all based on some behavioral characteristic of biological models, without dissolving in that of senior intelligence which is peculiar to mankind. In paper [9], the authors take some mankind behavioral characteristic as the spindle of the optimization method and

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G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 63–69, 2011.
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propose a optimization method imitating the fisherman's fishing behavior in the light of their habits or features of casting fishnet, i.e. an optimization approach on using fishing strategy (basic FSOA for short). But the basic FSOA just puts forward some preliminary conceptions and there still exist some shortages: ① since fishermen adopt a fixed "the boxes" detection format, it may lead to reduplication of the detecting points so as to reduce the searching efficiency; ② for each fisherman takes the strategy of constricting search, it increases the time complexity of algorithm; ③ this algorithm may be entrapped in local extremum easily with regard to complex optimization problems that have high dimension and large searching space.

In this paper, we propose an improving FSOA(IFSOA for short) optimization, a new optimization approach basing on mankind-intelligence for optimizing multi-model function. In this approach, first we choose the first detecting point randomly on the positive direction, and then determine other detecting points by the orthogonal rotation transformation of the first detecting point. Only the fisherman who is at the present optimal point that takes the strategy of constricted search, and the others make use of the strategy of moving search. The other parts of this thesis are organized as follows. The basic FSOA is briefly described in Section 2. The improving FSOA is described in section 3. A summary of results from numerical experiments on several benchmark functions is presented in Section 4. Conclusions are given in Section 5.

2 Brief Introduction of FSOA Algorithm

In basic FSOA[9], we suppose fishermen have no knowledge about the distribution of fish and the depth of the water level in their search space. Also, the distribution of fish (i.e. distribution density) will not change though fishermen fish in the operation area.

In basic FSOA, we adopt the strategy of constricted search and moving search and "the boxes" detection format. The main procedures are described as follows.

Let $D = D_1 \times \cdots \times D_n$ be the operation area, and $\mathrm{f}(X)$ be the objective function on D. The final goal of fishermen is to find the optimal solution of $\mathrm{f}(X)$ in D. $D_i = [a_i, b_i]$.

Supposing there are k fishermen in D, and the position of fisherman i at time t is $P^i(t) = [x_1^i(t), \cdots, x_n^i(t)]$. Then the fisherman i casts his fishnet according to "the boxes" detection format in the surroundings of point $P^i(t)$ (i.e. the centre of the operation area), and we get a set of casting fishnet $\Omega(P^i(t)) = \{X^i(t+1) = [x_1^i(t+1), \cdots, x_n^i(t+1)] \mid x_j^i(t+1) \in \{x_j^i(t) - l^{(-)}, x_j^i(t), x_j^i(t) + l^{(+)}\}, j = 1, \cdots, n\}$,where $x_j^i(t) \in D_j$, $l^{(-)} > 0$, $l^{(+)} > 0$, and if $x_j^i(t) - l^{(-)} \le a_j$, then let $x_j^i(t) - l^{(-)} = a_j$, or if $x_j^i(t) + l^{(+)} \ge b_j$, then let $x_j^i(t) + l^{(+)} = b_j$, $j = 1, \cdots, n$.

Moving search. If $\mathrm{f}(P^i(t+1)) = \max_{X^i(t+1) \in \Omega(P^i(t))} \mathrm{f}(X^i(t+1)) > \mathrm{f}(P^i(t))$, then the fisherman i moves from $P^i(t)$ to $P^i(t+1)$, where he continues his operation for a solution $P^i(t+2)$ that is better than $P^i(t+1)$. Such searching method is called "moving search".

Constricting search. If $\mathrm{f}(P^i(t+1)) = \max_{X^i(t+1) \in \Omega(P^i(t))} \mathrm{f}(X^i(t+1)) \le \mathrm{f}(P^i(t))$, then the fisherman i doesn't take any movement, and notes $P^i(t+1) = P^i(t)$. The fisherman i still casts his fishnet at point $P^i(t)$ according to "the boxes" detection format, and we get the point

set of casting fishnet $\Omega(P^i(t+1)) = \{[x_1^i(t+2),\cdots,x_n^i(t+2)] \mid x_j^i(t+2) \in \{x_j^i(t+1) - \alpha\alpha l^{(+)}, x_j^i(t+1), x_j^i(t+1) + \alpha l^{(+)}\}, j = 1,\cdots,n\}$. In which, α ($0 < \alpha < 1$) is called the shrinkage factor. Then we decide whether $\Omega(P^i(t+1))$ is better than $P^i(t+1)$ by the previous method. Such searching method is called "Constricting search".

Statement. a) there is a message board in this algorithm, which is used to record the optimal state found by fishermen. b) There is also a biggest threshold of the Constricted search times at the same point in this algorithm. If the Constricted search times of a fisherman at some point have reached the biggest threshold and his state still is unchanged, then this fisherman should choose another point randomly in the operation area.

3 The Improving FSOA Algorithm

3.1 Basic Thought

The main idea of IFSOA presented in this thesis is as follows: a) the improvement of searching method of detecting points. First every fisherman selects his first detecting-point in his positive direction randomly, and then determines some other detecting points by using orthogonal rotation transformation on the first detecting point. b) The improvement of the searching strategy. Only the fisherman who is at the present optimal point that takes the strategy of constricted search, and the others make use of the strategy of moving search.

3.2 Method Description

Let $\mathrm{f}(X)$ be the objective function on D, $D = D_1 \times \cdots \times D_n$, $D_i = [a_i, b_i]$. To facilitate the description during this thesis, we note M as the fishermen's population size, L as the fishnet radius the fishermen cast, α as the constricted factor, c as the threshold of the constricted times, Gen as the biggest threshold of the algorithm iterations, gbest as the Group message board, N as the number of the detecting points the fisherman selects at the same position.

Firstly initialize every fisherman's position and the message board. Select M points to be initial position and initial casting-net point of individual, suppose these M points to be $P^i(0) = [x_1^i(0),\cdots,x_n^i(0)]$ ($i = 1,\cdots,M$). Note $P(0) = \mathrm{optimal}\{\mathrm{P^i}(0), i = 1,\cdots,M\}$, and let $\mathrm{gbest} \leftarrow [P(0), \mathrm{f}(P(0))]$, $\mathrm{pbest(i)} \leftarrow [\mathrm{P^i}(0), \mathrm{f}(P^i(0))]$. Here optimal{ } means the optimal element in the set { }(the same in the following).

Secondly the fishermen take different strategies in different cases accordingly. Let the record of the message board be $\mathrm{gbest}=[P(t), \mathrm{f}(P(t))]$ up to time t. let $P^i(t) = [x_1^i(t),\cdots,x_n^i(t)]$ be the position of fisherman i at time t and his positive direction from $\mathrm{P^i}(t-1)$ to $\mathrm{P^i}(t)$ be $\overrightarrow{\mathrm{P^i}(t-1)\mathrm{P^i}(t)} = \{x_1^i(t) - x_1^i(t-1),\cdots,x_n^i(t) - x_n^i(t-1)\}$. Next, fisherman i selects a detecting point randomly in $\overrightarrow{\mathrm{P^i}(t-1)\mathrm{P^i}(t)}$:

$$X_1^i(t+1) = [x_1^i(t) + r(x_1^i(t) - x_1^i(t-1)),\cdots,x_n^i(t) + r(x_n^i(t) - x_n^i(t-1))] \quad (1)$$

In which r is a normal distribution of random numbers between ε and L, ε is a given positive number, $0<\varepsilon<1$, $\varepsilon<L$, L is the fishnet radius the fisherman cast. And the fisherman i determines $N-1$ detecting points by the following formula:

$$X_k^i(t+1)=\mathbf{A}_k X_1^i(t+1),\ k=2,\cdots,N. \tag{2}$$

In which $\mathbf{A}_k$ is a orthogonal matrix, i.e. $\mathbf{A}_k\mathbf{A}_k'=\mathbf{I}$, here $\mathbf{I}$ is a unit matrix, and each time the rotation angle is less than $\pi/3$. And if $x_j^i(t)+r(x_j^i(t)-x_j^i(t-1))<a_j$ or $x_j^i(t)+r(x_j^i(t)-x_j^i(t-1))>b_j$, then let $x_j^i(t)+r(x_j^i(t)-x_j^i(t-1))=a_j$ or $x_j^i(t)+r(x_j^i(t)-x_j^i(t-1))=b_j$. Underneath all adopt this deposing method.

Note $\mathrm{P}^i(t+1)=\mathrm{optimal}\{X_k^i(t+1),k=1,\cdots,N\}$, $\mathrm{P}(t+1)=\mathrm{optimal}\{P^i(t+1),i=1,\cdots,M\}$. Following, we will discuss different cases according to different conditions.

Case 1. if $\mathrm{P}(t+1)$ is better than $\mathrm{P}(t)$, then $\mathrm{gbest}\leftarrow[\mathrm{P}(t+1),\mathrm{f}(\mathrm{P}(t+1))]$, namely update the message board, and fisherman i moves from $\mathrm{P}^i(t)$ to $\mathrm{P}^i(t+1)$, thus the positive direction is $\overrightarrow{\mathrm{P}^i(t)\mathrm{P}^i(t+1)}$. Continue to search in D by this method.

Case 2. if $\mathrm{P}(t+1)$ is not better than $\mathrm{P}(t)$, then need not update the message board. To facilitate the description, we still use $\mathrm{P}(t+1)$ as the optimal position the group have found up to time $t+1$, i.e. note $\mathrm{P}(t)$ as $\mathrm{P}(t+1)$, $\mathrm{gbest}=[\mathrm{P}(t+1),\mathrm{f}(\mathrm{P}(t+1))]$. In this case, the fishermen choose different strategies according to their own situation.

As to fisherman i, ① if $\mathrm{P}^i(t)\neq\mathrm{P}(t+1)$, i.e. the group's optimal position $\mathrm{P}(t+1)$ up to now is not found by fisherman i, then he moves forward from $\mathrm{P}^i(t)$ to $\mathrm{P}^i(t+1)$ and determines N detecting points $X_k^i(t+2)$ ($k=1,\cdots,N$) at time $t+2$ by the formula (1) and (2). ② if $\mathrm{P}^i(t)=\mathrm{P}(t+1)$, i.e. the group's optimal position $\mathrm{P}(t+1)$ up to time $t+1$ is exactly that $P^i(t)=[x_1^i(t),\cdots,x_n^i(t)]$ of fisherman i' at time t, then he remains at $\mathrm{P}^i(t)$ and applies the strategy of constricted search. To facilitate description, we still use $\mathrm{P}^i(t+1)$ as the position of fisherman i at time $t+1$, as can be seen $\mathrm{P}^i(t+1)=\mathrm{P}^i(t)$. The strategy of constricting search the fisherman i applies at $\mathrm{P}^i(t)$ is as follows.

Fisherman i chooses a detecting point randomly in a sphere whose centre is $\mathrm{P}^i(t+1)$ and radius is αL:

$$X_1^i(t+2)=P^i(t+1)+\alpha L\mathbf{q}^i(t+2)/|\mathbf{q}^i(t+2)|, \tag{3}$$

In which $\mathbf{q}^i(t+2)=[r_1^i(t+2),\cdots,r_n^i(t+2)]$, $r_l^i(t+2)$ is a uniform distribution of random number in $[\varepsilon,1]$, $l=1,\cdots,n$. Then determine $N-1$ detecting points by the formula (2):

$$X_k^i(t+2)=\mathbf{A}_k X_1^i(t+2),\ k=2,\cdots,N. \tag{4}$$

Denote $\mathrm{P}^i(t+2)=\mathrm{optimal}\{X_k^i(t+2),k=1,\cdots,N\}$, $\mathrm{P}(t+2)=\mathrm{optimal}\{P^i(t+2),i=1,\cdots,M\}$. Then each fisherman chooses his next searching approach after analyzing "case1" and "case2".

If the times of fisherman i's constricting search has reached the threshold c at $\mathrm{P}^i(t)$, i.e. the record of the message board gbest is $\mathrm{gbest}=[\mathrm{P}(t),\mathrm{f}(\mathrm{P}(t))]=[\mathrm{P}^i(t),\mathrm{f}(\mathrm{P}^i(t))]$ from time t to time $t+c$, then at time $t+c+1$, fisherman i chooses a detecting point

$X_1^i(t+c+1)=[x_1^i(t+c+1),\cdots,x_n^i(t+c+1)]$ randomly and determines other $N-1$ detecting points by the formula (2).

According to the previously described methods or procedures to proceed, stop until the algorithm iterations reach at Gen , and output the message board gbest .

4 Numerical Experimental Research

In this thesis, in order to test the performance of the improving FSOA optimization, we choose some typical complicated functions as the objectives of the numerical experiment research. These functions are as follows.

(a) $f_1(x)=100(x_1^2-x_2)^2+(1-x_1)^2, -2.048\le x_1,x_2\le 2.048$. The theoretic minimum value of $f_1(x)$ is 0, and its corresponding minimum point is $(1,1)$.

(b) $f_2(x)=(x_1^2+x_2^2)^{0.25}[\sin^2(50(x_1^2+x_2^2)^{0.1})+1.0]$, $-100\le x_i\le 100$, whose global optimal point is (0,0), and its minimum is 0.

In this experiment, the parameters and orthogonal matrices are set as follows.

The fisherman's population size *M*=100, the maximal radius of fishermen' casting *L*=1, the shrinkage factor $\alpha=0.6$, the maximal shrinking threshold $c=4$, and the sum of maximal iterations of algorithm Gen=500.

As for $f_1(x)$ and $f_2(x)$, we set $N=5$ and choose the orthogonal matrices as follows.

$$\mathbf{A}_2=\begin{bmatrix}\cos\theta_2 & -\sin\theta_2\\ \sin\theta_2 & \cos\theta_2\end{bmatrix},\ \mathbf{A}_3=\begin{bmatrix}\cos\theta_3 & -\sin\theta_3\\ \sin\theta_3 & \cos\theta_3\end{bmatrix},\ \mathbf{A}_4=\mathbf{A}_2\mathbf{A}_2,\ \mathbf{A}_5=\mathbf{A}_3\mathbf{A}_3,\ \text{Here } \theta_2=\pi/6,\ \theta_3=-\theta_2 .$$

4.1 Evaluating Method and Experiment Results

We choose the indexes of Opt(the optimum value), Worst(the worst value), Aver(the average value), SD(the standard deviation), SR(succeed ratio), and TC(time consuming) as our evaluation index of the algorithm performance. We run each algorithm 50 times independently, and write down all the results of experiment. Finally the experimental results we got are listed in **table 1** as follows.

Table 1. The results for IFSOA and SFOA

		IFSOA	SFOA
worst	$f_1(x)$	3.089440477714233e-15	8.766668121976515e-05
	x_1	1.000000055580142	1.009361054116387
	x_2	1.000000111106598	1.018901962951763
Opt	$f_1(x)$	2.358802680385615e-19	1.323889450214542e-11
	x_1	0.9999999995322905	1.000003638181922
	x_2	0.9999999990776683	1.000007297347044
Aver	$f_1(x)$	3.439788553457224e-16	1.762665718765811e-05
TC(s)	$f_1(x)$	0.865625	1.903125

Table 1. (*continued*)

SR	$f_1(x)$	100%	100%
worst	$f_2(x)$	6.183133389368107e-07	3.410211332193457
	x_1	1.679785187630458e-13	0.9785609985446397
	x_2	3.218490410397396e-13	-11.58282744568907
Opt	$f_2(x)$	1.272120578342755e-7	1.844172798037022e-7
	x_1	-7.510234667610971e-15	9.839985766104176e-15
	x_2	1.406138642765274e-14	3.184544205183075e-14
Aver	$f_2(x)$	4.238167217487971e-7	4.403589638909193e-2
TC(s)	$f_2(x)$	1.3437500	23.142107
SR	$f_2(x)$	100%	45%

4.2 Experiment Analysis

It is obvious, from the experiment results listed in the **table 1**, that the searching stability, the accurate numerical solution and the success rate of running of the IFSOA algorithm are better than that of basic SFOA. So the performance of IFSOA is better than that of basic FSOA.

5 Conclusions

In this paper, considering that there still exist some shortages in basic SFOA, we propose an improving approach by using orthogonal transformation to determine the fishermen' detecting points. It shows, from the numerical experiment results of four typical benchmark functions, that the IFSOA algorithm has a better performance in global optimization. Therefore, this optimization algorithm is effective and feasible in solving complex function' optimization problems.

Acknowledgments. This work is supported by the Natural Science Foundation of Guangxi of China under Grant No.0832084.

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Commercial Credit Value Evaluation and Illustration Analysis on Internet

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Abstract. Taobao website online transaction evaluation has been well accepted, but its value has not been measured. This paper quantifies the value of commercial credit of salers in bringing sale purchase on Taobao website through three aspects of data as credit score buyer to saler, number of comments and rate of bad comments. The illustration results on Taobao online transaction credit evaluation show that number of comments, credit score and rate of bad comments have significant impact on sale revenue.

Keywords: credit evaluation, network commercial credit, value.

1 Introduction

Commercial credit refers to the commitment of commercial transaction to fulfill agreement made by both side in commercial society. The credit of sellers can affect consumers in purchase attitude and behavior, also affects their choices on selecting commodities and services.[1]

There always has not a good method to measure the value of commercial credit, illustrated online virtual commercial transaction platform could be considered a channel to study the value of commercial credit. In order to overcome reverse choice and moral risk of online transaction, service providers of electronic commerce presented credit assess on bilateral side of transaction, that is, both side of transaction gives the other side the comment on the transaction, comment score accumulates by increasing the number of transactions, different credit grade is given on both side in each transaction, meanwhile, provides safe and free ensurement of payment service on the third party.

To validate the value of network commercial credit in bringing commodity sales, firstly, need to measure how the network credit grade is built up; then, to analyze the relationship between variation of commodity sales and network credit grade.

This paper collects transaction data in a certain period of a homogeneous commodity of female casual shoes sales on Taobao website, by means of credit score, comments

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G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 70–75, 2011.
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number and rate of bad comments these three indices to examine the impact of saler's credit grade on transaction price and sale rate thus to reveal the value of network commercial credit. In this paper, first of all, introduce the rules of credit evaluation on Taobao website, expound how the transaction dealer receives network credit grade, then review and build up regression model, by the data from Taobao website to make the illustration analysis.

2 Credit Evaluation Rules Introduction and Network Credit Grade Measurement on Taobao Website

After the members of Taobao website finish their each online transaction successfully by alipay service, in the 15 days after the successful transaction, both side of transaction are entitled to comment on the transaction of the other side, this comment is called credit comment[2]. The comment is fell under one of three comment categories as Good, Medium, Bad, each comment category matches to a score, Good matches to plus one, Medium matches to zero, Bad matches to minus one. The comment score of members accumulates and displays on the Taobao website, that is credit of members. The credit is classified into 4 classes, eache class includes 5 grades, there are 20 grades in total: 4-250 scores are red heart, 251-10000 scores are diamond, 10001-500000 scores are blue crown, 500000-100000001 scores are yellow crown.

For the purpose of preventing credit cheat, credit speculation, Taobao prescrbes the scoring in each natual month of the same buyer and saler of transactions can not exceed 6 scores (time calculated subject to alipay system), the score beyond the scoring regulation rules is nullified. In 14 days (time calculated subject to alipay system), if the same buyer and saler of same commodity have several alipay transactions, their several good comment is scored plus one, their several bad comment is scored minus one.

3 Measurement Indices and Regression Model

On Taobao website, the better network commercial credit of salers, the better convience to consumers to accept the sale, and affect commodity sales. Here taken transaction comment score (credit of Taobao transaction dealers), comment number, negative comment as three indices to measure the value of network commercial credit of salers.

3.1 Comment Score (Credit of Taobao Transaction Dealers)

After the members of Taobao website finish their each online transaction successfully by alipay service, in the 15 days after the successful transaction, both side of transaction are entitled to comment on the transaction of the other side, members' comment score accumulates, that is credit of members. Normally, higher score, better credit, better convince to consumers to purchase commodities, thus affect the commodity sales. Clemons(2006) etc. found out clients' online comment is positive correlation to beer sales through analyzing consumers' online comment on beer producer in year 2001-2003, higher score commodity inclines to repetitive purchase[3]. Chevalier and

Mayzlin(2004) found out through books' comment record on Amazon website, to increase books' comment number and comment score can increase books sales[4].

For the purpose of preventing credit cheat, credit speculation, Taobao prescrbes the scoring in each natual month of the same buyer and saler of transactions can not exceed 6 scores (time calculated subject to alipay system), the score beyond the scoring regulation rules is nullified. In this paper, illustrated from a homogeneous commodity of female casual shoes of sales data in a natural month, its comment score is rather reliable.

3.2 Comment Number

Comment number is the number buyers comment on commodities online after successful transaction on Taobao website. More comment number indicates more consumers involve in comment and assessment of the commodity, the comment of buyers' experience on the commodity has enormous impact to potential purchasers. Liu[5] analyzed the effect of weekly movie comment information on Yahoo website on next week box office, concluded comment number has distinct impact on next week box office revenue, the more comment number, the high box office revenue. It is clear that comment number is an important factor in forming network credit value.

3.3 Negative Comment Rate

After successful online transactions, consumers can comment on the transaction of the other side on Taobao website, through comparing the purchased commodity reality with the description of the commodity on Taobao website, consumers also can comment on the commodities, if negative comments are given, these negative comments will have negative impact to potential consumers on commodity trust and purchase motive.

In past researches, there are plenty of account on negative comment. Dellarocas (2003) pointed out positive and negative comment numbers have huge effect on impacting consumers' behavior, especially recent negative comment has more effect. Chevalier[4] (2006) indicated negative comment effect on declining the commodity sales more distinct than positive comment effect on increasing the commodity sales. In this paper, relate to past research conclusions, considered the negative comment information is far more important than positive comment information, taken negative comment rate as a complement to measure network commercial credit value.

Based on above, in this paper, taken sample data on Taobao website to illustrate and analyze network commercial credit of impact on sale revenue and sale rate, to reveal the value of network commercial credit.

4 Regressive Model

Based on above analysis, here attributive variable takes log value of sale revenue, modeling as follows.

$L=a_1Val+ a_2Q+ a_3N+ a_4Ln(price)+\beta$

Val : salers received comment score

Q : comment number

N : negative comment rate

Price : average price of sampling (here taken female casual shoe)

On April 1st 2010, Taobao website declared on the premise of protecting personal and corporational private data, to disclose data to the outside hierarchically , one way is by Taobao digital magic cube platform to offer to corporations on paid, the other way is by cooperating with research institute on the third party, sellers can acquire service from research institute directly. In this paper, taken the transaction data on Taobao website to analyze, the transaction data originated from trade statistic website (www.maimaitongji.com). Table 1 shows part of female casual shoes sales statistic data in April 2010.

Table 1. Descriptive statistic on female casual shoes sale

variables	sample volume	minimum	maximum	Average value
comment score this month	22130	0	1016	272
comment number this month	22130	0	90	4
negativecomment number this month	22130	0	6	2
average sale price	22130	28	225	38

First, seen from sample sale revenue of female casual shoes chosen from Taobao website, monthly average revenue is 6625 yuan, the minimum is 0, the maximum is 46640 yuan. Although this sale revenue only occupies part of online sale revenue, it is basically from purchased members who comment on their purchasing after finishing online transactions, peeled off other factors, it simply reflects the impact of online credit to sale revenue, thus independent variable and attributive variable echo well.

5 Regression Result

Taken the log value of Taobao salers' monthly sale revenue as attributive variable, made a regressive analysis on the data through calculating time sequence regression function, considered the time made online comment lags behind the time buyer consums commodities, the attributive variable is the log value of online shop t+1period of sale revenue. Table 2 shows the regression result, model 1 is the regression result of network commercial credit effect, for better explaining the impact of network commercial credit on online shop sale revenue, we calculated the margin effect of each independent variable to attributive variable (elastic coefficient).

Iteration History

Table 2. SPSS software analyzing time sequence autoregression result of sample data

	Rho (AR1)	Regression Coefficients			Constant	Adjusted Sum of Squares	Marquardt Constant
		Buyer comment number	Buyer comment bad number	monthly sale number			
1	.000	.020	-.238	.0021	7.893	68.102	.001
2	-.066	.017	-.148	.0032	7.711	67.584	.001
3	-.147	.013	-.022	.0032	7.500	66.791	.000
4	-.249	.008	.155	.0034	7.258	65.517	.000
5	-.375	.003	.386	.0031	6.994	63.558	.000
6	-.509	.003	.624	.0033	6.746	61.269	.000
7	-.615	.006	.787	.0034	6.568	59.735	.000
8	-.677	.007	.865	.0035	6.470	59.163	.000
9	-.707	.008	.899	.0038	6.423	59.010	.000
10	-.721	.008	.913	.0039	6.401	58.974	.000
11(a)	-.728	.008	.920	.0039	6.391	58.966	.000

(a) The estimation terminated at this iteration, because the maximum number of iterations 10 was reached.

Seen from model $L=a_1Val+ a_2Q+ a_3N+ \ln(price)+\beta$, network credit from comment score and comment number has distinct impact on online shop sale revenue. Given unchanged other variables, for online shop with credit grade 1, if increased a unit of comment score this month, the sale revenue in next month will increase $L=0.021*1.01Val+ 0.02*Q-0.238*N+ Ln(price)+7.893$. If comment score increases largely, then sale revenue will increase largely.

In the same way, if comment number this week increases 1% of items, then the sale revenue next month will increase $L=0.021*Val+ 0.02*1.01*Q-0.238*N+ Ln(price)+7.893$, further inference, if calculated both on monthly maximum comment number of online shop (90 items) and average comment number of online shop (4 items), then the next month online shop sale revenue of maximum comment number will receiving more revenue 2848.75 元（(90-4)/4×0.02×6625) than average comment number online shop, it can see that the popularity of online participation is also the important factor to influence online consuming.

Comparing with above two credit factors, negative comment rate has huge cripple effect on online sale revenue, especially to low credit grade clients. For low credit grade client receives bad comment, consumers may give up purchasing; while high credit grade client receives bad comment, consumers may treat it as a miss or seldom case and

give understanding, not to give up purchasing. Seen from the point of coefficient, negative comment rate has more effect than comment score and comment number has, it validates the conclusion of negative comment rate has amplifying effect on sale in literatures.

6 Conclusion

From above analysis, concluded that network commercial credit will affect consumers purchasing and sale revenue. In this paper, through the sale data on Taobao website of female casual shoes, validated comment score, comment number and bad comment rate has distinct impact on sale revenue. So salers in electronic commerce transaction should improve their credit line to their best, improve comments among purchased consumers (reduce bad comment rate), thus can help increase online sale revenue. This research also indictates credit evaluation system set up by Taobao website can overcome the reverse choice made from information asymmetry of online transaction and moral risk.

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Analysis of Informationization Construction of Business Financial Management under the Network Economy

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Abstract. To strengthen the informationization construction of the financial management has great significance to the achievement of business management informationization, and under the network economic environment, it is an important task of the financial management that how to conduct informationization construction of traditional financial management to provide true, reliable and complete financial information system for the business managers. This paper thoroughly researches the problem of financial information orientation management (FIOM) by taking the method of combining theory with practice. This paper puts forward the thinking method of financial information management, makes the new contents of E-finance. At last, this paper rebuilds the system of finance internal control from four aspects such as control of organization and management, system development control and safety control of network system.

Keywords: Informationization, Network Economy, Financial Management, Financial Information Orientation Management.

1 Introduction

The network economy has forced the business environment on which the financial management relied to survive and develop and the economic information it reflected and controled to change dramatically, and this has also produced a series of influences on the basic ideas, contents and procedures of the financial management. The traditional financial management has been impacted by the network economy, and this is specifically shown in the following aspects: Impacts of network economy on financial accounting system; Impacts of network economy on the financial management analysis and evaluation system; Impacts of network economy on the budget control system.

2 Problems Still Existing in Current Financial Management Networking and Informationization in China

2.1 Security Issues

The financial information has always been quite confidential for a business. In recent years, as the hacker frequently attacks the web sites and users' legitimate operations,

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 76–80, 2011.
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the harm made on network accounting data is an upward trend, and the security of accounting information data has become a daunting challenge. The insecure factors mainly include the following several aspects: ① The security awareness of accounting personnel is weak. For example, they are lack of necessary network security measures, and they do not conduct security processing for the e-mails or accounting information resources downloaded from the network. ② The network accounting software itself has loopholes, and the technical inspection and testing or just simply using the name or phone number as a password will all lead to security issues. ③ The vulnerability of the computer system itself provides the possibility for the hacker to attack the web sites. Being prone to functional failure, vulnerable to the virus and poor anti-virus capabilities will all cause a serious threat to the network finance.

2.2 The Issue of the Quality of Financial Information

The inherent characteristics of the network structure and its operation mode have planted great hidden dangers for the quality of network accounting information. As a completely open network, it contains very much accounting information, and there must be some false and fake accounting information entering into the network to spread. Besides, the electronic organization of the network is loose, large and complex, and it is often unable to timely escrow the financial information, so this results in huge economic losses. To purify the network financial information resources is a thorny problem deadly needed to be solved at present.

2.3 Imperfect Supporting Measures of Networking and Informationization

Firstly, the "compound" talents with network and financial knowledge are in a great shortage. Secondly, the openness, breadth and immediacy of the network financial management also make some criminals use the network to conduct financial crimes, while corresponding matching law provisions are far from being perfect, so it is unable to timely process and solve the problems emerging in the financial management networking process. Thirdly, some currently popular network software in the market still has many problems and huge loopholes, which leaves opportunity for the hacker to attack the web sites. Many software manufacturers have not taken the dangers caused by imperfect network software into account while producing the software, and this has planted great hidden dangers for the network security.

3 Major Countermeasures for Strengthening the Informationization Construction of Business Financial Management

3.1 Unifying Leadership and Clarifying the Responsibilities and Tasks of Sectors at All Levels and Personnel

The network construction is the important foundation for the development of financial management informationization. Leaders at all levels must deeply understand and fully make use of the great significance of information networks for improving financial

effectiveness and efficiency, and consciously put the informationization network construction and application of financial management in place.

3.2 Overall Design to Improve the Starting Point and Quality of the Construction of Financial Management Informationization System

The business sectors mainly taking charge of the informationization should determine the construction goals, standards and technical specifications according to the information resources in all business fields and the demands for information networks, and construct and improve the basic architecture and construction layout of the information network which takes the integrated information network as the backbone and takes the TV system as well as the digital archive information system as the supplementation. Therefore, it can achieve the construction goals of compatible devices, reasonable structure, sound functions, matching coordination, stability and reliability as well as security and secrecy, and has the online office and management, conference and dynamic image transmission as well as the data storage, inquiry, rapid retrieval, classification access and other integrated functions.

The hardware constructions at all levels of the informationization network not only have to unify the technical systems and interface standards, but also have to determine the hierarchy of subsystems based on the actual situation in their sectors, especially paying attention to the do well the terminal function integration of all kinds of network devices and nodes; they have to consider the compatibility, but cannot excessively pursue the advanced technology. The server should adopt the modular design to reduce the data-processing links and bus congestion; the hardware of the monitoring system and telephone consulting system should be in integration design with the information network hardware to avoid duplication.

The software distributed and developed by the superior level should realize the online version, and the upper and lower sectors should uniformly install the same operating system software according to different characteristics of various types of networks, so as to eliminate the problems of low integration and poor interconnection operability.

The financial sector at all levels should strengthen the horizontal communication to timely know the developments of informationization network construction and application; as to the network upgrade and reform and other major issues, they should scientifically demonstrate and optimize the design, and with the research and assent of the informationization construction leading group at the same level, report to superior business supervisors for approval and then implement the design, so as to ensure the interconnection and coordinated development of the networks in all sectors.

3.3 Improving the Mechanism to Ensure the Stability and Security of the Operation of the Financial Management Informationization System

Improve the construction and development mechanisms. The business should correctly identify the gap between the existing features and requirements of the completed financial management informationization system, and focusing on the development, conduct the reform and upgrade in accordance with unified equipment, technology and software systems; the businesses with newly-built financial management

informationization network should strengthen the unified plan for the network infrastructure, network information system construction and application software system construction, and strictly implement the national standards, be strict on the project review system, organize and carry out in strict accordance with the network construction planning and technical standards to gradually build and improve the plan step by step.

The business should strengthen the security management and network anti-virus work for the computer end-users, and uniformly install the anti-virus software at the network terminals and conduct the update and upgrade regularly; it should strengthen the technical detection of network security, timely detect the security holes of the informationization network system, and monitor the irregularities of network users in real time.

To alleviate the problem of inadequate network maintenance costs, ensure the timely updates and maintenance of the network center, circuits and system equipment, and guarantee the normal operation of the network system. We can take the method of counterparts to maintenance of information business, and let the supervisors be responsible for the information and data input as well as backup and recovery in the business fields, so as to ensure the accurate, complete and timely updates of various information and data.

3.4 Strengthening the Management to Improve the Functions and Levels of the Application of the Financial Management Informationization System

The ultimate goal of the construction of financial management informationization system is application, and only by constantly expanding the scope of practical application can it gain continuous development and improvement. As the informationization of the business financial management is a reform involving the management model of the entire business, it combines the information technology with the financial management and uses advanced technologies to continuously improve the management level, thus to achieve the integration of finance and business. Therefore, it undoubtedly puts forward higher requirements for the quality and skills of financial personnel, who have to understand both the finance and the business. Similarly, it also makes higher demands for non-financial staff, and it asks them to have to acquire certain knowledge of financial management, even to change the ways of daily work management. All these require the staff to update and change their understanding and knowledge about financial management from the ideological and conceptual perspective. The business must begin to set the personnel training system at the early stage of system construction, and implement it in the whole construction process, so as to improve the business-related quality of accountants and other staff, and thus to enhance the accountants' consciousness to grasp network knowledge as well as learn and use the financial management informationization system well.

4 Conclusion

To sum up, the financial management informationization system can maximally play its application efficiency and effectiveness only through continuously fumbling for

and grasping its organization and application law, timely discovering the problems in network operations, properly conducting the system upgrade, improvement and supporting construction, and continuously developing and improving the functions of the network system.

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Research on the Problem and Countermeasures of Group-Buying

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Abstract. The threshold of group-buying is low, so the group-buying develops very fast. But at the same time, there are many goods which have low price and high quality service which is false to get the network users' trust. Therefore, consumers should keep a clear head and avoiding straying into the trap of business, the website of group-buying should strengthen self-construction to safeguard the consumers' interest. In addition, government needs to play its due role to protect the legitimate right of the consumers.

Keywords: Group-buying; problem; countermeasure.

1 Introduction

The group-buying is a way of shopping that consumers union, no matter they know each other or not, to increase bargaining power with business to get the optimal price. According to principle of small profits and large price, the vendor could give a lower price and better service. The group-buying on network is way of shopping that users on line gather to consume to get a high discount. Typically, there are very high discount through group-buying on network. Even on this basis, there are also coupons. This kind of shopping does have considerable appeal. At present, the entertainment and food catering are two major categories in the most popular services. Right now group-buying is popular in main cities ,including Beijing, Shanghai, Shenzhen, Guangzhou, Hangzhou, Chengdu ,Wuhan and other cities with higher e-commerce penetration, this kind of shopping will expand to second and third tier cities quickly.

The reason why the group-buying develops so quickly is that there is demand by website, merchants and consumers. The threshold of this operation mode is lower, and the demand of fund for group-buying is not too much. So it is liked by many entrepreneurs. Otherwise, many websites have many users, such as NuoMiTuan network which belongs to the RenRen network. For the merchants, they can provide more interest which is cut from the expense of advertisement for consumers. And it's better to advertisement through the group-buying than the traditional ways. It is so fascinated by group-buying because of the lower price, convenience and fun. But Ministry of Industry and Information Technology recently received many reports which claimed that there are many frauds on network group-buying. Often the merchant's provided lower price and quality service to get the users trust but actually it's false, to attract users deceived. Therefore, consumers should calm down when they shop through group-buying on network and learn to protect their own interests.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 81–85, 2011.
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2 The Main Problem of the Group-Buying on Network

2.1 "Cloning Site" Trap

In order to get the consumer's confidence, some sites copy the well-known sites with the similar name and interface to deceive internet users. For example, a user once involved in business activity on network group-buying in the handle network (lashou.com). These activity successes at end. However, there is exact same activity information on the other network site. But the result is "buy failure". Later, the result is that the other network site copied the handle network's interface.

2.2 The Unmatched between the Goods on Interface and the Actual One, Consumers Are Treated

Some consumers inflect that the goods through group-buy on the network which they bought are different between the photographs on the interface and the actual one they got. And normally, the quality is not qualified. For example, the price for cosmetic on network is only 30% -70% percent of the counter price. Anymore, you can just spend 20 or 30 RMB to get the products which worth hundreds. But when you get the products you will find they are totally different. Maybe they are only gift or trial installation of the cosmetic. And when consumers request to return the products, the merchant's response slowly.

2.3 No Guaranty of the Consumer's Fund through Payment on Line

Right now most of the websites ask the consumers to pay through PayPal or the online bank before they receipt the goods and satisfy. This mode is related to issue of websites and business payment and service. In this process if there are problems, you need a refund, some non-standard websites may find reason to delay the withdrawals, and there are potential problems of the payment security to the users.

2.4 Traffic beyond the Scope of Business under the Service Quality

For small and medium business the effect of group-buying is huge, but the supply and service efficiency is not enough to the unexpected large number of consumers, resulting in deterioration of the consumer experience level; and for the group-buying website the users' trust is frustrated and many users are lost, so ultimately it will affect the development of the website. For example, a customer bought ten coupons in one group-buying website. He spent 49 RMB for each one which war 139 RMB originally. When he went to Hall with friends and family, the waiter asked them to pay more 20 for each one to get the service. The business explains that they increase many dishes. If you don't pay more, they wouldn't let you in.

2.5 The Group-Buying Corporate Integrity Is not Sure, the After-Sale Service Is not Guaranteed

Many group-buying websites avoid the shortcomings of the product and exaggerate the benefit, or even brag about the performance of non-existent. Some businesses

even buy customized products which are has low quality for group-buying in order to reduce the cost of products, resulting in damaging the interests of consumers. In addition, some websites is due to the limited size and resources that their power is few when they in cooperation with the business. The responsibility between website and business is not clear. It is difficult to solve problem in after-sale, and both sides pass the buck, to the detriment of the interests of consumers. For example, some business requirements is that there is no invoices for group-buying. This provision will inevitably lead to difficult to guarantee the rights of consumers, because consumers can't provide the evidence of the complaints.

2.6 The Group-Buying Industry Is Lack of Standards and Rights Protection Mechanism

At present, there is none of laws of the group-buying online. As to the virtual and broad of the network, it is more difficult to monitor. According to the China Electronic Commerce Research Center revealed that there is few group-buying companies in the scope of companies which have the Internet information service for business license(referred to as ICP certificate) and company's business license for the site statistics. The phenomenon of non-registration of industrial and commercial enterprises is very common. Consumers group-buy the products in the website without business license, it is only regarded as private transactions among individuals. If there is s dispute, the consumer can only solve it through civil litigation but not the executive authorities for help.

3 The Countermeasure to Improve the Group-Buying Online

Due to the chaos in the group-buying online, consumers should keep a clear head and avoid straying into the trap of business; the websites should also strengthen self-construction to safeguard consumer's interests. In addition, the government departments need to play its due role to protect the legitimate rights and interests of consumers.

3.1 Before Consumption It Is Better to Know the Popularity, Reputation and Service Capabilities of the Group-Buying Websites

Consumers should prefer a website which has a professional team to operate, larger and better word of month. Customers should pay attention to the whether the network operates as company and the company name, telephone number, responsible person and other information. It's better to group-buy in the high-profile sites as much as possible. It also needs careful identification and examination details to avoid being taken. For example, there is a customer who avoided being trapped through the method of indentify the difference of the business address and phone number in the cloning-site.

3.2 It's Better to Master Accurate Information Before you Group-Buy to Avoid the Loss Because of the Opaque Situation

Although the group-buy is a fashion, the information that the organization provides maybe doesn't enough for consumer. There is a lot of space between the consumer

and business. Therefore, consumers don't only to pay attention to the price and discount but also to the detail description of the products, rules and website contact. It's better to book after you consulate. After booking, it's better to keep the related certification, especially for the huge amount of the group-buying.

3.3 Consumer Should Control Their Money

Due to the unsafe of the payment online, it's better to choose the website or business where there is third-party secured transaction, to pay after delivery and return freely when there is problem of the products. Don't pay advance through bank online for large sums of money. In this way, consumer should keep the relevant evidence (including electronic form or written record of the transaction, order, chat records, the screenshots of the trade, etc.) Once taken in, you can bring all the evidence to the police immediately. In addition, you can complaint the situation to the center of online transaction security to warn other consumers.

3.4 Consumers Have to Establish a Correct Concept of Consumption

Some consumers do not establish a correct view of consumption, often mindless consume and blindly following the trend of the consumption. Many consumers have the psychology of taking advantage or other. Buy it no matter if it is useful because of the cheap price. Most business use this psychology to attract consumers to pay the products. It leads many mindless consume. Actually, to buy products is to use. So consumers have to consider the value. Sometimes, you buy something online in order to save money, but at the end you cost more. For example, for some products of the food and beverage, the price is very affordable indeed. However, when consumers go to consume, they will find that it is too far or there is no time to spend. So the results are not affordable. Therefore, consumers should establish a correct concept of consumption, do not blindly follow the trend of fashion, or don't buy products beyond their own needs.

3.5 Group-Buying Websites Strengthen Self-construction Sites and Establish the Concept of Business Integrity

At present, there is large number of group-buying websites, but there are many less well known and small-scale websites, there is no guarantee to ensure the integrity. Therefore, group-buying websites should minimize the risk of consumers and protect consumer interests. Website should pay more attention to the products when they select the business. When consumers discover the quality of goods or question the business service and complaint to the website, the website should confirm the compliant and compensate and then communicate with business to seek solutions. The group-buying website should strength its own building to seek long-term development.

3.6 Strengthen the Supervision and Monitoring for Group-Buying on Network

The complaint of group-buying is hot recently. For this situation, government should speed up to formulate relevant national laws and regulations. Or government can learn from the practices in developed countries, to mark the rating number and monitor the

company. For example, Group-buying rises in American; it needs to provide the proof of identity, address, office address, type of service and other information. Once the website constitutes fraud the consumer, there is likely to face hefty fines of up to billions of dollars to avoid the website to maximize the benefits.

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Strategies on the Implementation of China's Logistics Information Network

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Abstract. The economic globalization and trend of e-commerce network have determined that the logistics industry will be rapidly developed in the 21st century. In order to achieve the optimal allocation of resources, a worldwide rapid and sound customer service system should be established. The establishment of a corresponding modern logistics system is the inevitable choice of this requirement. It is also the inevitable choice for the development of modern logistics industry in China. The perfect combination of modern logistics and information network can better promote the development of the logistics industry. Through the analysis of Status of Logistics Industry in China, this paper summed up the domestic logistics enterprise logistics information system in the building of some common problems. According to logistics information systems planning methods and principles set out logistics information system to optimize the management model.

Keywords: modern logistics; information network; e-commerce.

1 Introduction

Modern logistics is the third profit source for enterprises to reduce material consumption, improve labor productivity, and create benefits, which has been increasingly recognized by enterprises. With the acceleration of global economic integration, modern logistics is becoming and important industry and new economic growth point for China's economic development in the new century. Especially since China's entry into WTO, some world's major consortia and multinational enterprises have entered the Chinese market and participated in the investment and construction of logistics. On the one hand, they have promoted the development of the logistics industry in China. On the other hand, they have made the competition in domestic logistics industry fiercer. This requires us to establish a modern information network and enhance the competitiveness of the logistics industry.

2 Characteristics of Modern Logistics in the Information Age

As we all know, the traditional commodity circulation consists of information flow, trade flow, material flow and capital flow. Under the e-commerce model, the modern logistics transforms the trade flow and capital flow into the information flow, and

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 86–89, 2011.
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delivery is carried out in the online way. Therefore, the modern logistics is based on informatization, and its most important characteristic is informatization. In summary, the characteristics of modern logistics are as follows: informatization of logistics, network of logistics, intellectualization of logistics, automation of logistics.

3 Status of Logistics Industry in China

Chinese logistics industry has a broad development space and vast market potential, and the modern logistics industry will become an important industry of China's economic development and the new economic growth point. At present, China has built the integrated transport system, consisting of 5 modes of transport (railway, highway, waterway, air and pipeline). China's third-party logistics companies have also started, the distribution centers have been steadily developed, and the application of modern logistics technology has been strengthened. However, due to the late start, lagging concepts, aging hardware, high costs and backward management system in China's logistics industry, various links in logistics process are still in the independent and divided state, and there is still a certain gap between the current logistics industry and the integrated, information-based, and large-scale modern logistics industry. Faced by challenges of foreign logistics enterprises with advantages in capital, technology and management, the application of modern logistics concepts and advanced mode of operation, improvement of the level of logistics services, and dealing with the international competition in the logistics market, have become top priorities for China's logistics industry.

According to the *Survey on Logistics Service Demand of Multinational Enterprises in China* sponsored by *International Business Daily*, China's logistics service concept and information service level should be improved, and the competitiveness of China's logistics enterprises should be urgently enhanced. This survey has covered nearly one hundred foreign-invested enterprises in China, and 80% of the enterprises have rated the satisfaction on current logistics providers as “average”. Respondents believe that aspects need to be improved by logistics service providers are information transfer efficiency, operating costs, ability to meet demand fluctuations, operating speed, service content and service attitude respectively. More than one third of the enterprises still adopt the “manual information processing”, and only less than 2% of the enterprises adopt the “mechanized operation and information processing”.

4 Strategies on the of Logistics Information Network

Implementation modes of information network mainly include Internet, Intranet, EDI, and so on: Internet is the network system integrates with technology, information technology and computer technology; Intranet connects various branches of the enterprises with management departments based on Internet, in order to realize the electronic network of internal information flow of the enterprise; EDI or electronic data interchange is used to transfer commercial documents between enterprises in the standard electronic data format, in order to reduce the data flow time of the whole operating system and eliminate spatial barriers. Based on the transaction object of

logistics information network, the above three modes can be divided into three levels: ①transaction between customers and enterprises, such as the Internet-based online shopping; ②transaction between enterprises, such as the transaction is achieved through EDI-based data transfer; ③corporate internal transaction, such as the exchange of information and the share of resources in the enterprise through Intranet.

4.1 The Effective Use of the Internet Should Be Strengthened

Foreign logistics enterprises have attached great importance to the effective use of Internet resources, and developed various Internet-based online inquiry systems. Through high-speed Internet technology, query information of customers can be timely answered, and various interactive contents can be protected by encryption and password. Complex queries will be answered by e-mail and phone. Meanwhile, client tools have been issued, which navigate the on-line query system for charges in the form of desktop tool bar, in order to facilitate customer inquiries on personal computers. Some large logistics enterprises in China have also begun to use the Internet to obtain information. Although their approach is not mature in comparison with the foreign advanced approach, it fully shows the ability and awareness of China's logistics enterprises to use Internet. Of course, regarding the effective use of Internet technology, there is a huge big between China and the outside world. In terms of the effective use of the Internet, the logistics enterprises in China should focus on the specific national conditions, and pay attention to the following aspects: the use of conventional data should be strengthened; the initiative of information release should be strengthened; the timeliness management of information.

4.2 The Construction of the Intranet Should Be Strengthened

The Intranet of logistics enterprise is the application of Internet technology in logistics enterprises. It is the internal network created by a logistic enterprise with the aid of Internet technology, and the infrastructure for the internal information management and exchange by the logistics enterprise. Logistics enterprises should make full use of Internet, in order to design and implement the corporate Intranet solution.

4.3 The Construction of WBM Network Management Model Should Be Accelerated

The advantages of WBM network technique: ① the enormous task of computing and storage can be transferred to the Web server, so that customers can access WWW server via the simple and cheap client. It can greatly reduce the equipment costs and increase the flexibility of customer access. ② WBM has the features and network management technology of Web. Network administrators can use WBM to inspect and control enterprise network through Web server and any site. It has solved the interoperability interference problem resulted from the multi-platform structure, and greatly reduced MIS training and application fees of enterprises, so that more customers can use the enterprise management information network. ③ WBM can link with a dedicated Intranet website through a browser, and customers can access network and update information and data. It avoids the frequent work connection between the

client and the network management center, which is an ideal mode to release operation information.

4.4 Artificial Intelligence / Expert System Settings Should Be Considered

Artificial intelligence and expert system are information-based techniques that are conducive to logistics management. Artificial intelligence refers to a set of techniques to enable computers to simulate human reasoning. Artificial intelligence focuses on the symbolic reasoning, rather than numeric processing. Techniques of artificial intelligence include expert system, natural language translator, neural network, robot, sound recognition, 3D vision and so on. Expert system is a kind of artificial intelligence, which provides experts with a kind of structure that records questions and answers, so that experts can solve and analyze problems in the operation. The expertise of expert system can increase the return on the assets for enterprises, and software applied includes carrier selection, international marketing and logistics, inventory management, and information system design.

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Research on the Rationality of China Telecom Price Cap Regulation

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Abstract. Through econometric model, this paper analyzed empirically the data of China telecom output in 1990-2009, studying the rationality of the price regulation on the development of China telecom. During the research, this paper paid more attention to the specific issues and made conclusions by the econometric analysis and testing. It is concluded that price-capping regulation is an effective measure to promote China telecom industry development, while the effect of relax into control is not significant.

Keywords: Telecommunications, Price cap regulation, Rationality.

1 Introduction

Since 1980s, with the advancement of telecommunication technology, telecom technical and economic barriers greatly reduced and control theory unceasingly innovated. In order to adapt to the requirements of the development of China's telecom industry, after consulting the foreign successful experience, China started on attempting regulatory reform in October, 2005, setting price-capping only for part of charges, gradually entering a phase of deregulation and rebuilding regulation. Deregulation is mainly to relax market access regulation, reflected in the reality is the increase in the number of operators; reconstructing regulation is mainly to establish price cap regulation mechanism, the intuitive result is the decline of telecommunication fees. Thus, the impact of the two kinds of regulation on China telecom industry development would be proved from the perspective of positivism.

In the past research, Majumdar (1997)[1] utilized the 45 local telecom operators data from 1988 to 1993 to inspect the impact of incentive regulation reform on production efficiency in the U.S. telecom. The results showed that the influence of price cap regulation on local telecom operators was of significant stimulation. Meanwhile, there were also other scholars holding different opinions about price cap regulation. Wang Jianming (2006)[2] considered that price cap regulation also existed many potential problems, misapplication could produce adverse effect, too. Look at the present research status within the country, domestic scholars' researches paid more attention to the analysis of the enlightenment of western reform experience regarding the regulatory reform of Chinese natural monopoly industries, while lacking the researches that analyzed empirically the effect of price-capping regulation on China

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 90–96, 2011.
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telecom development was favorable or not. So, those specific issues were the starting points of the study.

In order to study different influences of price cap regulation and increasing operators on telecom industry development scale, China telecom output in 1990-2009 and the relevant data were collected, and the fees level of telecom were calculated by using factor analysis method. Besides considering the effect of production factors input such as capital, labor force on output, the impact of the fees level and operators quantity on output would be taken into account as well.

2 Model and Variable Selection

2.1 Model Design

Here choose telecom output scale for measuring the level of its development, and its development scale set as function containing input key points of labor and capital, regulation of price level and operators quantity. With the purpose of analyzing conveniently, supposed that the influence of regulation system vicissitudes on telecom industry was linear, enterprise's technical possibilities level did not change, so a production function model with the level of the output scale of the telecom industry as the dependent variable, telecom investment in fixed assets[1], the number of staff and workers, telecom price level and telecom operators quantity as the independent variable could be constructed, which was $Y_t = AK_t^{\alpha}L_t^{\beta}P_t^{\gamma}Q_t^{\delta}$. Take the logarithm of both sides of the production function resulted:

$$\ln Y_t = \ln A + \alpha \ln K_t + \beta \ln L_t + \gamma \ln P_t + \delta \ln Q_t + \varepsilon_t . \quad (1)$$

Among them, Y represented telecom output scale; A stood for technical progress; K signified fixed investment; L symbolized number of staff; P meant price level; Q was for operators' quantity; t was the year.

2.2 Data Selection

(1) Telecom output scale(Y). This paper chose telecommunication business volume to measure telecom output level. In order to remove price changes factors, telecommunication business total volume had been adjusted in accordance with the constant price in 1990.

(2) Investment in fixed assets (K). Telecom investment in fixed assets is a comprehensive indicator reflecting the telecom industry fixed asset scale, structure and development speed; a main way to expand telecom business scope, to raise the technical level, to advance the communication capacity and business lines, and to improve the quality of telecom service. Due to the telecom fixed assets investment are all calculated at current prices, the amount of investment here are adjusted according to constant price in 1990.

(3) Number of staff (L). Because before 2003, there was no national standard being declared about the number of telecom staff and workers, and before 1998, the number

[1] Here adopt fixed asset investment measuring capital inputs, staff number measuring labor inputs.

of postal and telecommunication workers was calculated together, here staff quantity was the number of the staff and workers in post and telecommunication industry. The value at the end of year was adopted.

(4) Price level (P). The statistics of telecommunication costs level contain fixed-line telephone and mobile phones price level. Fixed telephone charges are mainly consisted of four parts, they are installation fees, monthly rental, local and long-distance call charge; mobile phone charges are mainly made up of five parts, they are mobile access fee, monthly rental, local and long-distance call charge and roaming charge. Because telephone traffic of international calls accounts for a small proportion of total traffic, so it would not be considered.

The telecommunication price level of each year was listed as the follows:

Table 1. 7 Indexes of Telecommunications Price Control Level

Year	PL of FP				PL of MP				
	IF	LCC (PM)	LDCC (PM)	MR	MAF	LCC (PM)	LDCC (PM)	MR	RC
1990	4000	0.03	0.6	11.6	10500	0.5	0.7	150	1.1
1991	4000	0.03	0.6	11.6	10500	0.5	0.7	150	1.1
1992	4000	0.03	0.6	11.6	10500	0.5	0.7	150	1.1
1993	4000	0.03	0.6	11.6	10500	0.5	0.7	150	1.1
1994	4000	0.03	0.6	11.6	10500	0.4	0.6	50	0.6
1995	2500	0.03	0.6	11.6	3000	0.4	0.6	50	0.6
1996	2500	0.04	0.6	11.6	2500	0.4	0.6	50	0.6
1997	2000	0.04	0.6	11.6	2500	0.4	0.6	50	0.6
1998	2000	0.04	0.6	18	2000	0.4	0.6	50	0.6
1999	750	0.07	0.4	18	1250	0.4	0.6	50	0.6
2000	750	0.07	0.4	18	1000	0.4	0.6	50	0.6
2001	375	0.09	0.4	18	500	0.4	0.6	50	0.6
2002	0	0.09	0.3	18	0	0.2	0.4	50	0.6
2003	0	0.09	0.3	18	0	0.2	0.4	30	0.6
2004	0	0.09	0.3	18	0	0.2	0.4	30	0.6
2005	0	0.09	0.3	18	0	0.2	0.4	30	0.4
2006	0	0.09	0.3	18	0	0.2	0.2	30	0.4
2007	0	0.09	0.3	18	0	0.2	0.2	30	0.4
2008	0	0.09	0.3	18	0	0.2	0.2	30	0.4
2009	0	0.09	0.3	18	0	0.2	0.2	30	0.4

PL was abbreviation of price level; MP of mobile phone; FP of fixed telephone; IF of installation fees; LCC of local call charge; LDCC of long-distance call charge; MR of monthly rental; MAF of mobile access fee; RC of roaming charge; PM of per minute.

It could be seen from the graph that only local call charge and monthly rental of fixed telephone among all nine variables were on the rise. This was mainly because for a long time in the past, the local telephone call charges had been less than the cost. Although there were long-distance services for cross subsidy, large-area losses were stilled caused to the fixed phone nationwide. Therefore, since 1990, policies were issued constantly aiming to make adjustments to the over-low charging standard of fixed telephone. While all the rest seven variables were on the decline continuously, the description of the telecom fees standard must contain some common factors among them, so factor analysis was carried out for all nine variables. It could be drawn from the analysis results that:

$$\begin{aligned} P = {} & 0.2988 \text{ x IF} - 0.2883 \text{ x LCC (FP)} + 0.2830 \text{ x LDCC (FP)} \\ & - 0.2710 \text{ x MR (FP)} + 0.2820 \text{ x MAF} \\ & + 0.2853 \text{ x LCC (MP)} + 0.2677 \text{ x LDCC (MP)} \\ & + 0.2654 \text{ x MR (MP)} + 0.2691 \text{ x RC} \end{aligned} \tag{2}$$

(5) Operators' quantity (Q). Before 1994, there was only one operator, China telecom. Following the example of the two oligarch competition situation in Britain, there were two operators, China telecom and China Unicom on the market in 1994-1998. In February 1999, the original China telecom was separated into three companies: new China telecom, China mobile and China Satcom. Paging business was merged into China Unicom. At the same time, China Netcom, GBnet and China Railcom obtained telecom operation permit. In October 2001, China telecom north-south breakup plan issued. After splitting and reorganizing, 5 + 1 new pattern was formed, including China telecom, China Netcom, China mobile, China Unicom, China Railcom and China Satcom.

Synthesizing the above improved data, see the table below:

Table 2. The Adjusted China Telecom Relevant Data

Year	K (billion)	L (million)	P (dimension)	Q	Y (billion)
1990	51.2	98.1	4193.65	1	109.59
1991	66.54795	101.7	4193.65	1	146.6515
1992	112.6841	113.3	4193.65	1	205.9909
1993	229.0094	118.7	4193.65	1	303.0791
1994	405.8636	113.2	4166.92	1	378.1185
1995	478.0365	113.8	1603.72	2	477.3405
1996	492.0578	118.1	1462.72	2	608.5065
1997	566.8103	116.7	1313.32	2	797.8373
1998	817.063	147.1	1170.59	2	1118.368
1999	818.9898	88.2	585.52	7	1568.467

Table 2. (*continued*)

2000	1122.003	113.2	515.02	7	2274.435
2001	1283.02	111.3	261.97	7	2029.733
2002	1040.291	111.4	8.78	6	2596.782
2003	1088.66	125.5	3.47	6	3197.507
2004	1022.362	130.6	3.47	6	4345.548
2005	959.6523	135.1	3.41	6	5322.098
2006	1003.155	142.5	3.36	6	6710.517
2007	1007.375	145.8	3.36	6	8179.655
2008	908.2742	142.1	3.36	3	9527.545
2009	1205.547	174.2	3.36	3	11020.86

3 Analysis of Regression

After taking the logarithm of the data in table 2, so regression analysis was conducted to the data. The results were as follows:

α	β	γ	δ	R^2	Adjusted R^2	F
0.4530** (2.4727)	1.9288* (2.0820)	-0.1927*** (-3.5112)	0.3719 (1.3340)	0.9631	0.9533	98.0899

***, ** and *indicate significance at the 1%, 5%, and 10% levels. The data in parentheses below the coefficient is t value.

It could be seen from the results of the operation that there was a very strong linear relation between four explanatory variables and explained variables: numerical value of R^2 and the adjusted R^2 were close to one, which illustrated that goodness-of-fit was relatively high. F statistic was 98.09, stating that the significance of regression overall was obvious. Four conclusions were mainly acquired from the regression equation.

(1) Investment in fixed assets (K). Fixed assets had significant positive influence on telecom output scale. Under the condition that other variables did not change, 1% proportion of the fixed assets was invested each time; the average growth rate of telecom output became 0.4530%. This was very similar to the reality, as a developing country, capital had been the important sources promoting China's economic development, especially telecom, this kind of natural monopoly industry which needed massive investments.

(2) The number of staff and workers (L). Number of staff and workers had significantly positive impact on the telecommunications output scale. Under the condition that the other variables did not change, every increased number of staff and workers

by 1% proportion, the average growth rate of telecom output would be 1.9288%, which was the same with the reality, as human capital was of enormous impetus for the development of the telecommunications industry.

(3) Price level (P). T statistic of price level was - 3.511, the big numerical value suggested that price level had notably negative influence on the telecom output scale; influence coefficient was - 0.1928, telecommunication costs level dropped by half each time, output scale would grow nearly 10%. Although since 1990, the fact that telecoms price level dropped substantially caused the decline of telecommunication business profit per unit. But at least two points could compensate for this part of the loss: the first one was a sharp rise in the number of users caused by the reduction of price level. The second one was due to the constant application of the new technology, the continuous decline of the cost of every telecom business made up for the loss of the decrease in price.

(4) Operators quantity (Q). The positive influence of operator quantity (N) on telecom output scale was weak. When the influence coefficient was below 10% of significant level, it could not pass the test, which indicated that increased telecom operators quantity barely affected output scale. This seemed to be completely different from the experience. The reform experience of developed countries abroad could suggest that the increase in the number of operators played a role in promoting competition. The reinforcement of the competition promoted the development of telecommunications industry further, but in consideration of some special cases in China telecom, this kind of empirical conclusions would be different.

From 1994 to 2008, although in the telecommunications market operators quantity increased substantially, most of the time, fixed communications market was monopolized by telecom, in the mobile communications market China Mobile was absolute advantage, which played a limited role in promoting the competition, much less to promote the overall development of the telecommunications industry.

From October 2008, China Unicom CDMA net was formally incorporated into China telecom. Three telecom operators with comparatively equal scale, all mountain and full service management were formed in China telecom market, which was a latest attempt in the reform. But as a result of a short reform time, here the effect of the reform couldn't be verified. While, according to experience, it could be believed that after years, the influence of the reform would be remarkable.

4 Conclusion

Time series data that affected China telecom industry development level from 1990 to 2009 had been tested. The inspected results indicated that traditional fixed assets and human capital had made great contributions to the development level of the telecom industry. One of the two factors of telecom regulation was a decrease in the level of fees, which promoted the development of the telecommunications industry scale level. Therefore, it was reasonable to practice price cap regulation in China telecom industry. For another factor of the regulation, an increase in the number of operators was concerned, due to until 2008, China telecom formed three operators that could be comparative in scale, the effect of increasing the number of operators on telecom development scale was not significant. Of course, there were some fees such as roaming

fee in China telecom which the telecom in other developed countries didn't charge. Thus, there was a certain room for adjustment of price level. As for how to determine the price cap level, it needed further investigation.

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A Study on Standard Competition with Network Effect Based on Evolutionary Game Model

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Abstract. Owing to networks widespread in modern society, standard competition with network effect is now endowed with new connotation. This paper aims to study the impact of network effect on standard competition; it is organized in the mode of "introduction-model setup-equilibrium analysis-conclusion". Starting from a well-structured model of evolutionary game, it is then extended to a dynamic analysis. This article proves both theoretically and empirically that whether or not a standard can lead the market trends depends on the utility it would bring, and the author also discusses some advisable strategies revolving around the two factors of initial position and border break.

Keywords: network effect; standard competition; evolutionary game; tactics.

1 Introduction

Since economists discovered the impact of network effect on the demand function in typical network industries – telecommunications, network effect has been given to more concern. Moreover, under the frame of network economy, standard competition is used as a general rule in the development of relevant industries. Thus it is urgent and significant to do such a research on the relationship between network effect and standard competition.

In the previous research, scholars have applied evolutionary game theory to analyze network effect, but there are more or less deficiencies and limitations in their study methods. Katz and Shapiro (1992) analyzed the equilibrium and welfare properties of network standard competition base on dynamic mode. Haruvy and Prasad (2001) used the method of evolutionary game to study the best price and quality of free software under the condition of network externalities.

However, in most of the literature, network effect was not introduced in consumer utility function. Thus, this article establishes an evolutionary game model with a consumer utility function by adding the network effect, and tries to explain the dynamic influence of network effect on the standard competition. At the end of the article, the author provides some standard competitive strategies to instruct the practice of standard competition.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 97–103, 2011.
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2 Model Setup

The first step is to build up a consumer utility function by adding the network effect, and then specification of this model shows as follows:

Assuming that the capacity of a market with network effect is N, and there are K kinds of incompatible standards. In reality, not all the consumers have to make decisions at each period, so "wait-and- see" strategy is considered as "standard 0". Thus, a pure strategy set of alternative standards is $S_{K+1}=\{s_0,s_1,\ldots,s_k\}$; assuming that $n_i(t)$ is the number of consumers who choose standard *i* at time *t*, then $\sum_{i=0}^{K} n_i(t) = N$, and $n_0(t)$ indicates the number of "wait-and-see" consumers at time t. That is, the potential consumers will choose their strategy at time *t+1* on the basis of time *t*. Moreover. Suppose that $x_i(t)$ shows the share of consumer groups, so $x_i(t) = n_i(t)/N, i = 0,\cdots,K$, and $X(x_0(t), x_1(t), x_2(t),\cdots, x_K(t))$ stands for the distribution of consumers at time *t*.

Now consider the consumers' payment level. Firstly, because of the existence of network effect, consumer utility of a chosen standard will be influenced by other consumers' decisions, this relationship should be considered in the function of consumers expected payment. Therefore, $f(s_i, X)$ indicates expected payment of standard *i*, and $f(s_0, X) = 0$. This is because there is no interactions when consumer choose "wait-and- see" strategy. Secondly, if $f(s_i, X) > f(s_j, X)$, then the consumer will choose the standard *i*. Furthermore, the expected average payment is a weighted average of different choices of standards:

$$f(X, X) = \sum_{i=0}^{K} x_i f(s_i, X) = x_0 f(s_0, X) + \sum_{i=1}^{K} x_i f(s_i, X) = \sum_{i=1}^{K} x_i f(s_i, X). \tag{1}$$

To build up a dynamic equation, consider the growth rate of $x_i(t)$. As the network effect can result in positive feedback, when a standard brings a higher payment for consumers, more people will choose this standard. So, the growth rate of $n_i(t)$ is in proportion to expected payment $f(s_i, X)$. Thus, the derivation is as follows:

$$\frac{dn_i}{dt} = n_i(t) f(s_i, X), i = 1, 2, \cdots, K \tag{2}$$

.

$$n_i(t) = x_i(t)N \tag{3}$$

.

$$\frac{dn_i(t)}{dt} = N\frac{dx_i(t)}{dt} + x_i\left[\frac{dn_0(t)}{dt} + \sum_{i=1}^{K}\frac{dn_i(t)}{dt}\right] \tag{4}$$

.

$$n_i(t) f(s_i, X) = N \frac{dx_i(t)}{dt} + x_i \left[\frac{dn_0(t)}{dt} + \sum_{i=1}^{K} n_i(t) f(s_i, X) \right] \cdot \tag{5}$$

$$\begin{aligned} x_i(t) f(s_i, X) &= \frac{dx_i(t)}{dt} + x_i \left[\frac{1}{N} \frac{dn_0(t)}{dt} + \sum_{i=1}^{K} \frac{n_i(t)}{N} f(s_i, X) \right] \\ &= \frac{dx_i(t)}{dt} + x_i \left[\frac{1}{N} \frac{dn_0(t)}{dt} + f(X, X) \right] \end{aligned} \tag{6}$$

In general, there are always a large number of consumers in the market, then *1/N* equals approximately to zero, so the equation (6) can be written as follows:

$$\frac{dx_i(t)}{dt} = \left[f(s_i, X) - f(X, X) \right] x_i, i = 1, 2, \cdots, K \cdot \tag{7}$$

Based on the analysis above, a conclusion can be drawn here that if expected payment of standard *i* is larger than average payment. That is, when $f(s_i, X) > f(X, X)$, user groups of this kind of technical standards will increase with time, and vice versa.

3 Equilibrium Analysis

3.1 Equilibrium of System

To simplify the equilibrium analysis, this model assumes that there are only two technological standards in the market, then K = 2. So, consumers' payoff matrix is:

Table 1. Consumers' Payoff Matrix of the Game

Consumer i,j	Standard A	Standard B	Wait-and-see
Standard A	(aNx_1, aNx_1)	(0,0)	(0,0)
Standard B	(0,0)	(bNx_2, bNx_2)	(0,0)
Wait-and-see	(0,0)	(0,0)	(0,0)

As table 1 shows, the model assumes that: aNx_1 and bNx_2 represent the network utility, a and b indicate the coefficient of network effect, where $a, b \in (0,1)$. Standards are not compatible among each other, so when consumers choose different standards, the network effect is zero. Based on the assumptions above, the consumer utility of taking "wait-and-see" strategy is zero. u_0, v_0 stand for own utility of standards, it is independent of other consumers' decisions. Thus, the equations of expected payment are:

$$f(s_1, X) = u_0 + f(x_1, x_0) + f(x_1, x_1) + f(x_1, x_2) = u_0 + aNx_1;$$
$$f(s_2, X) = v_0 + f(x_2, x_0) + f(x_2, x_1) + f(x_2, x_2) = v_0 + bNx_2;$$
$$f(X, X) = x_1 f(s_1, X) + x_2 f(s_2, X) = x_1(u_0 + aNx_1) + x_2(v_0 + bNx_2).$$

By equation (6), the dynamic equations of market share of standard A and B are:

$$\frac{dx_1(t)}{dt} = \begin{bmatrix} u_0 + (aN - u_0)x_1 - \\ aNx_1^2 - v_0 x_2 - bNx_2^2 \end{bmatrix} x_1 . \tag{8}$$

$$\frac{dx_2(t)}{dt} = \begin{bmatrix} v_0 + (bN - v_0)x_2 - \\ aNx_1^2 - u_0 x_1 - bNx_2^2 \end{bmatrix} x_2 . \tag{9}$$

Let $\frac{dx_1(t)}{dt}$ and $\frac{dx_2(t)}{dt}$ be zero, then the author discusses the existence of equilibrium solution of the standard competitive system. By solving the binary quadratic equation groups, the following four balanced points can be found: (0,0), (0,1), (1,0), $\left(\frac{v_0 - u_0 + bN}{(a+b)N}, \frac{u_0 - v_0 + aN}{(a+b)N}\right)$.

3.2 Stability Analysis of Equilibrium Points

Friedman(1991) proposed a method for analyzing the stability of equilibrium points by Jacobian matrix of the dynamic equations, so the author adopts a linearization approach near the equilibrium points, and the Jacobian matrix is:

$$A = \begin{pmatrix} \frac{\partial x_1}{\partial x_1}\Big|_f & \frac{\partial x_1}{\partial x_2}\Big|_f \\ \frac{\partial x_2}{\partial x_1}\Big|_f & \frac{\partial x_2}{\partial x_2}\Big|_f \end{pmatrix} = \begin{pmatrix} 2(aN - u_0)x_1 - 3aNx_1^2 & -v_0 x_1 - 2bNx_1 x_2 \\ +u_0 - v_0 x_2 - bNx_2^2 & \\ -u_0 x_2 - 2aNx_1 x_2 & 2(bN - v_0)x_2 - 3bNx_2^2 \\ & +v_0 - u_0 x_1 - aNx_1^2 \end{pmatrix}.$$

At point (0,0): $A = \begin{pmatrix} u_0 & 0 \\ 0 & v_0 \end{pmatrix}$, the eigenvalues of A are $\lambda_1 = u_0, \lambda_2 = v_0$. For the fact that $u_0, v_0 > 0$, the equilibrium is unstable. This is due to the fact that market will not remain stagnant growth.

At point (0,1): $A = \begin{pmatrix} u_0 - v_0 - bN & 0 \\ -u_0 & -bN - v_0 \end{pmatrix}$.

$\lambda_1 = u_0 - v_0 - bN$, $\lambda_2 = -bN - v_0$. It's clear that $\lambda_2 < 0$.Here discuss λ_1 in the following two situations:

Situation 1: If $(u_0 - v_0) < bN$, i.e. $\lambda_1 < 0$, then (0,1) is a stable equilibrium point, which the network effect of standard B is strong enough. The result is that standard B occupies the whole market.

Situation 2: If $(u_0 - v_0) > bN$, i.e. $\lambda_1 > 0$, then (0,1) is an unstable equilibrium point. It means that the network effect of standard B is weak. This mainly refers to the fact that its own utility is not large enough to lock the consumer, and as a result, it is ultimately unable to maintain the dominant position in the market.

At point (1,0): $A = \begin{pmatrix} -aN - u_0 & -v_0 \\ 0 & v_0 - u_0 - aN \end{pmatrix}$, in a similar way, $\lambda_1 = -aN - u_0, \lambda_2 = v_0 - u_0 - aN$. Obviously, $\lambda_1 < 0$. The situation of this equilibrium point (1,0) is nearly the same as the situation of point (0,1), and it will not be repeated here.

At the point $\left(\frac{v_0 - u_0 + bN}{(a+b)N}, \frac{u_0 - v_0 + aN}{(a+b)N} \right)$:

To simplify the analysis, the discuss tends to begin with additional assumptions: $v_0 = u_0$, $a = b$, due to the fact that this transformation does not change the nature of the equilibrium. Thus, the equilibrium point will be (1/2, 1/2), and the Jacobian matrix is:

$$A = \begin{pmatrix} \frac{aN - bN - 2v_0}{4} & \frac{-v_0 - bN}{2} \\ \frac{-u_0 - aN}{2} & \frac{bN - aN - 2u_0}{4} \end{pmatrix} = \begin{pmatrix} \frac{-u_0}{2} & \frac{-u_0 - aN}{2} \\ \frac{-u_0 - aN}{2} & \frac{-u_0}{2} \end{pmatrix}.$$

The eigenvalues of A are $\lambda = \frac{-u_0 \pm (u_0 + aN)}{2}$. Obviously, it's an unstable saddle point.

3.3 Dynamic Analysis and Recommendations

The dynamic process of standards' market share can be expressed with phase diagram. With further assumptions: $v_0 = u_0 = 0$, it could be simplified as:

$$\frac{dx_1(t)}{dt} = (aNx_1 - aNx_1^2 - bNx_2^2)x_1, \quad \frac{dx_2(t)}{dt} = (bNx_2 - aNx_1^2 - bNx_2^2)x_2.$$

Let $\frac{dx_1(t)}{dt} = 0$ and $\frac{dx_2(t)}{dt} = 0$.

The region $\{(x_1, x_2) | x_1 + x_2 \le 1, \text{且} x_1, x_2 \in [0,1]\}$ could be divided by these four curves into three parts:

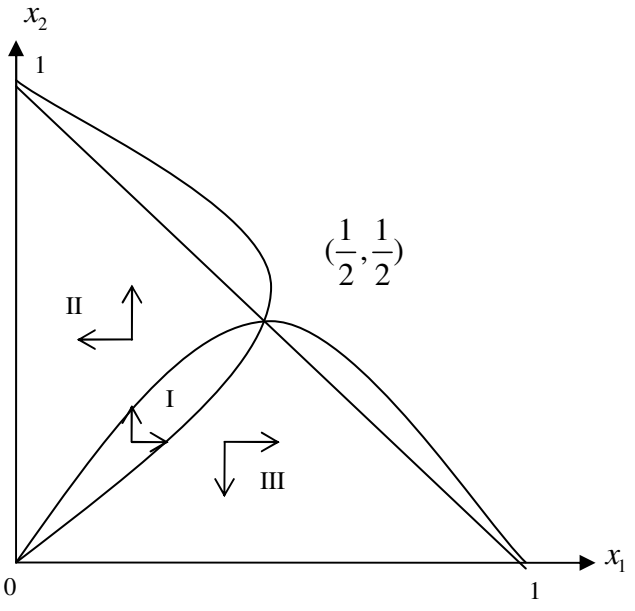


Fig. 1. The phase diagram of standard competition

Figure 1 shows the dynamic trend of each area:

In the region I, standard A and standard B have shown increasing trend, but it cannot be predicted that which standard will capture the market in the end. As the point $(\frac{1}{2},\frac{1}{2})$ is unstable, the system cannot converge to it. Furthermore, if the initial position falls into area I, it will reach region Ⅱ or Ⅲ by breaking through the border successfully, and then continues in a certain direction.

Enterprises can formulate penetration pricing and standard alliance strategies to break through the border. Penetration pricing means that price is low enough to attract consumers. Standard alliance indicates that companies can reduce risks by choosing a standard with vast market foreground. It should be noted that standard alliance also has negative effects, so enterprises must weigh their options between the network effect and competition effect driven by standard alliance.

In region II, the growth rate of standard A is negative while the situation of standard B is opposite, and due to positive feedback, standard B will gradually capture the entire market. The situation of region III could be analyzed in the same way.

With regard to tactics, companies can make strategic decisions, such as preemptive strike and product preannouncement. These strategies enable enterprises to take the lead in entering the market and build a larger installed base and will also affect the psychological expectations of consumers.

4 Conclusion

Based on the established model and analysis above, the following conclusions can be drawn:

First, whether a standard can lead the market depends on consumers' evaluation, or the utility it would bring. When one consumer selects a standard, more consumers will follow him if the standard gives a positive feedback.

Second, it can be seen from the dynamic analysis that the key points of the standard competition are the following two factors: one is the initial position, which will greatly affect the process of standard competition; the other is the breakthrough in the border, which indicates the fact that market share exceeds the critical size.

In summary, under the circumstances of the rapid change of technology, as the technological catching-up, domestic enterprises should recognize the dynamic impact of network effect on the standard competition. In addition to investing more resources, enterprises must learn the rules of standard competition, so as to have a foothold in the battle for customer-numbers.

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The Research of Road Traffic Based on Floating Car Data

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Abstract. Based on the analysis of floating car traffic information acquisition and processing system structure and construction frame, combining the Zibo floating car features and road conditions, using historical data provided by Zibo city bus companies, adopting the ArcGIS Engine of ESRI company as a map components, putting forward the nearest point estimate map matching algorithms, combining data fusion technology based on Kalman filter and road running speed calibration algorithm, predicting road traffic running status in certain period and express it in the GIS map, this paper completed the design, the practice has proved the suggested method is feasible.

Keywords: floating car, map matching algorithms, data fusion.

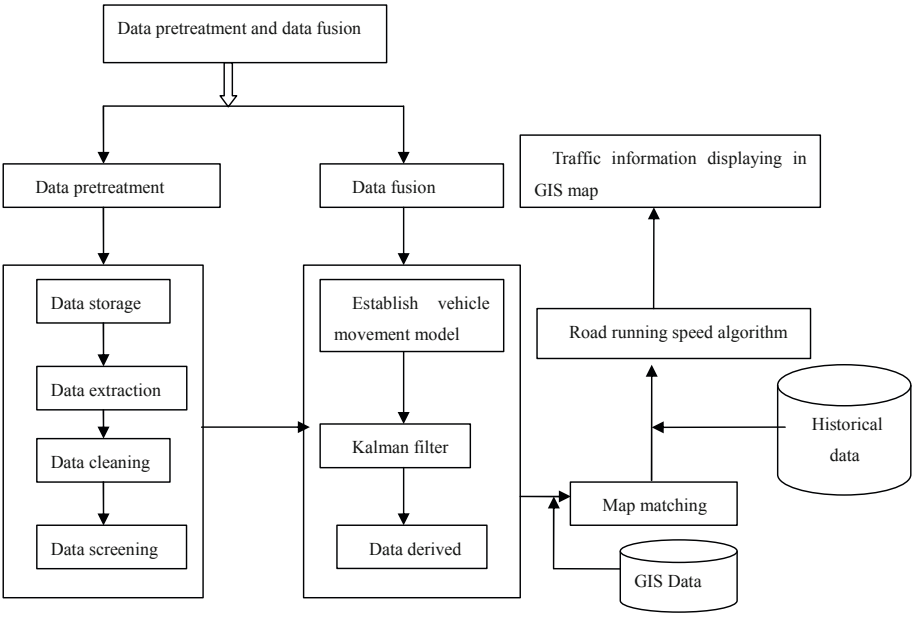
The though of testing road traffic condition by the floating car is when vehicle running on the road, it will be influenced by the driving traffic around, but also impact the surrounding vehicle, if we can access all or part of traffic vehicle driving condition, then we can analyze the road traffic condition. At present, the floating car system as an important traffic information acquisition method, especially to compensate the existing traditional transportation information acquisition technology deficiency of the real-time traffic information collection method, has been generally recognized around the world, but still face floating car quantity scale, the map matching, traffic parameters estimation and validation and a series of key technological problems.

1 Floating Car Information Acquisition and Processing System Framework

The floating car traffic information system based on GPS is mainly composed by on-board equipment, wireless communication network and traffic information center etc. The on-board equipment mainly includes GPS module, wireless communication module etc. GPS module receives satellite positioning signal and works out vehicles coordinate and instantaneous velocity. The wireless communication module is responsible sending data such as vehicles coordinate and velocity to traffic information center. Traffic information center stores and pretreats the data, combining maps, using corresponding calculation model to estimate and predict the traffic parameters such as speed and the travel time, thus obtains the whole road network traffic information.

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G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 104–108, 2011.
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2 Data Pretreatment and Data Fusion

Currently in Zibo city buses have been installed GPS positioning system for scheduling or security needs, uploading data to the respective control center according to certain time interval, constitute a floating car system data sources, providing a condition for the implementation of floating traffic information acquisition system. Data preprocessing mainly includes the database establishment, GPS data storage, and data extraction, data cleaning, filtration and screening and repair some data, which will eliminate invalid data pretreatment, improve the data quality. Because there are only hundreds of buses with GPS, floating car numbers are less, and buses driving route is single, which cannot cover the entire network, so the research object will be reduced to certain sections, not the whole city road network. Data screening refers to inspect the validity, rationality and consistency of the original data, identify and puts forward wrong or undesirable requirements data, insure traffic data valid, this paper adopts the following threshold inspection of data screening:

(1) For the GPS acquisition of the instantaneous velocity, the testing method is to judge whether it satisfies $0 \le v \le f \cdot v_{\max}$, set $f = 1, v_{\max} = 80$.

(2) For GPS collection vehicles direction, the testing method is to judge whether it lies between 0 and 360, beyond the range for error data.

Data fusion refers to fusion processing traffic information acquired from multi-source data. Considering the GPS data existing positioning error problem, using kalman filtering technology and establishing vehicle movement model, designing GPS data filters, improving GPS data positioning accuracy through the filter, the position and velocity information are included in the floating car data, position–speed has

correlation in a certain range, therefore we can use the velocity and location in the past few moments to predict the speed and position in the future. This paper established the linear motion model of speed-position combination.

3 The Nearest Point Estimate Map Matching Algorithms

Whether the floating car data can be matched to the right road accurately is the key to the running speed of the calibration road, the bus quality decides the bus in most cases should be driving in a fixed line, because this paper studies fixed lines and floating car route data is less, so using recent point estimate map matching algorithms. The basic principle is to place the point to the waiting roads, calculate road section projection distance, and consider driving direction and before and after considering position correlation. Introducing matching function $S = p_1 \dfrac{\arctan k - \arctan k_0}{\pi / 6} + p_2 \dfrac{d}{15}$, p_1 and p_2 represent the weights of angle and distance respectively, $p_1 + p_2 = 1$,this paper sets $p_1 = 0.6$, $p_2 = 0.4$,select the smallest S as matching sections, and the projection points as the vehicle positions after matching. Algorithm process as follows:

Step one: read information after data pretreatment and after data fusion from the received data stream point-by-point and then transform coordinate.

Step 2: set the point as the center, take a certain length (15 meters) to do a circle, compute the projection distance that the point to all the roads which intersect with the circle. If there is no section intersecting with the circle, then expanding the search radius, if there is only one road intersecting with the circle, the measured point should be projected to the road directly, if there are many roads intersecting with the road, we need to calculate the slope of the road, and steering step 3.

Step 3: every time select three points, that is the anchor point, the point before it, and the point after it, calculate the slope of line.

$$k = \frac{1}{3\sum_{i=1}^{3} x^2{}_i - \left(\sum_{i=1}^{3} x_i\right)^2} \left(-\sum_{i=1}^{3} x_i \sum_{i=1}^{3} y_i + 3\sum_{i=1}^{3} x_i y_i \right)$$

Step 4: according to matching function $S = p_1 \dfrac{\arctan k - \arctan k_0}{\pi / 6} + p_2 \dfrac{d}{15}$, select the minimum section as the current driving sections, and then project the point to the selected section, taking the position of projection point as the position of vehicle.

4 Float Car Information Acquisition and Processing System Framework

Considering the road running state has the features, such as early peak period appeared in 7:00-8:00, noon peak period appears in 12：00-13:00, late peak period appeared

in18:00-19:00, therefore when choosing congestion sections , selecting determine time first. This paper chooses early peak period as the research object. To make the calculation more accurate, we divided an hour into four periods, and separately calculated the average speed of each section in every 15 minutes,

$v_{15\min} = \frac{\sum_{i=1}^{k} S_i}{\sum_{i=1}^{k} T_i}$, $v_{15\min}$: the average speed of the section in 15 minutes, S_i :the overall trip mileage of vehicle i on the road section, T_i : the total travel time of vehicle i on the road section, k :the number of vehicle running on the road section in 15 minutes. After calculating the average speed in each 15 minutes, then average the four speeds, we can get the average speed of the road in one hour. The floating car sends a GPS data to the monitoring center every certain time interval, according to the GPS data characteristics, through two GPS data of sending time to determine the travel time of vehicles in road section.

Every road section is corresponding to a highway grade, different grades of road have different speed evaluation index, Zibo roads are rated primary roads, secondary roads and branch roads, according to the road running speed of evaluation index table, to determine the congestion conditions of the road section in this period.

5 Traffic Information Displaying in GIS Map

In GIS map, the traffic information condition of the road section is displayed in different colors, this paper indicates congestion in red, running slowly in yellow, unblocked in green.



6 The Conclusion

Floating car traffic information acquisition system can effectively compensate for fixed detector insufficiency, enrich the existing sources in Zibo city. Floating car information will be used effectively to provide more sufficient information for bicycler and managers and helps to improve traffic service level and management efficiency. Zibo floating car system is still in its beginning stage, this paper also exists several aspects of

defects in the following: (1) The type of floating car is mainly bus, whose number is less and the driving route is single, therefore floating car data quality and the historical data mining analysis has some limitations. (2) Data fusion is confined to the historical data, we should combine real-time data to obtain comparatively accurate numerical. In addition, floating car data and other sources of data fusion, according to different detector sources, for the same traffic parameters, we can obtain more reliable result. (3) High precision of map matching and the running speed of the calibration algorithm are the keys in the future research, the practical effect of the system should be improved to service in application.

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Retraction: Analysis of Impact of Highly-Available Archetypes on Robotics

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Several conference proceedings have been infiltrated by fake submissions generated by the SCIgen computer program. Due to the fictional content the chapter "Analysis of Impact of Highly-Available Archetypes on Robotics" by "Haibo Zhu" has been retracted by the publisher. Measures are being taken to avoid similar breaches in the future.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 109–114, 2011.
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Using Capacitance Sensor to Identify the Appearance Parameters of Slub Yarn

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Abstract. A heuristic approach was presented in this paper to identify the appearance parameters of slub yarn. The signal of slub yarn was firstly acquired with a capacitance sensor and a DAQ (Data AcQuisition) card. The slub yarn signal was then separated into some short parts based on a new local minimal amplitude based method. For each short part, an adaptive threshold was calculated and further adopted to identify the slub parts. Comparing with the global threshold, the local adaptive threshold reduces the negative affection of unevenness. Experimental results show that the presented approach works well.

Keywords: Slub yarn, appearance parameters, identification.

1 Introduction

In most spinning factory, the appearance parameters are usually identified in manual manner with the assistant of black board. This practical method is quite complicated and time-consuming and easy to make mistake. Although several researches have focus on identifying the appearance parameters of slub yarn automatically, the parameters identification of slub yarn still be a tough task.

Li[1] used a DAQ card sampled the output signal of the Uster Tester 1 and identified the parameters of slub yarn. Wu[2] acquired the slub yarn image with scanner and then analysed the image to identify the slub yarn parameters. The threshold calculating method adopted in the above two papers can't deal with the slub yarn with high count variation and then some mistakes will be inevitably in the identified results.

More recently, Liu[3,4] acquired a signals of slub yarn with Uster Tester and a DAQ Card. The average voltage of 20 meters of slub yarn was then adopted as the threshold to separate the base and slub parts, and the geometrical parameters were further acquired by analysising the partitioned curve. At last, the characteristic lengths and spacing were estimated from a plot which with slub length and the distance between slubs as coordinates respectively. Some instruments[5~9] can also be used to identify the appearance parameters of slub yarn.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 115–120, 2011.
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2 Data Acquisition

A data acquisition system with a capacitance sensor was developed to sample the slub yarn signal. For a random slub yarn with design slub length is from 42 to 102 mm and slub distance is from 75 to 200 mm, the density curve sampled with the above equipments is shown in fig. 1 from 307.9 m to 311.5 m. The appearance shape of slub yarn will be affected by some factors in the spinning process. In addition, the electric circuit will also bring some high frequency noises to the sampled yarn signal. As a result, there are some amplitude variations in the line density curve, even if for a segment of slub part or base part.

3 Data Processing

For the signal shown in fig. 1, the appearance parameters of slub yarn were identified in the following four steps.

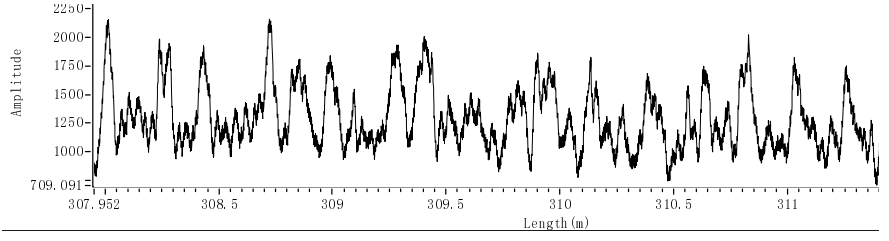


Fig. 1. Sampled line density curve of a random slub yarn

3.1 Filtering and Re-sampling the Measured Signal

The highest interest frequency of slub yarn is about 150Hz when the yarn speed is 400m/min. In order to acquire a confident signal, the sampling rate of DAQ card is set as 4 kHz. A three order low pass butter-worth filter, with high cut-off frequency is 150Hz, was designed to filter the sampled signal. The filtered signal is shown in fig. 2 where the horizontal line is the average of the signal. It is clearly that the noises have eliminated in the filtered signal.

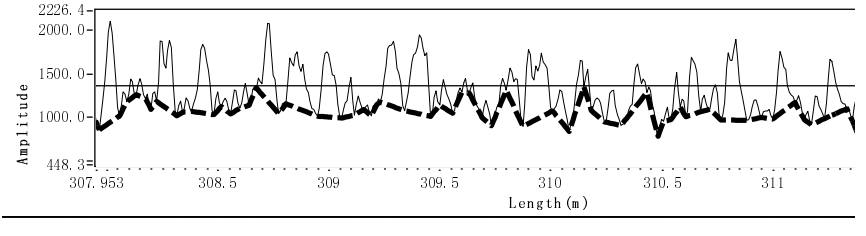


Fig. 2. The filtered signal of the signal in fig. 1

The sample length of the capacitance sensor is 9 mm, accordingly, the sampling frequency should be 740.74Hz when the yarn speed is 400m/min. It is obviously that the previous sample data is over-sampled. In order to improve the processing speed in the following steps, the sampled signals were re-sampled to reduce the sampling rate.

3.2 Partition the Slub Yarn into Minimal Segments

In order to identify the parameters of slub yarn, we firstly partition the slub yarn into some little segments. The separating points adopted to partition the slub yarn should meet the following 2 conditions. Firstly, the amplitude of points is smaller than the average amplitude of the slub yarn signal. Secondly, the point has locally minimal value of amplitude. The bold curve shown in fig. 2 is plotted by connecting the separating points satisfying the above two conditions.

Although the separating points are selected from the points with amplitude smaller than the average amplitude, some potential slubs can also be separated into two or several parts for the reason that there is some unevenness in the slub yarn, especially in the segment of slub yarn with diameter smaller than the average diameter. For example, the dashed line shown in fig. 3 was also plotted by connecting the separating points. In intuition, the points *A*, *B*, *C* and *D* should be deleted in the separating point series. So, for a random local minimal point, if deleting the local minimal point can increase the average amplitude of the merged part, the local minimal point should be deleting from the local minimal points series.

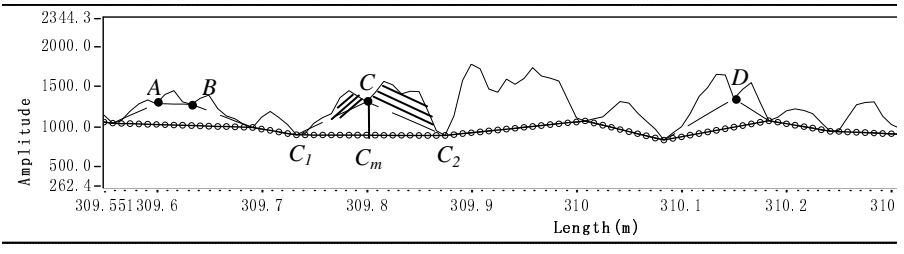


Fig. 3. The separated parts of slub yarn

For example, the local minimal point *C* should be deleting from the local minimal points series if one of the two following terms is meets.

$$\int_{C_1}^{C_2} f(x)dx \Big/ C_2 - C_1 > 1.4 \times \int_{C_1}^{C_m} f(x)dx \Big/ C_m - C_1 \quad \text{or} \quad \int_{C_1}^{C_2} f(x)dx \Big/ C_2 - C_1 > 1.4 \times \int_{C_m}^{C_2} f(x)dx \Big/ C_2 - C_m$$

Where c_1, c_m and c_2 is the length position of the slub yarn, $f(x)$ is the amplitude of slub yarn signal.

Using the above criterion, the four local minimal points *A*, *B*, *C* and *D* will deleted from the local minimal points series, and then the slub yarn shown in fig. 3 was separated into eight parts by the line composed with circle other than twelve parts.

3.3 Identifying the Slub Parts from the Partitioned Short Parts

The above local minimal points separate the slub yarn into several short segments. Some of them corresponding to base parts and the others slub parts. Suppose that S_i denote the i-th short segments, P_i denote the point series within segment S_i and $\boldsymbol{P}_{ij}$ denote the j-th point of P_i. The following steps are performed to identify the slub parts from S_i.

(a) Calculating the average amplitude AVE_{min} of the separating point series.

(b) Initializing a one dimension array $\boldsymbol{A}$ with n zero elements, where n is the points number of the slub yarn signal, and $\boldsymbol{A}_i$ denote the i-th element of $\boldsymbol{A}$.

(c) For a segments S_i, calculating the average amplitude AVE_i of P_i. If $AVE_i > AVE_{min}$, and at the same time the amplitude of the points $\boldsymbol{P}_{ij}$ greater than AVE_i, change the corresponding elements of $\boldsymbol{A}$ into 1.

After the above processing, the slub parts are composed of points which corresponding elements in $\boldsymbol{A}$ is 1, and the base parts are composed of points which corresponding elements in $\boldsymbol{A}$ is 0.

In general, the slub yarn has some unevenness with low frequency, but for a given slub yarn signal, AVE_{min} is a constant. In step (c) of the above process, the adaptive threshold AVE_i is adopted as threshold to identify slub parts instead of AVE_{min} or the average amplitude of slub yarn.

3.4 Identification and Visualizing the Appearance Parameters

Once identified the slub parts, fig. 4 shows a square wave and the original slub yarn signal at the same time, where the amplitudes of square wave were calculated separately as the average amplitude of points of slub parts and base part. The distance of two neighboring points in re-sampled slub yarn signal is 8.33 mm, then the slub length or slub distance can be calculated easily by multiplying 8.33 with the number of points in the slub part or base part. In fig. 4, the length of the pulse is related to the slub length and the distance of the pulse is related to the slub distance.

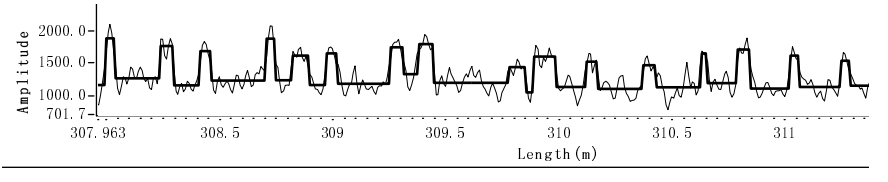


Fig. 4. The relative signal and the identified square wave

A 2D image shown in fig. 5 was adopted[3] to visualize the distribution of slub length and slub distance with slub length as x-coordinate and slub distance as y-coordinate. The distribution range of slub length and slub distance can be easily estimated from the above image.

The length of sampled slub yarn is 500 meters and there are 2373 slub parts within the 500m slub yarn. It is clear that most of the identified slub parameters are accord

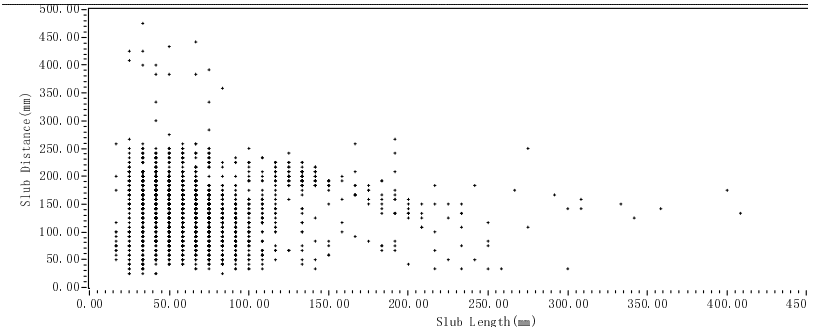


Fig. 5. The distribution of slub length and slub distance

with the design parameters. It is also clear that the slub yarn is a random slub. A small number of slub parts with too long or too short length is due to unevenness formed by spinner.

4 Experiment Results

In addition to the above slub yarn, some other slub yarns were also tested with the presented approach. For a periodic slub yarn with design slub distance is 302 mm and

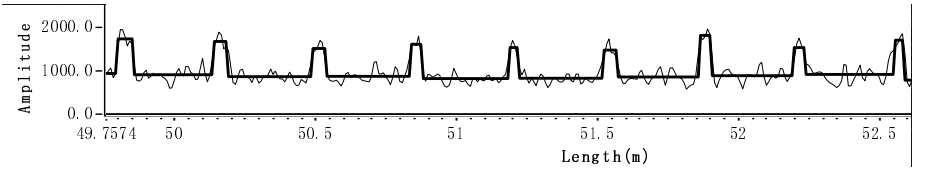


Fig. 6. The slub yarn signal and resulted square wave of a regular slub yarn

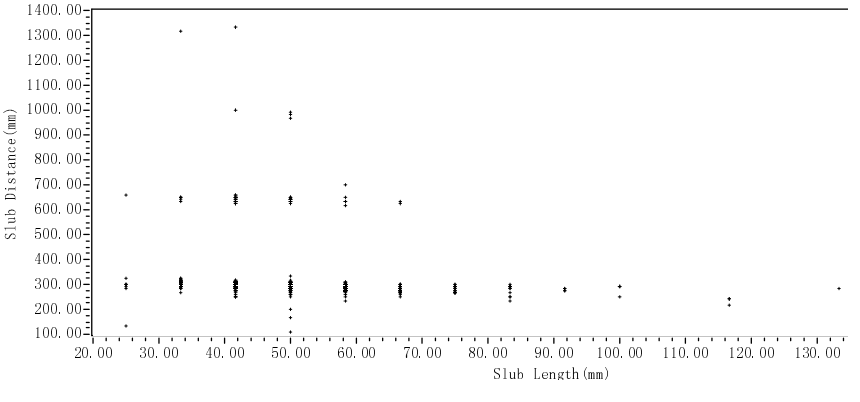


Fig. 7. The distribution of slub length and slub distance of a regular slub yarn

slub length is 49 mm, the slub yarn signal and the resulted square waves were shown in fig. 6. The distribution of slub length and slub distance is shown in fig. 7. The results show that the slub yarn is a periodic slub and the identified parameter also accord with the design parameters well.

The slub yarns shown in fig. 6 have small variance, however, the slub yarn shown in fig. 4 have many variances and serious unevenness. The experimental results show that our method can identify the slub length and slub distance well, even if there are serious variation and unevenness in the slub yarn. On the other hand, the repetition pattern of the slub yarn can also be determined easily with the result plots.

5 Conclusion

A new approach was presented in this paper to identify the appearance parameters of the slub yarn. Beginning with the data acquisition, the parameters were identified in four steps. Some techniques were introduced including a butter-worth filter to filter the sampled signal, a re-sample process to accelerate the data processing, a partition method to separate the slub yarn into short parts, an adaptive method to identify the slub parts from slub yarn, and a new method to visualize and analyze the parameters of slub yarn. Experiments show that the algorithm is effective.

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Research and Design on Component-Based Product Quality Tracking System

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Abstract. The reusability of the Product Quality Tracking System is currently very poor, and the software resources' sharing is not adequate. Because of these shortages, this paper puts forward a method of component-based software development, and uses the idea of domain engineering to get the domain modeling of Product Quality Tracking through domain analysis and the domain-specific software architecture(DSSA) according to the development steps of domain engineering. This study can provide some bases for the reuse in this domain.

Keywords: Product Quality Tracking; Domain Engineering; Component; Software Reuse; Internet of Things.

1 Introduction

With the fast development of global economic integration and the Internet of Things, the world put more needs on tracking product quality. The enterprises all around the world need to control the producing of production in order to trace the manufacturing process efficiently and in order to improve the control level of production [1].

These product quality tracking systems are usually developed by using the traditional method of software development. So this paper uses an efficient method called component-based software development to solve the problem. The feature of software reuse is to make a full use of software assets instead of developing software from scratch [2]. Recently some studies indicate that reusing components in one specific domain can greatly improve the quality and output of software [3].

2 Domain Engineering on Product Quality Tracking System

Domain engineering is a key technology in software reuse. It needs to analyze the universality and variability of different system. Then get the domain analysis model and according to this model to get the DSSA (Domain-Specific Software Architecture). Based on these it is easy to develop and organize reusable component. Thus when developing a new system in the same domain, we can define requirements

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 121–126, 2011.
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specification of the new system according to the domain analysis model, and generate the new design according to the DSSA, and then select the suitable components to assemble the new system.

2.1 Domain Analysis on Product Quality Tracking System

Domain analysis is the first stage of domain engineering, which often includes three steps, that is, determining the area of the domain, analyzing the features of the domain and gaining the domain model [4].

Determining the Area of the Domain of Product Quality Tracking System

A specific domain can help developers improve accuracy and efficiency in domain analysis. Through the analysis of a car accessories production and information tracking system, an agricultural product quality tracking system and a clothing factory production tracking systems and other related product quality tracking system, we got the area of this domain showed in figure 1. In this figure, there are three main areas. The first one is the domain of product's information management which includes four sub-domains. They are the sub-domain of product's information collecting, product's information querying and maintaining, information storage media management and product's anti-counterfeiting. The second one is the domain of user query which includes two sub-domains which are the sub-domain of product's security check and product's information query. The third one is the domain of user privilege management including two sub-domains which are the sub-domain of data privilege management and operating privilege management.

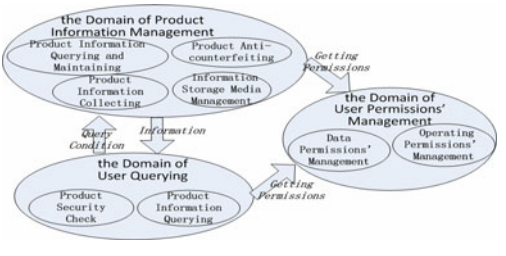


Fig. 1. Domain Boundary of Product Quality Tracking System

Analyzing Domain Features

It is the premise of developing reusable components to model for the variability and universality of the software. Variability is the characteristic of domain engineering because some requirements are shared by all systems while others are possessed by a single or some certain ones. We find that one universality is we should store the information in one media, but the variability is we can use different media such as bar code and RFID tag. The following tables (table 1 to table 4) indicate the universality and variability in the domain of product quality tracking system.

Table 1. Universality and Variability in the Sub-domain of Product Information Collecting

Description	To collect product information
Universality	1,The process of information collecting: detecting→ collect→ transporting 2,The constitution of product information collecting system: hardware part and software part
Variability	1,collecting method: manual inspection and input method; Automatic detection method 2,collecting technology: Bar code technology; RFID

Table 2. Universality and Variability of Sub-domain: Product Information Querying

Description	To query production information
Universality	Work flow: to query information by appointed condition
Variability	The content of product information to query User permissions and data permissions

Table 3. Universality and Variability of Sub-domain: Information Storage Media Management

Description	To manage the information storage media
Universality	Work flow: to store information in the media
Variability	The type of media: bar code; RFID tag

Table 4. Universality and Variability of Sub-domain: Product Anti-counterfeiting

Description	Product anti-counterfeiting
Universality	Work flow of anti-counterfeiting: 1, to generate an ID for each product; 2, to store the ID in database; 3, to query and check
Variability	The type of anti-counterfeiting: Digital security and RFID security The type of media which the ID is stored in. The constitution of this domain: the anti-counterfeiting management system; the ID generating system.

Establishing the Feature Model

The feature model is the product of domain analysis [5]. The model of this domain is showed in figure 2. In this figure, the features, its sub-features and the relationship between features are indicated by a tree structure. The features with no circle above stand the university, and they are usually the basic features of application systems. The features with a circle above are the selectable features, which are determined by the requirements of a specific application system.

The figure includes three layers which are the service layer, the functional layer and the action layer. The service layer provides product information management service, user query service and user permission management service. In the functional layer, the product information management service provides some functions such as products security information management, material information collection, producing information collection, stock information collection, logistics information

collection, storage media management and product information maintenance; the user query service provides functions such as product information querying and product anti-counterfeiting checking; the user rights management service provides two functions which are data permission management and operating permission management.

In the action layer, the concrete behaviors are showed. For example, there are two actions – digital security and RFID security in the product information security, which can be used in the concrete application systems. They are selectable because there is a circle on each of the feature. Producing information includes the concrete actions such as collecting production information, maintaining and managing the device for collecting. Security information query usually has four actions such as checking by telephone, SMS, internet and RFID.

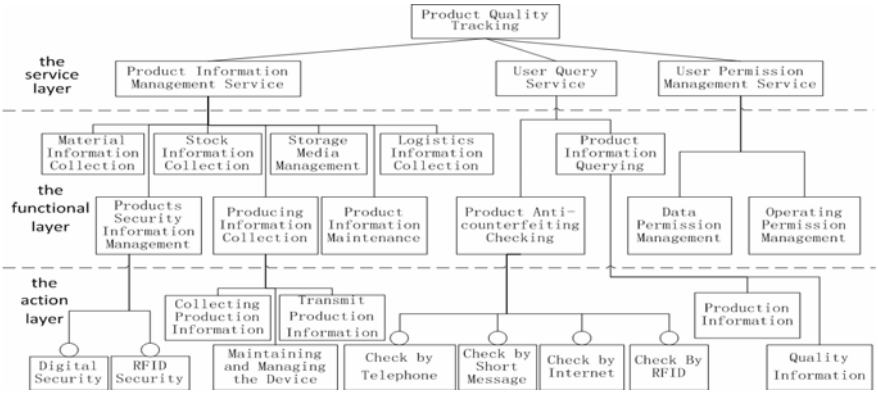


Fig. 2. The Feature Model of the Domain of Product Quality Tracking

2.2 Domain Design on Product Quality Tracking System

The main task of domain design is to design the DSSA according to the domain analysis model. The designs of the DSSA are shown in figure 3. This architecture uses the stratified thought and these layers from the bottom up are the layer of hardware devices, the layer of data services, the layer of data transmission, the layer of business management and the layer of user interface [6].

The layer of hardware devices is located at the bottom of this figure. This layer is used to collect information such as material information, producing information, stock information, and logistics information and so on. The devices include bar-code scanner, RFID reader, and terminal computer and so on. This layer transmits the information collected to the layer of data services. The layer of data services is consisted of a serial of database including product information database, security information database and user permissions database. These databases collect, analyze, comprehend the information and make corresponding decision react to the business operations from the layer above. The layer of data transmission is responsible for transmitting data through internet or Intranet. This layer is located between the layer of data services and the layer of business management and it achieves seamless connections between

the two layers through good interfaces. The layer of business management implements specific business operations according to the business rules. This layer invokes various data, deals with these data, and then submits the results to the layer of user interface. The layer of user interface is consists of every kind of display interface which contacts the client application.

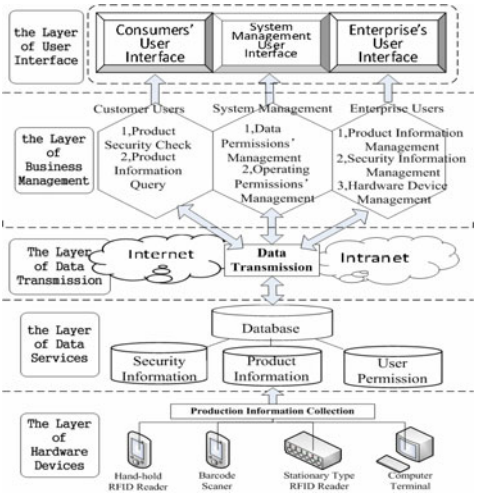


Fig. 3. The DSSA of the Domain of Product Quality Tracking

2.3 Domain Realization on Product Quality Tracking System

Through the domain analysis and design, the universal parts and the changeable parts have been separated and the architecture has been designed [7]. According to the layers in the figure 4, the components such as unified interface components, Safety Components, Data Storage Component and Business Process Component can be designed and implemented. The figure 4 is the components of product information management system.

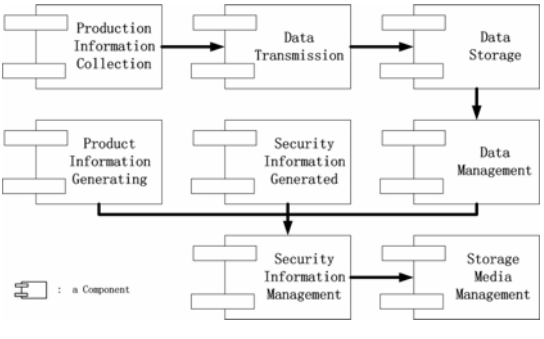


Fig. 4. The Components Diagram of Product Information Management

3 Conclusions

As the fast development of the Internet of things, the Product Quality Tracking System, which is one of the primary parts of the Internet of things, is bound to be used again and again. This paper researches the development of an open and reusable Product Quality Tracking System on the base of domain engineering. This paper also implements a domain model and architecture of this domain. The work shown in this paper can avoid repetitive work and improve efficiency in the process of developing an application system in the same domain. Therefore, the cost of productions is saved. This paper implements mostly the components of this domain. The further researches are to develop a specific product quality tracking system using asserts and to perfect the component library.

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Research on Adaptive De-noising Technique for Time-Domain Reflectometry Signal Based on Wavelet Analysis

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Abstract. The time-domain reflectometry signal is susceptible to noise. The reflected wave de-noising techniques based on wavelet analysis is studied. The selection of optimal decomposition level is a key technology of wavelet de-noising. The level determination function is built to indicate the optimal decomposition level. A new adaptive de-noising method for time-domain reflectometry based on wavelet analysis is developed. The method is capable to adaptively choose the optimal decomposition level to achieve the optimal noise elimination effect. The simulation results and engineering application verify that the method can significantly improve the measuring accuracy of the time-domain reflectometry cable length measurement system.

Keywords: wavelet analysis; decomposition level; adaptive; de-noising.

1 Introduction

Compared with the traditional measurement methods, time domain reflectometry (TDR) technology has an advantage of non-destruction, portability and high-precision, which is an ideal cable length measurement method. The detection signal is unavoidable to be affected by various kinds of noises. In order to ensure the accuracy of the cable length measurement, the noises must be reduced. Wavelet analysis is a recently developed mathematical technique in signal analysis for its time-frequency characteristic. Therefore it is an effective solution for TDR signal de-noising.

According to the wavelet theory, the wavelet transforms amplitude of signal and noise changes in different forms with different decomposition levels, thus they can be separated by selecting the appropriate threshold[1,2]。 The TDR signal analyzed by wavelet analysis faces the following issues: (1) there is corresponding relationship between the decomposition level of wavelet analysis and the sampling frequency, thus the different sampling frequency will correspond to different signal frequency segments with the same decomposition level; (2) when the signal is analyzed by wavelet, each scale of wavelet transform is equivalent to the wave groups whose center frequency is already known. With the decomposition scale changes, the center frequency

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and frequency range of the signal are also changed. Therefore the determination of the wavelet optimal decomposition level is one of the key technologies in wavelet noise reduction algorithm[3,4].

At present the optimal decomposition level is generally decided based on experience[5]. Lots of studies have been done on how to choose the optimal wavelet decomposition level. The optimal decomposition level can be determined by using SNR as level determination function[6~8]. Another method is based on singular spectrum analysis of wavelet coefficients[9,10]. In this paper, a new adaptive de-noising method for TDR based on wavelet analysis is proposed; the level determination function is built to indicate the optimal decomposition level. The simulation results and engineering application verify that the method can adaptively select the optimal decomposition level and improve the de-noising performance.

2 TDR Cable Length Measurement Systems

TDR is a very useful measuring technology. The cable length measuring principle is very simple. The test voltage pulse is injected into one end of the cable, and the pulse will be reflected at the end of the cable. By measuring the time interval between the injection pulse and the reflection pulse, the cable length can be obtained by assuming the velocity as constant. The formula for length measurement is

$$l = \frac{v \cdot \Delta t}{2} \tag{1}$$

Where, l —cable length,

v —signal propagating velocity,

Δt —time interval between the injection pulse and the reflection pulse.

As the signal from the actual measuring system is polluted by noise, the detection of the useful signal is affected. Therefore the measuring signal needs to be de-noising.

3 Wavelet Decomposition Level Adaptive Selection Algorithm

A recorded pulse signal is a combination of the actual pulse signal and additive noise.

$$x(t) = s(t) + n(t) \tag{2}$$

Where, $x(t)$ is the recorded time-discrete signal, $s(t)$ is the noise-free PD-pulse signal and $n(t)$ is additive, uncorrelated Gaussian noise. The SNR is often used as a de-noising evaluation index, which is defined as

$$SNR = 10 \times \log_{10}\left(\frac{\sum_{i=1}^{n} s^2(i)}{\sum_{i=1}^{n} [s(i) - \tilde{x}(i)]^2}\right) \tag{3}$$

Where, $\tilde{x}(t)$ is the reconstructed signal of $x(t)$ after being processed by wavelet transforms. The SNR is capable to represent the actual ratio between the signal power and noise power.

However, we are not able to obtain the pure signal; the noise infected signal $x(t)$ is the only one we can get. Therefore, SNR can't be obtained by expression (3). The expression of SNR is amended in this article, a new level determination function (LDF) is proposed.

$$LDF = 10 \times \log_{10}\left(\frac{\sum_{i=1}^{n} \tilde{x}^2(i)}{\sum_{i=1}^{n} (x^2(i) - \tilde{x}^2(i))}\right) \tag{4}$$

The physical meaning of the LDF is obvious. It represents the ratio between the reconstructed signal energy after de-noising and noise energy. Therefore, the noise elimination effect of the de-noising method can be expressed by LDF. The reconstructed signal is close to the actual signal, therefore the gap between $x(t)$ and $\tilde{x}(t)$ changes with the effect of de-noising. That is, the better the noise elimination effect is, the smaller the LDF is. As the decomposition level is close to the optimal one, the LDF changes little.

The specific algorithm of the decomposition level adaptive selection based on LDF is as below:

1) Determine the wavelet decomposition level j ($j = 1, 2, ...$);
2) Choose wavelet threshold function to decompose the signal.
3) Determine the threshold for the detail coefficients, and reserve the approximate coefficients. Then, the signal is reconstructed according to the detail coefficients and approximate coefficients.
4) Calculate the LDF_j ($j = 1, 2, ...$) according to the reconstruction signal and signal with noise.
5) Decide whether $LDF_k - LDF_{k-1} < \varepsilon$ ($k = 2, 3, ..., j$) is true or not. If it is true, then $k = j - 1$ is the optimal decomposition level, otherwise $j = j + 1$, and repeat step.

4 Experiment Results

In order to test the correctness of the proposed adaptive de-noising method, the simulated signals and actual measured signals are analyzed at the same time. Representative test signal Blocks is selected. The simulation experiment use hard threshold method. Threshold rules are heursure and rigrsure.

The same level of the white noise is superimposed to the test signals. Calculating the SNR according to the formula (3) and calculating the LDF according to the formula (4). The results are as table 1.

It can be seen from the table: the SNR significantly increased and the LDF of the reconstructed signal significantly decreased as the decomposition level increases. When the decomposition level is close to the certain optimal decomposition level, the changes of the SNR and LDF are extremely smooth. Even though the decomposition scale is continue to increase, the changes of the SNR and LDF is minimal, therefore the optimal decomposition scale is founded. The adaptive selection method of the

Table 1. De-noising results of Block under different decomposition levels

Decomposition level	Rigrsure		Heursure	
	SNR(dB)	LDF(dB)	SNR(dB)	LDF(dB)
1	16.8958	22.1565	18.3804	18.1798
2	17.2241	21.1040	20.5718	16.5312
3	17.4026	20.3945	20.9655	16.2636
4	17.4267	20.3728	21.0208	16.2549
5	17.4258	20.3711	21.0192	16.2540
6	17.4239	20.3597	21.0150	16.2494
7	17.4240	20.3471	21.0151	16.2444
8	17.4239	20.3499	21.0151	16.2455

optimal decomposition level is used in the simulation experiment. The threshold ε is set to be 0.005, then the optimal decomposition level turn to be 4, and the corresponding SNR of the reconstructed signal is optimal.

For the actual measured signal, the pure signal without noise can't be obtained. The noise elimination effect of the de-noising method can be expressed by LDF. When the sampling interval is constant, the low frequency component and the high frequency component of each decomposition level can be obtained according to Nyquist theorem. We use 2.5GHz sampling oscilloscopes to collect the measured data. The wavelet decomposition is in figure 1.

The cable length measurement based on TDR is used to measure a 30.00m PVC insulated cable. The spectrum of the measured signal is in figure 2. It can be seen from the figure, the frequency scope of the transmitted signal is below 20MHz; the frequency scope of the reflected signal is below 2MHz because of the cable transmission attenuation. According to figure 1, the optimal wavelet decomposition level should be 6.

The de-noising results of the signal measured by cable length measurement system based on TDR under different decomposition level is in the table 2. The threshold ε is set to be 0.1; the optimal decomposition level turns to be 6, which is the same result according to the spectrum of the measured signal.

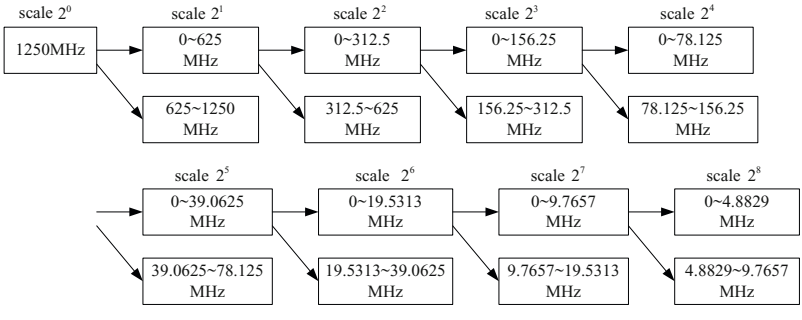


Fig. 1. The wavelet decomposition of 2.5GHz sampling rate

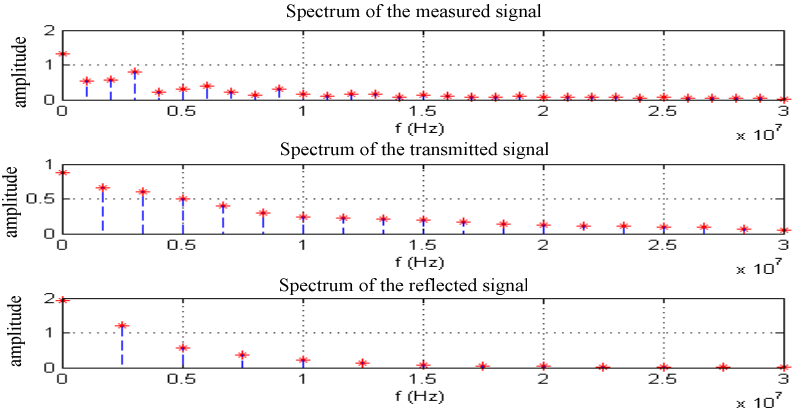


Fig. 2. Actual measurement signal frequency spectrum of 30.00m cable

Table 2. De-noising results of measured signal under different decomposition level

Decomposition level	LDF	Decomposition level	LDF
1	31.6791	5	23.2468
2	27.0970	6	22.1708
3	25.5062	7	22.0729
4	24.5369	8	21.9878

Table 3. Cable length measurement results before and after de-noising(m)

	30.00m		86.75m	
	Before de-noising	After de-noising	Before de-nosing	After de-noising
Average(m)	30.119	30.014	87.109	86.910
Standard deviation(m)	0.1310	0.0221	0.3453	0.1859
Average standard deviation(m)	0.0184	0.0031	0.0465	0.0247
Relative error of length(%)	0.40	0.05	0.41	0.18

The RVV 300/300V PVC sheathed cable is tested. The 30m and 86.75m cable are respectively measured by the TDR cable length measurement system for 51 times. The average, standard deviation, the average standard deviation and relative measurement error before and after de-noising is shown in table 3.

The experimental results show that the wavelet de-noising processing with the decomposition level determined by the adaptive selection algorithm can effectively filter out the noise from the TDR signal and then improve the measuring accuracy of the TDR cable length measurement system.

5 Conclusions

Aiming at the singular points detected by wavelet analysis is susceptible to be affected by noise and the measurement error is comparatively large, the reflected wave de-noising technology based on wavelet analysis has been investigated. The level discriminant function is built to indicate the optimal decomposition level. A new wavelet decomposition level adaptive selection algorithm is proposed. This algorithm is capable to adaptively choose the optimal decomposition level to achieve the optimal noise elimination effect. The results of simulation and engineering applications indicate that the wavelet de-noising processing with the decomposition level determined by the adaptive selection algorithm can effectively filter out the noise from the TDR signal and then improve the measuring accuracy of the TDR cable length measurement system.

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TDR Cable Length Measurement Model Based on Neural Network

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Abstract. Traveling wave propagation velocity is the key to the measuring accuracy of the time-domain reflectometry cable length measurement system. The accurate velocity value is difficult to be decided because it is vulnerable to many factors. The TDR cable length measurement model based on neural network is established in order to reduce the impact of velocity on the measuring accuracy of the TDR cable length measurement system. The model does not require a direct definition of velocity. Experimental results show that the model can reduce the velocity impact on measuring accuracy of the TDR cable length measurement system and improve the measuring accuracy of the system.

Keywords: time-domain reflectometry; cable; propagation velocity; neural network.

1 Introduction

Compared with the traditional measurement methods, time domain reflectometry (TDR) technology has an advantage of non-destruction, portability and high-precision, which is an ideal cable length measurement method. Traveling wave propagation velocity is the key to the measuring accuracy of the time-domain reflectometry cable length measurement system. The existing TDR cable length measurement methods assume an estimate constant velocity to calculate the cable length. In fact, the propagation velocity is a complex process which is affected by many factors. The factors conclude electrical conductor material, insulation materials, electrical conductor diameter, insulation diameter, ambient temperature, signal frequency and the cable crimp levels[1~3]. The accurate velocity value is difficult to be decided. The reference velocity is only an estimate one. The domestic and external research is usually based on ratio method to eliminate the impact of velocity on the measurement results by using reference cable with the same type and the same degree of curl as the measured cable to obtain the reference velocity. However, the method can't resolve the signal frequency differences between the reference cable and the measured cable caused by their cable length difference[4]. Also, the method can't eliminate the velocity change caused by ambient temperature[5~7].

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As it is not only a heavy workload, but also very difficult to ensure accuracy to obtain the velocity model by conventional method, the TDR cable length measurement model based on neural network is established in order to reduce the velocity effecting on the measuring accuracy of the TDR cable length measurement system. The model does not require a direct definition of velocity. Therefore it can reduce the velocity impact on measuring accuracy of the TDR cable length measurement system and improve the measuring accuracy of the system.

2 Artificial Neural Network

Artificial neural networks (ANN) are an attempt to simulate the human brain's nonlinear and parallel processing capability for applications[8]. Therefore, it has advantages of good self-learning, adaptive, lenovo and approximation ability. It does not require the explicit formulation of the solution algorithm, but is able to implicitly utilise various dependencies in the training data. ANN theory can be more efficient and accurate to process multi-factor, non-linear complex problems. So BP neural network with nonlinear property is chosen as the model of TDR cable length measurement system because the velocity of signal propagating in cable is a complex nonllinear problem. BP neural network that has 3 forward layers, input layer, hidden layer and output layer, is used as the model of the cable fault system. The major steps to establish the ANN model are shown in Fig. 1.

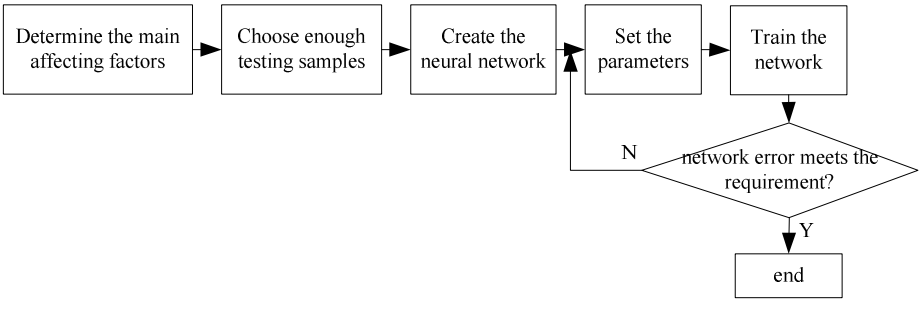


Fig. 1. Establishment process of the neural network

The hyperbolic tangent function is adopted as the activation function of hidden layer of the neural network.

$$f(x) = \tanh(\frac{x}{2}) = \frac{1-\exp(-\frac{x}{2})}{1+\exp(-\frac{x}{2})} \tag{1}$$

Where x is input variable and f is the output function.

The squared error function E_p of the neural network is defined as

$$E_p = \frac{1}{2}\sum_j (Y_j - O_j^M)^2 \tag{2}$$

Where Y_j is the desired output of the neural network, O_j^M is the actual output of the neural network.

The algorithm ends when the error function is smaller than an arbitrary positive number given in advance.

The typical BP neural networks model is shown in Fig. 2.

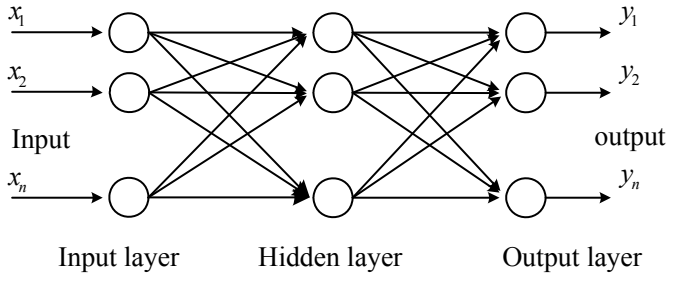


Fig. 2. Typical neural networks model

3 Establishment of the TDR Cable Length Measurement Model

TDR is a very useful measuring technology based on high-speed pulse technology. The cable length measuring principle is very simple. The test voltage pulse is injected into one end of the cable, and the pulse will be reflected at the end of the cable. By measuring the time interval between the injection pulse and the reflection pulse, the cable length can be obtained by assuming the velocity as constant. The formula for length measurement is

$$l = \frac{v \cdot \Delta t}{2} \tag{3}$$

Where, l —cable length.

v —signal propagating velocity.

Δt —time interval between the injection pulse and the reflection pulse

The existing TDR cable length measurement methods assume an estimate constant velocity to calculate the cable length. In fact, the propagation velocity is a complex process which is affected by many factors. It is not only a heavy workload, but also very difficult to ensure accuracy to obtain the velocity model by conventional method. For a measured cable with known type and a certain degree of the cable crimp levels, the ambient temperature and signal frequency are the main affecting factors to velocity. The signal frequency changes reflect in the nonlinear error of the time interval measurement. Therefore, the ambient temperature and the time interval measurement result of the TDR cable length measurement system are two nodes of the input layer of BP neural network. The hidden layer consits 4 nodes. Here is only one node in the output layer, which represents the traveling wave propagation velocity. The length of the cable tested by the TDR cable length measurement model can be represent as

$$l = f(T_{\text{temp}}, t) \tag{4}$$

Where l is the length of the cable under test, f is the nonlinear function, T_{temp} is the ambient temperature, t is the time interval between the time interval between the injection pulse and the reflection pulse.

4 Experimental Results and Analysis

The TDR cable length measurement model based on neural network is applied to the actual measurement data. Several different cable length is measured in different ambient temperature to obtain the training samples for the TDR cable length measurement model. In order to indicate the measuring precision difference between the traditional ratio method and the proposed mathod, several datas of ambient temperature and time interval are used as in table 1.

Table 1. Test datasets of TDR cable length measurement model

No.	Ambient temperature(℃)	Time interval(ns)	Cable length(m)
1	29.4	385.4	37.17
2	21.0	511.9	50.38
3	31.4	662.6	63.59
4	23.6	785.3	76.80
5	35.0	946.4	90.01
6	23.3	1055.0	103.22
7	19.2	1178.7	116.43
8	25.1	1331.4	129.64
9	21.4	1454.1	142.85
10	29.8	1483.9	142.85

For the traditional ratio method, the reference cable length is 37.17m, the reference ambient temperature is 17.8℃. Figure 3 is the measuring error comparison of the cable length measurement model and the traditional ratio method.

It can be seen from the picture that the measuring accuracy of the proposed method is much more higher than the traditional method because of reasons below:

1. In order to obtain the reference velocity, the traditional ratio method for cable length measurement must specify the reference cable length and the ambient temperature. When the cable length is actual measured, the propagation velocity changes with the external ecvironment conditions. Therefore, the traditional ratio method can't resolve the signal frequency differences between the reference cable and the measured cable caused by their cable length difference. Also, the traditional ratio method can't eliminate the velocity change caused by ambient temperature.

2. The TDR cable length measurement model based on neural network proposed in this paper does not require a direct definition of velocity. It can not only compensate the nonlinear error of the system, but also compensate the temperature error.

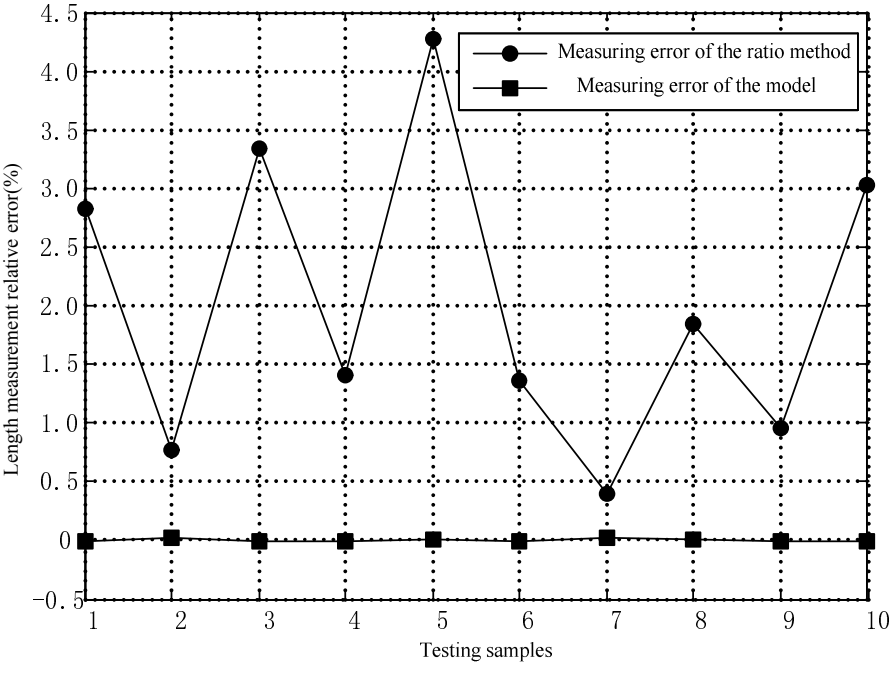


Fig. 3. Measuring error comparison of cable length measurement model and traditional ratio method

5 Conclusions

In order to reduce the impact of velocity on the measuring accuracy of the TDR cable length measurement system, the TDR cable length measurement model based on neural network is established. The model does not require a direct definition of velocity. The model is trained and tested. Experimental results show that the model can reduce the velocity impact on measuring accuracy of the TDR cable length measurement system and improve the measuring accuracy of the system.

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Research on Colorful Trademark Images Retrieval Based on Multi-feature Combination and User Feedback

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Abstract. Current systems of colorful trademark images retrieval mostly rely upon single feature which leads to lower retrieval accuracy. Therefore colorful trademark images retrieval based on multi-feature combination and user feedback is studied in the paper and an experimental retrieval system is built. Color moments and shape-region descriptors can be extracted as features of colorful trademark images. Gaussian normalization is used to normalize and combine different features. Absolute Euclidean distance similarity algorithm is applied to retrieve colorful trademark images initially. In addition, the experimental system adopts user feedback module through which users can estimate initial results, then adjust the weights needed and retrieve again. Experimental results display that the retrieval results obtained by multi-feature combination are much better than the results obtained by single feature, and weights adjusting by user feedback can retrieve better results and achieve higher accuracy.

Keywords: colorful trademark images retrieval; multi-feature combination; user feedback; weighs adjusting.

1 Introduction

Trademark is not only one of the most important identifications of merchandise, but also an indispensable mean to protect legal rights of merchandise. Colorful trademark image retrieval can prevent unscrupulous businessmen or individuals, who want to obtain illegal benefits, from registering by similar or counterfeit trademarks in legal ways, thereby protect benefits of legitimate businessmen. Therefore, research on colorful trademark image retrieval is fairly significant. However, current systems of colorful trademark images retrieval mostly rely on single feature which leads to low accuracy. Single feature only represents partial attribution of an image and it has been proven that colorful trademark image retrieval based on single feature always obtains unsatisfactory results.

Therefore colorful trademark images retrieval based on multi-feature combination and user feedback is studied in the paper and an experimental retrieval system is built. Color moments and shape-region descriptors can be extracted as features of colorful trademark images. Gaussian normalization is used to normalize and combine different features. Absolute Euclidean distance similarity algorithm is applied to retrieve

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 139–145, 2011.
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colorful trademark images initially. The experimental system adopts user feedback module through which users can estimate initial results, then adjust the weights needed and retrieve again. Comparing to single feature retrieval, results obtained by multi-feature combination are much better. Moreover, weights adjusting by user feedback can achieve higher retrieval accuracy and efficiency.

2 Multi-feature Combination Based on Color and Shape-Region

Firstly, RGB color space of colorful trademark image is converted to HSV color space, which complied with human visual perception better. Then low-order color moments of colorful trademark image, which can describe the spatial distribution of color, are extracted. Thirdly, color images are transformed to gray images, from which low-order Hu moments and eccentricity, global shape descriptor, are extracted as shape-region features. Finally, Gaussian normalization is used to normalize and combine different features.

2.1 Color Feature Extraction

Color is the most outstanding features of colorful trademark image due to its natural rotation and scale invariance. Swain and Ballard [1] propose to describe color images with color histogram. However, color histogram can only describe global color distributions of an image and can not reflect spatial distributions of an image. Stricker and Orengo [2] put forward color moments which can effectively describe color spatial distributions. In order to support quick search in large-scale image database, Smith and Chang [3] come up with color set as an alternative of cumulative color histogram. Because color histogram and color moments can not express color spatial location of an image, Pass [4] suggests color coherence vector. To reflect different colors on spatial correlation, color correlogram is then proposed [5].

Color information concentrate on low-order color moments. As a result, the first-order original moment μ_i (i.e., mean), second-order central moment σ_i (i.e., deviation) and third-order central moment s_i (i.e., skewness) of color matrix of image can express color distributions, as shown in (1), (2) and (3), in which h_{ij} represents color gray probability of pixel j in i-channel, n indicates gray-scale levels.

$$\mu_i = \frac{1}{n} \sum_{j=1}^{n} h_{ij} \tag{1}$$

$$\sigma_i = \left(\frac{1}{n} \sum_{j=1}^{n} \left(h_{ij} - \mu_i \right)^2 \right)^{\frac{1}{2}} \tag{2}$$

$$s_i = \left(\frac{1}{n} \sum_{j=1}^{n} \left(h_{ij} - \mu_i \right)^3 \right)^{\frac{1}{3}} \tag{3}$$

2.2 Shape-Region Feature Extraction

Hu moments and eccentricity are extracted from trademark image as shape-region features in the paper. Hu moments, which are consisted of second-order and third-order central geometric moments, are invariant to translation, scaling and rotation. Hu moments of region can be calculated by all pixels in the region of an image. Suppose $f(x, y)$ denotes a trademark image, $^{N}{}_{pq}$ denotes $p+q$ order normalized central moment of $f(x, y)$, then Hu moments can be obtained by normalized central moments T_1 and T_2, as shown in (4) and (5).

$$T_1 = N_{20} + N_{02} \tag{4}$$

$$T_2 = (N_{20} - N_{02})^2 + 4N_{11}^2 \tag{5}$$

Eccentricity is one of the most important ways to describe shape-region. Inertia axis ratio is applied to define eccentricity as shown in (6), which can calculate mass of whole region. This way is hardly affected by noises.

$$E_c = \frac{(N_{20} - N_{02})^2 - 4N_{11}}{(N_{20} + N_{02})^2} \tag{6}$$

2.3 Multi-feature Combination

For the purpose of multi-feature combination, similarity measurement and feature normalization need to be done. Due to less complexity, absolute distance can be used to measure the similarity between two images. Suppose A denotes inquiring trademark image and B denotes original trademark image. After feature extraction of color moments, low-order Hu moments and eccentricity, similarity between A and B can be calculated by absolute distance as shown in (7).

$$d(A,B) = \sum_{i}^{N} |f_d(T_i) - f_W(T_i)| \tag{7}$$

Different features have different meanings, so normalization need to be done within one feature and between features. Gauss normalization is applied to multi-feature combination, and the weight of each feature can be adjusted flexibly [6].

3 User Feedback

User feedback can make user estimate initial retrieval results according to relativity, then adjust the corresponding weights and retrieve again for higher accuracy. Feature standard deviation proposed by Rui and Huang (1998) is applied to combine multi-feature and adjust weights. Let Q denotes inquiring trademark image and I denotes original trademark image. Let $F = \{f_i, i = 1,2,\cdots, I\}$ describe underlying visual feature set of image, and $R = \{r_{ij}, i = 1,2,\cdots, I, j = 1,2,\cdots I\}$ is a specific feature descriptor set. The process of colorful trademark image retrieval can be described in Fig. 1. All the

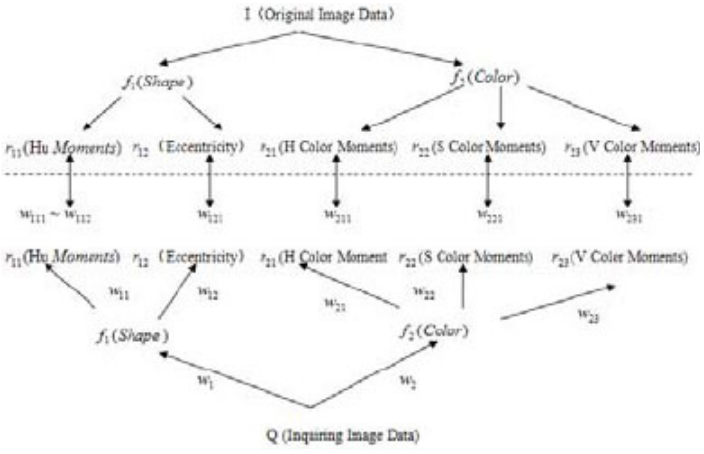


Fig. 1. Process of colorful trademark image retrieval

weights $W = [w_i, w_{ij}, w_{ijk}]$ are initialized when retrieving initially. Every feature is supposed to allot the same weight to retrieve images for the first time. Results obtained by initial retrieval indicate which feature contributes to the retrieval images to a great extent. And then user can judge the retrieval images whether they meet with the needs and adjust the corresponding weights for the second retrieval.

4 Experiments and Results Analysis

An experimental retrieval system is built according to multi-feature combination and user feedback. Color and shape-region features are extracted from colorful trademark images. Gaussian normalization and absolute distance similarity are used to implement multi-feature combination retrieval. Moreover, initial retrieval results can be estimated through user feedback module by adjusting the weights needed and retrieve again. In the paper, 10 colorful trademark images of 24bits, which are translated, scaled and rotated, are used to form original trademark image database including 100 images. After user inputs an inquiring trademark image in experimental retrieval system, color and shape-region features are extracted and matched. Then 15 trademark images can be obtained initially which are ranked according to similarity from small to large. If unsatisfied with initial result, user can estimate and adjust feature weights then retrieve again for higher accuracy.

In first experiment, colorful trademark images retrieval are based on single feature of color (i.e., color moments) or shape-region (i.e., low-order Hu moments and eccentricity). Retrieval results are shown as Fig. 2 and Fig. 3 respectively. It's shown that retrieval based on single feature performs not very well.

In second experiment, colorful trademark images retrieval are based on multi-feature combination of color and shape-region. Retrieval results are shown as Fig. 4.

Retrieval results of Fig. 4 indicate that 10 transforming trademark images and relevant images are well retrieved based on color and shape-region features. Moreover,



Fig. 2. Retrieval results by single feature of color



Fig. 3. Retrieval results by single feature of shape-region



Fig. 4. Retrieval results by multi-feature combination of color and shape-region

they are ranked in the top row of similarity. Compared with the first experiment based on single feature, the retrieval technique of multi-feature combination meets with the feelings of human eyes better, which is the technique based on single feature can not achieve.

In third experiment, colorful trademark images are retrieved based on multi-feature combination and user feedback. Results are shown as Fig. 5 and Fig. 6 respectively.

If unsatisfied with initial results after retrieval by multi-feature combination in Fig. 5, user can estimate initial results and adjust weight of color feature, then retrieve again shown in Fig. 6 for higher accuracy.

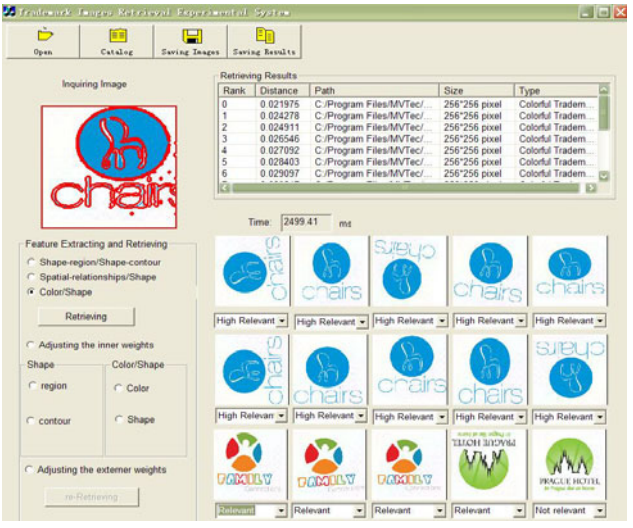


Fig. 5. Initial retrieval results by multi-feature combination of color and shape-region

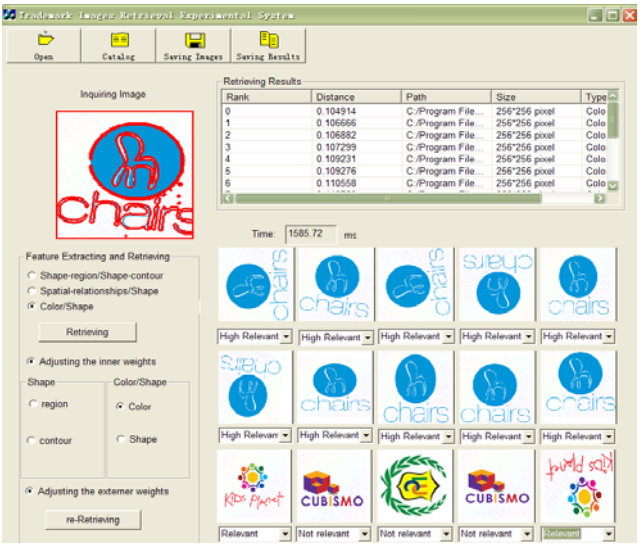


Fig. 6. Final retrieval results by user feedback through weight adjusting of color feature

5 Conclusion

Colorful trademark images retrieval based on multi-feature combination and user feedback is studied in the paper and an experimental retrieval system is built. Color and shape-region features are extracted from colorful trademark images. Gaussian normalization and absolute distance similarity are used to implement multi-feature

combination retrieval. User feedback can be used to estimate initial results and adjust feature weights for higher accuracy.

Experimental results display that the retrieval results obtained by multi-feature combination are much better than the results obtained by single feature, and weights adjusting by user feedback can retrieve better results and achieve higher accuracy.

Acknowledgement

This paper is supported by Scientific Research Common Program of Beijing Municipal Commission of Education (Grant No. KM201010015003) and Funding Project for Academic Human Resources Development in Institutions of Higher Learning under the Jurisdiction of Beijing Municipality (Grant No. PHR201108349).

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Research on a New Key-Frame Extraction Algorithm of Printing Video

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Abstract. The scenes and contents of printing video almost describes the operation, usage and running of printing machines. Based on these features of printing video, this paper introduces some approaches of key-frame extraction. In commonly used traditional algorithms, key-frame extraction algorithms based on average histogram and based on shot boundary are described in detail. Moreover, this paper proposes a novel approach of key-frame extraction based on average frame-difference. The experimental results indicate that the new approach is very effective and efficient for extracting key-frames of printing video.

Keywords: printing video, HSV histogram, key-frame extraction, average histogram, shot boundary, average frame-difference.

1 Introduction

With the rapid development of science and technology, multimedia technology and internet technology are becoming increasingly popular. Our studies and lives depend on multimedia more and more, also in printing industry. In the field of printing, there are lots of videos about printing machine and other videos of providing service information. They provide great convenience for the people who engaged in printing industry. But, at the same time, the vast amounts of video information also bring us many troubles. According to the material of Seybol in 2000, there are 40% duplicate files in company storage, and 30% of them can be reused according to a little modification. And the material also indicates that: a creative staff will search files 75 times, 3 hours are spent on data management and 3 hours are spent on file transmission every people every week.

Facing to the huge video data on the internet, how can we find the video which we need quickly and correctly? Obviously, traditional video retrieval technology based on text can not meet the requirements of people. Then, video retrieval based on content is proposed. It is a video retrieval approach with high efficiency. Key-frame extraction is one of the major technologies in the video retrieval technology. Key-frame is still image with information of the shot that it locates. Key-frame represents shot, which is similar to the role of key-word of text retrieval [1]. This paper is mainly about the key-frame extraction algorithms.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 146–152, 2011.
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2 Introduction of Printing Video Key-Frame

The structure diagram of the printing video is given in Fig. 1.

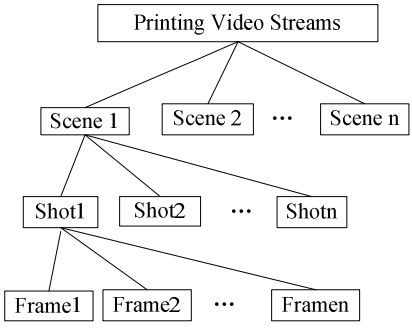


Fig. 1. The structure of diagram of printing video

Video stream is mainly composed by a series of scenes. The scene of video can be divided into some shots [2]. And each shot content is continuous that shot by a camera. So, each shot is composed by lots of frames which are still images actually.

On the base of shot detection, key-frames can be extracted from every shot and represent the location shot. Because every shot is shot in one scene, changes in the adjacent frames are small and almost the same. So, to store all frames of video will waste lots of storage and will take much time to retrieval. The key-frame of a shot can reflect the main information of the shot and represent the shot briefly. Additionally, there is another advantage using key-frames instead of shots in the stored process. Therefore, video retrieval can be transformed into image retrieval [3].

3 Traditionally Key-Frame Extraction Algorithms

The purposes of key-frame extraction contain two parts. One purpose is that key-frame can represent the theme and main content of video. Another purpose is to extract color, texture, shape and other features as data source of video features library [4].

Several traditionally key-frame extraction algorithms are given out in following paper.

3.1 Key-Frame Extraction Algorithm Based on Shot Boundary

Key-frame extraction algorithm based on shot boundary is the easiest method of key-frame extraction. In this method, the first frame and last frame of a shot are thought as key-frames. This method is very easy to operate and be understood, and it is very suitable for shots with almost still content, but it does not consider the complexity of video content. Apart from this, it also has other disadvantages. It limits the number of key-frames. Key-frames can not represent shot well, and its results are instable.

There are many types of video programs, such as news, sports, movies, and so on. Each kind of video has its own special feathers. Taking news for examples, its main contents are composed by a series of news story units. Each story unit is a relatively independent event in content, and anchor shots always exist at the beginning of a story unit [5]. In the field of printing, printing video has its own special feathers, too. Generally, the scenes of printing video are comparatively simple, and video contents are relatively simple, and no complicated explosion scenes of movies. The content of printing video introduces the machine running and operation and other comparatively simple scenes. But, there are some videos that shot by non-professional people, this kind of video always have some interferences, such as uneven illumination and camera with shake and so on which require that the shot detection algorithms used in this kind of videos must have certain tolerance with movement and light.

Because of these characters, it is very important to choose right shot detection method. This type of video is very sensitive to light. Therefore, this paper gives up RGB color model when detect cut shot, but choose HSV color model. In this paper, H component or S component of HSV color model can be used to detect shot of printing video, and V component is given up because it can be affected by light.

HSV color model is a color model for visual perception, the three color components are hue (H), saturation (S) and value (V). Hue refers to the color, saturation is the degree of color, value refers to the human eye can feel the degree of light [6].

Color image is changed from RGB color model to HSV color model. The equation is given by:

$$\mathrm{H} = \begin{cases} \theta & \mathrm{G} \geq \mathrm{B} \\ 2\pi - \theta & \mathrm{G} < \mathrm{B} \end{cases} \tag{1}$$

In the equation,

$$\theta = \cos^{-1}\left[\frac{\frac{1}{2}[(R-G)+(R-B)]}{\sqrt{(R-G)^2+(R-B)(G-B)}}\right] \tag{2}$$

$$V = \frac{1}{\sqrt{3}}[R+G+B], \qquad R,G,B \in [0,1] \tag{3}$$

$$S = 1 - \frac{\sqrt{3}}{V}\min(R,G,B) \tag{4}$$

Then, the hue histogram is calculated.

And then, the adjacent frame-difference $\mathrm{T_i}$ is calculated by the following equation.

$$\mathrm{T_i} = H_n^H(x,y) - H_{n-1}^H(x,y) \tag{5}$$

Finally, determine whether the difference between adjacent frames $\mathrm{T_i}$ whether is bigger than the pre-set threshold T, if $\mathrm{T_i} \geq T$, we can think that cut shot takes place here, otherwise, shot is not change.

The following images are shot boundary frames extracted from a matchbox printing video by the algorithm described above. In these images, Frame 39 and Frame 40, Frame 118 and Frame 119, Frame 170 and Frame 0 belong to two shot, and Frame 0 and Frame 39, Frame 40 and Frame 118, Frame 119 and Frame 170 are beginning frames and ending frames of one shot. Experimental results show that the method is used to detect the printing video shot is very effective.

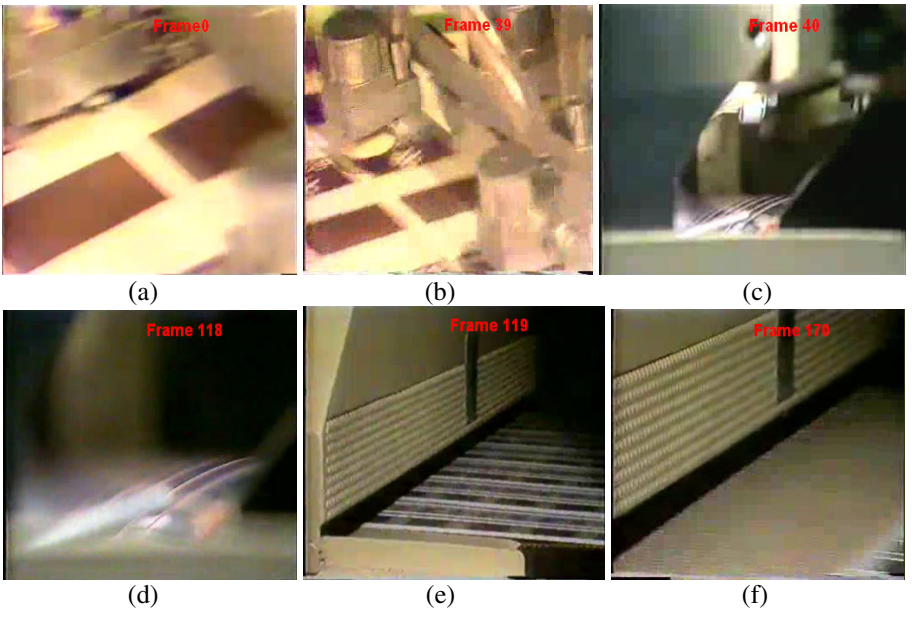


Fig. 2. Key-frames extracted by algorithm based on shot boundary

3.2 Key-Frame Extraction Algorithm Based on Average Histogram

From Fig.2 we can see that, the first frame and the last frame of every shot are extracted as key-frames. But there is no big difference on content, there is much duplicate information. Moreover, from Frame 0 and frame 39 we can know that, they are not very clear at all and not propitious to observation.

The content of printing video is very simple, each shot is very stable, and no big changes occur between the first frame and the last frame. Because of this feature of printing video, and for saving more storage, only one key-frame is needed. Then, key-frame extraction algorithm based on average histogram can achieve this effect. Following gives the process of key-frame extraction algorithm based on average histogram.

On the basis of shot segmentation above, all histograms of every shot are added and the average histogram is obtained. The equation is given by:

$$H_{mean}^{H} = \frac{1}{N}\sum_{i=0}^{N-1} H_{i}^{H} \tag{6}$$

In the equation, H_{mean}^{H} is the average histogram of a shot, N is the frame number of a shot.

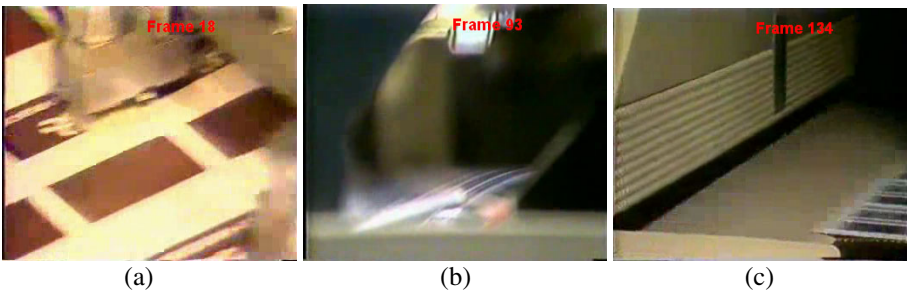
Average hue histogram of an image describes the average distribution of each frame of a shot, which can describe the content of a shot mostly. So, it is suitable to choose a histogram which is nearest to the average histogram and choose the frame corresponding to the nearest histogram as key-frame. The equation is given by:

$$H = | H_{mean}^{H} - H_{i}^{H} | \tag{7}$$

We can get a sequence $\{H_0, H_1, H_2, H_3, \cdots, H_N\}$ whose length is N given by equation above, then the smallest value in the sequence can be extracted by $\min\{H_0, H_1, H_2, H_3, \cdots, H_N\}$.

The video of printing matchbox is used for experiment again using the algorithm of based on average histogram to extract key-frames, the results are given as follows:

The following three images are key-frames obtained by key-frame extraction algorithm based on average histogram on the basis of shot segmentation. The three key-frames belong to three shots. Contracting to the six key-frames obtained by key-frame extraction algorithm based on shot boundary, the three key-frames save half of the storage, and can not cause vision redundancy. At the same time, it also saves the retrieval time.



(a) (b) (c)

Fig. 3. Key-frames extracted by the algorithm based on average histogram

3.3 Other Algorithms of Key-Frame Extraction

Apart from the two classic key-frame extraction algorithms above, there are also some commonly used algorithms, such as key-frame extraction algorithm based on sampling, key-frame extraction algorithm based on clustering, and so on.

Key-frame extraction algorithm based on sampling: the key of this method is setting a time interval T. A frame is extracted at every time interval as key-frame. This method not only causes much redundancy, but also may miss some real key-frames.

Key-frame extraction algorithm based on clustering: firstly, an initial class center should be determined. Then, whether the current frame belongs to the class or not is determined by the distance between class center and current frame, if it does not

belong to the class because of a long distance, it should be a new class center. Frames of shot are classified by this method. Every class center is a key-frame [7].

4 Key-Frame Extraction Algorithm Based on Average Frame-Difference

Frame-difference reflects the changes between adjacent frames based on hue histogram. Average frame-difference of a shot reflects the average changes of shot content. We can get average frame-difference by:

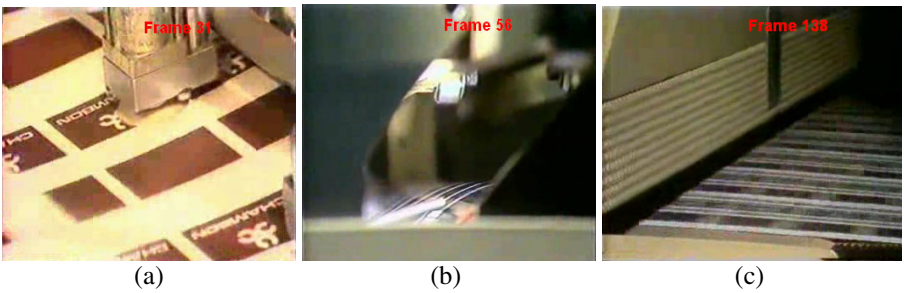
$$T_{mean} = \frac{1}{N-1}\sum_{i=0}^{N-2} T_i \tag{8}$$

Then,

$$t = | T_i - T_{mean} | \tag{9}$$

Then, a sequence $\{t_0, t_1, t_2, t_3, \cdots, t_{N-2}\}$ whose length is N-1 is obtained. It describes stability of the shot. Then, according to $\min\{t_0, t_1, t_2, t_3, \cdots, t_{N-2}\}$, we can get the most stable frame-difference.

The following three images are key-frames extracted by key-frame extraction algorithm based on average frame-difference on the basis of shot segmentation. From the images we can know that, it is very well to extract key-frames by this method. The three images belong to three shots. Compared with the results of key-frames extracted by algorithm based on shot boundary, it not only can save storage, bur also can save retrieval time and does not cause visual redundancy. Compared with the results of key-frames extracted by algorithm based on average histogram, the key-frames are clearer and more accurate.



(a) (b) (c)

Fig. 4. Key-frames extracted by algorithm based on frame-difference average

5 Conclusion

This paper is mainly about algorithms of key-frame extraction of printing video. In commonly used traditionally key-frame extraction algorithm, key-frame extraction

algorithms based on shot boundary and based on average histogram are described in detail. And, on this basis, this paper proposes a new approach which is key-frame extraction algorithm based on average frame-difference. This approach not only can save storage and retrieval time, but also can describe the content of shot better. Through the experimental comparison we know that, this approach is very effective to extract key-frames of printing video.

Acknowledgements. This paper is supported by Scientific Research Common Program of Beijing Municipal Commission of Education (Grant No. KM201010015003) and Funding Project for Academic Human Resources Development in Institutions of Higher Learning Under the Jurisdiction of Beijing Municipality (Grant No. PHR201108349).

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An Improved Sanitizing Mechanism Based on Heuristic Constraining Method

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Abstract. An injection flaw is the result of an invalidated input. Some input validation programs are poorly written, lacking even the most basic security procedures for constraining input. Enforcing proper input validation is an effective countermeasure to use as a defense against injection attacks. However it may induce some detection errors because of improper sanitizing rules. In this paper, we propose a heuristic mechanism that can automatically generate proper validation rules based on each vulnerable injection point. The method can also both guarantee security (false negatives) and convenience (false positives). The experimental results show that our method has better detection accuracy while compared with other constraining strategies.

Keywords: Injection point, Security model, Input validation.

1 Introduction

Injection attack is dangerous and ubiquitous, contributing enormously to some of the most elaborate Web hacks. It takes advantage of a weakness in the Web application design to insert intentionally some extra characters in input data, causing the inline application to bypass or modify the originally intended functionality of the program. Many application's security vulnerabilities result from generic injection problems. Examples of such vulnerabilities are SQL injection, Shell injection and Cross site scripting (XSS). Enforcing input validation is an effective countermeasure to protect from injection attacks but traditional sanitizing methods usually use single validation rules to sanitize all input. Thus it is susceptible to error (either false positive or false negative).

There are numbers of the researches related to protect Web site against malicious attack: Huang et al. had developed a WebSSARI and a WAVES [1-2]. The Open Web Application Security Project (OWASP) had launched a WebScarab project [3]. The other available commercial scanners also include SPI Dynamics' WebInspect and IBM Rational's AppScan [4-5]. Above-mentioned tools just focus on finding Web application flaws. On the other hand, Sanctum Inc. provides a AppShield adopting Security Gateway to prevent application-level attacks [6], and some advanced firewalls now also incorporate deep packet inspection technologies for filtering application-level traffic [7]. We continued to find automated method to protect against or fix vulnerabilities of the applications all the time. For example, we had proposed a

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 153–159, 2011.
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fixing tool that can be used to revise injection vulnerabilities [8]. It can produce proper input validation functions related to the source codes of applications. Next an enhanced prototype adopting a security gateway in front of web server to filter malicious input data had been proposed solving the problem as source code may not be modified [9]. The above tow methods both use only single rule to constrain all input, so errors (false positive or false negative) will be troublesome. Afterward a primary proposal adopting adjustable validation function had been proposed and proved that it can reduce false [10].

Nowadays, Web application firewalls (WAF) is a popular solution to used to create an external security layer to improve security, detection, and prevention of attacks before they hit web applications [11-12]. For WAF, the sanitizing mechanism is a critical technique. However traditional sanitizing methods using single validation rules to sanitize all input are susceptible to error. In this paper, we propose an innovative method that can generate a proper blacklist for each vulnerable injection point. The method not only guarantees same amount of false negative but also reduces more amount of false positive while constraining inputs. The rest of this article is organized as follows: The second section surveys a number of works relevant to injection vulnerability and discusses related researches having been proposed. In third section, we describe our technical details of constraining malicious injection. The system implementation and its effectiveness are evaluated in fifth section. The last section concludes the whole article.

2 Input Validation

Input validation is a secure input handling way for verifying user input to ensure that input is safe prior to use. In general, it checks the user input based on two security model: positive (whitelist) and negative (blacklist) model.

2.1 Positive Model

Validation based on positive model can ensure that all requests are denied unless specifically allowed. The allowed items are usually represented by a list of some accepted items. This list may involve setting character sets, type, length, format, and range.

The benefit of using a positive model is that new attacks, not anticipated by the developer, will be prevented. A generic solution may not be easily implemented but we can know that is acceptable input data for application program in a localized way. It is much easier to validate data for known valid patterns but it may induce more false positives.

2.1 Negative Model

On the other hand, a negative security model defines what is disallowed, while implicitly allowing everything else. When performing input validation, the negative model dictates that you should specify the characteristics of input that will be denied. However, the negative model can be quite tempting when you're trying to prevent an

attack on your site. Ultimately, however, adopting the negative model means that you'll never be quite sure that you've addressed everything. In general case, a configurable set of malicious characters is used to reject the input but it is an unrealistic idea assuming that all the variations of malicious injection had been known.

While useful for applications that are already deployed and when you cannot afford to make significant changes, the "deny" approach is not as robust as the "allow" approach because bad data, such as patterns that can be used to identify common attacks, do not remain constant. Valid data remains constant while the range of bad data may change over time. A negative security model allows more abundant input data than a positive security model. That is to say, a negative security model often can support more elastic input data than a positive model but it may induce more false negatives.

3 Sanitizing Mechanism

3.1 The Heuristic Constraining Method

A negative security model allows more abundant input data than a positive model so validation based on negative security model can cause fewer false positives than positive model. Although a negative model often can support more elastic input data than a positive model, it may induce more false negatives. Thus a validation based on negative model should prefer assuring of acceptable false negative, and do everything possible to reduce false positive. A generic whitelist usually allows case-sensitive alphanumeric characters so we have to validate all characters other than these characters to maintain same false positive if we adopt negative model. Therefore traditional negative model always do its best to put all possible malicious characters in a blacklist. The method can guarantee false negative, whereas it may cause more false positives. A better method is only put necessary characters in a blacklist for generating an optimal rule, but it needs an intelligent selector to assist in choosing necessary characters.

We have inspected some strings for injection attack and find that most special (not case-sensitive alphanumeric) characters in the strings don't appear alone. The clue inspires us to propose a new algorithm to generate a proper constraining rule. The algorithm can generate an exact blacklist only including really necessary constraining characters and is shown in table 1. Validation based on this blacklist can cause fewest errors. A special character really required to be added in the blacklist should be in accordance with following features. (1) The character appears in injection string alone. (2) For all special characters in the injection string, the character is used most times in all injection strings in comparison with other special characters.

For the special characters used in the same injection string, just only one of them is required to be added in a blacklist. Thus the character having highest usage rate is preferable. Traditional negative model usually add all suspiciously malicious characters in a blacklist to guarantee false negative, whereas it may cause more false positives. In comparison with traditional method, our scheme can't only guarantee same false negative but also reduce more false positives through an optimal blacklist.

Table 1. The algorithm of generating a heuristic constraining rule

```
FOR EACH injectionString i
  Let candidateString i = all special characters (not case-sensitive alphanumeric) in injection
string
  Remove same characters from candidateString i
  Sum up the amount of special character in candidatString i
Count the amount of each special character appearing in all candidate_strings and STORE
to appearRate(j)
END FOR
FOR EACH candidateString
      SORT the characters in the candidateString by appearRate into descending order
       IF (the first character in the candidateString can't be found in blackList)
            ADD the character to blackList
       END IF
  END FOR
```

3.2 Meta-programs

Here the Input Validation Testing (IVT) is defined as choosing proper test case that attempt to show the presence or absence of specific errors pertaining to input data [10]. A Web application vulnerability scanner is a common tool for IVT. After completing IVT, the flaws of each injection point should be stored in an injection point list. Our sanitizing mechanism can constrain malicious input via meta-programs. The meta-programs can be translated by a code generator. Each parameter of the same URL in the list can generate a meta-program to effectively constrain inputs. For example, if there are some records having the content of a URL field as 'verify.php' in the vulnerability list, our mechanism can automatically generate a meta-program named 'verify.php'. Tne algorithm of generating a meta-program is shown in Table 2. It needs to be noted that the italic words should be replaced by the parameter field and the constraining rule field in the vulnerable injection point table.

Table 2. The algorithm of generating a meta-program

```
  // A algorithm for generating a meta-program
  OPEN an injection point list
  FOR EACH distinct url in a injection point list
     FOR EACH parameter having same url
// To generate a validation segment for each parameter
          STORE parameter value
          GET its sanitizing rule
          If (preg_match(sanitizing rule, parameter value)
          ECHO error message
          EXIT // a validation logic end
     END FOR
     SESSION all parameter value
     REDIRECT to original Web server's url
// To generate a meta-program named url
 FILEWRITER above code and is named url
  END FOR
```

4 System Implementation and Experimental Evaluation

To verify the effectiveness of our scheme, we implement a constraining device named sanitizer and present its architecture diagram in Figure 1. The sanitizer is allocated in front of the protected Web servers. All HTTP\HTTPS requests to the protected Web servers are routed through the sanitizer that can either deal with the request itself or pass the request partially to Web servers. After passing all check, the requests are forwarded to the Web server. The sanitizer deals with both the requests coming from client and the response pages coming from the Web server and then forward to server\clients. If the surfing destination may have flaws, the request will be directly processed by a meta-program designed to sanitize input. Furthermore, a meta-program only has sanitizing functionality so it can not replace original program. Thus after completing constraining work, it needs to be redirected to original program for completing prime service. All navigational information will be kept in the Web access log. The injection pattern generator can analyze the log and generate various injection patterns. These patterns can be categorized according to attack types and kept in the testing pattern table. Thus, the heuristic constraining rule generator can organize new constraining rule to protect against new injetion attack.

Next, all primary tests had been performed on an experimental Web site including some client-side Web pages and vulnerable Web applications. To emphasize the importance of individual constraining rules, some injection points have been designated as special cases having only one specific flaw. For example, after vulnerability assessment, we discover that the third injection point only has XSS injection vulnerability and the fourth injection point has SQL vulnerability. This is then considered as a false positive if some pattern designed to locate SQL injection is filtered on the third injection point.

The tests relevant to verifying the effectiveness of the sanitizer are divided into two phases. In the first phase, the IVT begins to directly inspect the web server for vulnerability assessment to create a vulnerable injection point table. In the second phase, the sanitizer is allocated in front of the web server. In this phase, the meta-program in the sanitizer will adopt different validation rules to verify detection accuracy of various sanitizing model. All parts of the testing results are shown as follows.

A false positive occurs when the normal input data is mistakenly blocked by a constraining rule, while a false negative occurs when the rule cannot constrain the

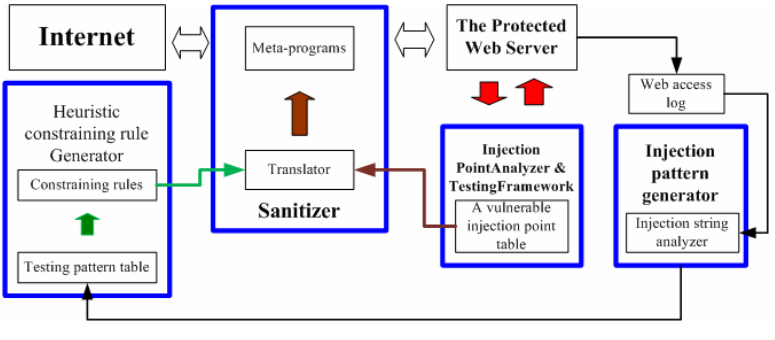


Fig. 1. The architecture diagram of our sanitizing mechanism

Table 3. Error induced by a generic whitelist

Injection point #	Constraining rule	False positive	False negative
1, 2	/[^a-zA-Z0-9\s]/{1,20}	9	0
3		19	0
4		19	0

Table 4. Error induced by a generic blacklist

Injection point #	Constraining rule	False positive	False negative
1, 2	/[=$\-@;\:<>'\"&%\#]/	5	0
3		15	0
4		15	0

Table 5. Error induced by the heuristci sanitizing mechanism

Injection point #	Constraining rule	False positive	False negative
1, 2	/[%';=<]/	2	0
3	/[%<]/	1	0
4	/[';-]/	2	0

malicious injection. From a security defense viewpoint, the least false negative should have a higher priority than the false positive and it follows that, in general, the false negative is zero. Table 3 shows the errors induced by a whitelist that handles the adoption of a generic validation rule which applies to a common situation; Table 4 reports the errors relative to generic blacklist handling; and Table 5 shows the errors induced by heuristic sanitizing mechanism. The experimental results prove that our scheme only render fewest errors in comparison with other strategies. In particular, the effectiveness of reducing errors is most obvious while the injection point, such as the third and fourth point, only has a specific vulnerability.

5 Conclusions

In the rush to bring new software products to market, few companies test their products from a security perspective, yet users rely on these products every day. Many Web applications have injection vulnerability so given even a tiny hole in a Web-application code can break into most commercial websites. Unless a web application has a strong, centralized mechanism for validating all input from HTTP requests (and any other sources), vulnerabilities based on malicious input are very likely to exist. In this paper, we come up with a prototype to sanitize malicious injection. The sanitizer encompasses a meta-program to perform input validations instead of the protected Web site. It can be allocated in front of the protected Web server to mitigate malicious injection. Generating proper constraining rule for each injection point is a critical work for the sanitizer. Here we propose an algorithm to assist in choosing the most necessary constraining characters and validate input based on negative security

model. According to the experimental results, our constraining method has been proved to render fewest false positives while false negative is zero. Thus the method can both guarantee security (false negatives) and convenience (false positives).

Acknowledgement

This work was supported by the National Science Council of Taiwan under grants NSC 99-2221-E-412-003.

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Time Interval Analysis on Price Prediction in Stock Market Based on General Regression Neural Networks

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Abstract. This paper studied the price prediction in sock market based on general regression neural networks (GRNN), and paid more attention to analyzing the time interval effect on the prediction model. Simulations and comparisons were made on actual data and pointed out the relationship between the time interval and the prediction error is not monotonic rise or monotonic decline. Finally, some guidelines for further development were outlined.

Keywords: time interval, prediction, stock market, GRNN.

1 Introduction

The stock market is originally with high-yield and high-risk features. Stock market analysis and forecast research have already been studied for years and put forward some classic models, such as ARCH model [1], SV model [2], et al. But the stock market is with highly nonlinear characteristics, many stock analysis methods and application effects are as difficult as intention. Recently, with the rapid development of computer technology and artificial intelligence technology some new techniques and methods are proposed for the stock market modeling and predicting [3].

Neural network, for its widespread adaptability and learning ability, have been extensively applied in nonlinear system prediction, and also by some scholars applied to predict shares in stock market [4][5]. The most famous neural network learning algorithm is BP algorithm [6], as is widely used to train a feed-forward neural network. But in the actual application BP algorithm has two main problems:

(1) Slow convergence speed
(2) Target function has local minimum points

General regression neural networks (GRNN) is an effective feed-forward neural network [7][8]. Since the output layer of GRNN is the linear weighting combination of the middle layer, GRNN can avoid the problems of neural network. Furthermore, GRNN has high speed and extrapolating ability, and has the strong nonlinear mapping capability. GRNN realizes the nonlinear data conversion from the input space R^N to the output space R^M by linear combination of nonlinear base functions (RBF). While stock data is a class of time series with strong nonlinear characters, to carry on the

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 160–166, 2011.
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forecast for them, namely base on the past N data to predict the future M data, is essentially to find out the nonlinear relationship from the input space R^N to the output space R^M. Therefore, it can be said that the GRNN model is particularly suitable for nonlinear time series, such as stock market forecast system.

This paper studies the price prediction model based on GRNN, and pays more attention to analyzing the time interval effect on the prediction model. In section 2 the temporal characteristics of stock data are summarized, and the algorithm of price prediction based on GRNN model and time interval is proposed in section 3. In section 4 the efficiency of the algorithm is verified by actual data and comparisons on different time intervals are made to analyze their influence on the forecast results. Finally, some guidelines for further development are outlined in section 5.

2 Data in Stock Market

The data in stock market are closely linked with the time variable, so they can be regard as time series. Let the set $\boldsymbol{X}=\{x_i \mid x_i \in \boldsymbol{R}, i=1, 2, \cdots, L, \cdots\}$represent a stock data, the prediction problem of stock market can be described as using the past data x_1 , x_2 ,$\cdots$, x_N to predict the future data x_{N+1} , x_{N+2} ,$\cdots$, x_{N+M}. The commonly used data processing method of time series analysis is regarding the past N data as sliding windows, and mapping them for M values. These M values represent the M predictive values of the moment after this window. Table 1 lists a kind of method to partition time series data. It divides the data $\boldsymbol{X}$ into K overlapped segments, whose length is $N + M$. Each segment can be regarded as a sample, so that we can get $K = L - (N + M) + 1$ samples. The former N values of each sample are defined as input for GRNN, the rest M values as a target output. Through the GRNN learning, the mapping from the input space R^N to the output space R^M is realized, and the purpose of time series prediction is also achieved.

Table 1. Partition methods of time series data

N Input data	M Output data
x_1 , x_2 ,$\cdots$, x_N	x_{N+1} , x_{N+2} ,$\cdots$, x_{N+M}
x_2 , x_3 ,$\cdots$, x_{N+1}	x_{N+2} , x_{N+3} ,$\cdots$, x_{N+M+1}
$\cdots$	$\cdots$
x_K , x_{K+1} ,$\cdots$, x_{N+K-1}	x_{N+K} , x_{N+K+1} ,$\cdots$, $x_{N+K+M-1}$

So before the GRNN model training there are three variables (L, M, *and* N) needed to be determined from the stock data. For given data $\boldsymbol{X}$, the value of L is usually known. But the values of M and N are not fixed. According to the different values of M and N, there will be a big difference among different learning models. Experience shows that for time series forecasting accuracy is generally reduced with the increase of the prediction days. Since stock data is a class of time series with strong nonlinear characters, we set M =1, which means only the next day is predicted, to guarantee the accuracy of prediction with maximum. The number of the previous days (i.e. N) is the

most difficult variable to be determined. For short-term investors, medium-term investors and long-term investors the numbers of N are different and for different types of stock the numbers of N are also different.

Suppose the data $x_{t-p}, \cdots, x_{t-1}$ are known, the data x_t is to be predict and its prediction is y_t. When time interval $p = N_1$, $p = N_2$, $p = N_3$, $p = N_4$, $p = N_5$, we will get 5 different predictions y_t^1, y_t^2, y_t^3, y_t^4, y_t^5.

$$\begin{aligned} p = N_1, &\quad f_1(x_{t-N1}, \cdots, x_{t-1}) \rightarrow y_t^1 \\ p = N_2, &\quad f_1(x_{t-N2}, \cdots, x_{t-1}) \rightarrow y_t^2 \\ p = N_3, &\quad f_1(x_{t-N3}, \cdots, x_{t-1}) \rightarrow y_t^3 \\ p = N_4, &\quad f_1(x_{t-N4}, \cdots, x_{t-1}) \rightarrow y_t^4 \\ p = N_5, &\quad f_1(x_{t-N5}, \cdots, x_{t-1}) \rightarrow y_t^5 \end{aligned}$$

How to determine the optimal prediction model from these predictions is the key discussed in this paper, namely finding the rules to determine the value of time interval p based on the RMSE of predicted value and real value:

$$\text{RMSE of prediction } i\text{: } \sigma^i = \sqrt{\frac{1}{L-N_i} \sum_{t=N_i+1}^{L} \left(y_t^i - x_t\right)^2} \tag{1}$$

3 GRNN Model and Its Learning Algorithm

3.1 Architecture of GRNN Model

GRNN model is proposed by Donald F. Specht in 1990 to formulate the weighted-neighbor method in the form of a neural network, and it typically has four layers: an input layer, a pattern layer with a nonlinear RBF activation function, a summation layer and a linear output layer (Fig. 1).

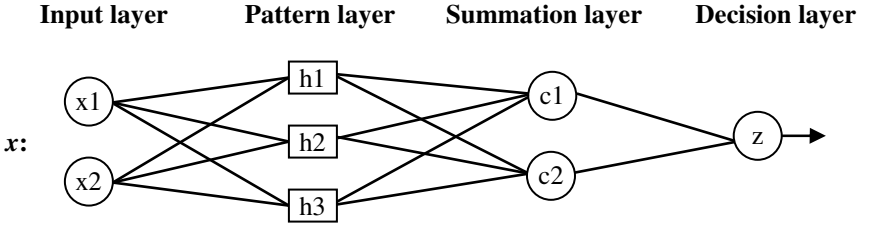


Fig. 1. Architecture of General regression neural networks

- **Input layer** — there is one neuron in the input layer for each predictor variable. In the case of categorical variables, N-1 neurons are used where N is the number of categories. The input neurons (or processing before the input layer) standardize the range of the values by subtracting the median and dividing by the inter-quartile range. The input neurons then feed the values to each of the neurons in the pattern layer.

- **Pattern layer** — this layer has one neuron for each case in the training data set. The neuron stores the values of the predictor variables for the case along with the target value. When presented with the x vector of input values from the input layer, a hidden neuron computes the Euclidean distance of the test case from the neuron's center point and then applies the RBF kernel function using the sigma value(s). The resulting value is passed to the neurons in the summation layer.
- **Summation layer** — there are only two neurons in the pattern layer. One neuron is the denominator summation unit the other is the numerator summation unit. The denominator summation unit adds up the weight values coming from each of the hidden neurons. The numerator summation unit adds up the weight values multiplied by the actual target value for each hidden neuron.
- **Decision layer** — the decision layer divides the value accumulated in the numerator summation unit by the value in the denominator summation unit and uses the result as the predicted target value.

The output, $F: R^n \to R$, of the network is thus

$$F(x) = \sum_{i=0}^{N} w_i \varphi(\| x - c_i \|) \tag{2}$$

where N is the number of neurons in the hidden layer, c_i is the center vector for neuron i, and w_i are the weights of the linear output neuron. In the basic form all inputs are connected to each hidden neuron. The norm is typically taken to be the Euclidean distance and the basis function is taken to be Gaussian

$$\varphi\left(\left\|x - c_i\right\|\right) = \exp\left[-\beta \left\|x - c_i\right\|^2\right] \tag{3}$$

The Gaussian basis functions are local in the sense that

$$\lim_{\|x\| \to \infty} \varphi(\left\|x - c_i\right\|) = 0, \tag{4}$$

i.e. changing parameters of one neuron has only a small effect for input values that are far away from the center of that neuron. The weights w_i, c_i and β are determined by the following algorithm that optimizes the fit between φ and the data.

3.2 Algorithm of GRNN Model

GRNN model is trained by a mixed learning algorithm; the clustering center c_i of hidden layer is learned by C-mean algorithm, and the correction on the connection weights w_i of output layer is learned by mature BP algorithm. C-mean algorithm is described in Fig.2.

Because GRNN use Gaussian function as the base function in hidden layer, and Gaussian function is a negative nonlinear function with symmetry attenuation of center radial by local distribution, GRNN generate response to the input signal in local area. Namely when the input signal is near the central area of base function, hidden nodes will produce larger output. So GRNN has local approximation ability, and this

(1) Initialize the clustering center $c_i(0)$ (i = 1, 2, …, m) and learning rate $\beta(0)$ ($0 < \beta(0) < 1$). In most cases they are generated randomly

(2) Calculate the Euclidean distance of the step k and choose the point of minimum.

$$d_i(k) = \| x(k) - c_i(k\text{-}1) \|, i=1, 2, \ldots, m$$
$$d_{\min}(k) = \min d_i(k) = d_r(k)$$

(3) Correct network center

$$c_i(k) = c_i(k - 1), 1 \le i \le m, i \ne r$$
$$c_r(k) = c_r(k - 1) + \beta(k) [x(k) - c_r(k - 1)]$$

(4) Recalculate the Euclidean distance of point r

$$d_r(k) = \| x(k) - c_r(k\text{-}1) \|$$

(5) Correct learning rate

$$\beta(k) = 0.9 (1 - k / 1000)$$

Fig. 2. *C*-mean algorithm in General regression neural networks

is also the reason why GRNN is learning faster. Furthermore, GRNN needs few parameters with artificial regulation, except β. The learning of GRNN model all depends on the data samples. This characteristic makes the network maximally avoid the influence of subjective assumption on forecast results.

4 Simulations

The stock with code 600519 is randomly chosen as the original sample data, and data acquisition range is the closing price from 20100409 to 20101220, total 168 data. Simulations are performed in Matlab, and the key network creating code is:

```
net = newgrnn(P,T,spread);
```

"P" is the input vector of training samples; "T" is the output vector of training samples; "spread" is the expansion rate of RBF function, associated with β. The larger the spread is, the smoother the function approximation will be. To fit data very closely, use a spread smaller than the typical distance between input vectors. To fit the data more smoothly, use a larger spread. In the simulation "spread" is set from 0.1 to 1 with the change of time interval p.

To meet the data requirements of network training, the training data is normalized according to formula (5), and the output of network is limited within [0, 1].

$$x = \left(x - x_{\min}\right) / \left(x_{\max} - x_{\min}\right) \tag{5}$$

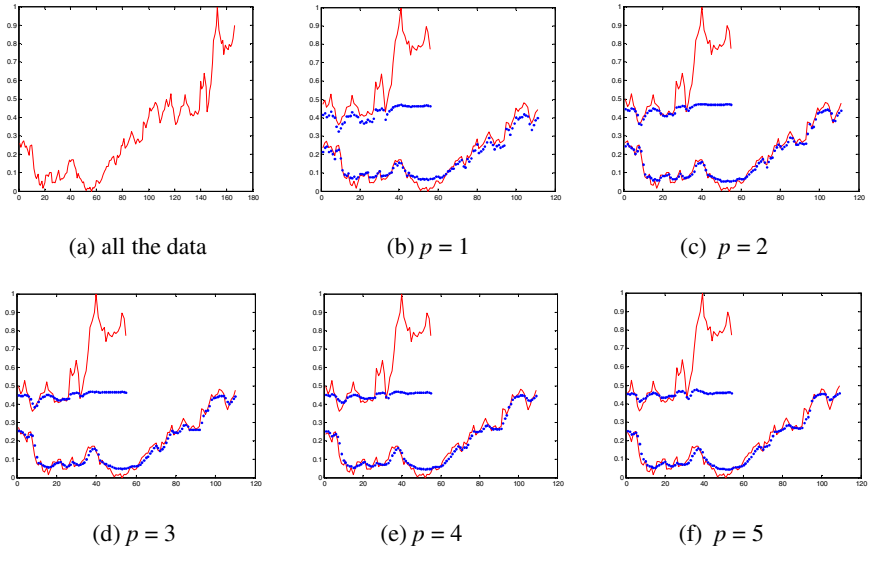
Then time interval p changes from 1 to 5 to form different GRNN models, and Table 2 lists their simulation results based on different time interval p and spreads.

Remark 1. RMSE of training data are much lower than that of testing data. Since the selected stock data (code 600519) has highly nonlinear characteristics (shown in Fig.3 (a)), test result is not very good, although the training effect is still good.

Remark 2. If p is fixed, the larger that spread is, the larger the RMSE is. This happen both in training data and testing data and it verifies the rule of GRNN: the smaller that spread is, the more accurate the function approximation will be. But too small a spread means many neurons will be required to fit a smooth function, and the network may not generalize well. Too large a spread means the data will fit more smoothly, but the RMSE is bigger.

Table 2. RMSE based on different time interval p and spreads

p / spread	1		2		3		4		5	
	train	test	train	test	train	test	train	test	train	test
0.1	0.030	0.224	0.022	0.220	0.024	0.222	0.025	0.224	0.026	0.226
0.2	0.075	0.277	0.052	0.242	0.042	0.234	0.039	0.233	0.037	0.232
0.3	0.102	0.343	0.081	0.284	0.068	0.261	0.060	0.251	0.055	0.244
0.4	0.114	0.387	0.100	0.332	0.089	0.300	0.081	0.281	0.074	0.265
0.5	0.120	0.410	0.111	0.369	0.103	0.338	0.096	0.316	0.091	0.295
0.6	0.124	0.423	0.118	0.394	0.112	0.368	0.106	0.348	0.102	0.326
0.7	0.126	0.431	0.122	0.409	0.117	0.3900	0.113	0.372	0.111	0.353
0.8	0.127	0.436	0.125	0.420	0.121	0.405	0.118	0.391	0.117	0.375
0.9	0.128	0.440	0.127	0.427	0.124	0.415	0.122	0.404	0.121	0.391
1	0.129	0.442	0.129	0.432	0.126	0.423	0.124	0.414	0.124	0.403



(a) all the data (b) $p = 1$ (c) $p = 2$

(d) $p = 3$ (e) $p = 4$ (f) $p = 5$

Fig. 3. Simulation results of stock data. (a) draws all the data. In (b) ~ (f), 2/3 of the data are selected as training data and their simulation results are the lower lines, the rest data are selected as testing data and their simulation results are the upper lines. The red lines are real values, and the blue lines are predictions. The spread are all set to 0.1.

Remark 3. If spread is fixed, though in most cases the larger that p is, the smaller the RMSE is, there exist exceptions, such as spread=0.1. This means the relationship between the time interval p and the RMSE is not monotonic rise or monotonic decline. Because of the highly nonlinear characteristics of stock market and its time series data, the value of time interval should be analyzed particularly based on particular cases.

5 Conclusion

The price prediction in stock market is a highly nonlinear regression challenge. This paper explores the problem based on general regression neural networks (GRNN), and pays more attention to analyzing the time interval effect on the prediction model. Simulations and comparisons on actual data show that the parameters of GRNN are easily set while the value of time interval should be analyzed particularly based on particular cases, because its relationship with the RMSE is not monotonic rise or monotonic decline. So the future work will focus on the statistic characters of time interval effect on different stocks preferred by short-term investors, medium-term investors and long-term investors. The influence of politics, economics and other object factors on time interval will also be considered.

Acknowledgement

This work is supported in part by the National Natural Science Foundation of China (No. 60903089), the China Postdoctoral Science Foundation (No. 20080440820), and the Natural Science Foundation of Hebei Province (No. F200900231).

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The System Dynamics Analysis on the Evolvement of Mechanism of Convention and Exhibition Industry

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Abstract. The purpose of this paper is to defines the factors and the way which influence the evolvement of convention and exhibition industry cluster (CEIC for short). From the perspective of system dynamics, the author designed the system flow chart and SD Model to show how the different factors exert positive/negative influencing on the CEIC. The author used Vensim to stimulate the SD Model and to verify its validity and application value. The research shows the evolvement of CEIC is the result of combined strength which comes from both the external and the internal system, the supply factors of the internal system and the market demand from the external system are key strengths for the evolvement of CEIC system. The model had a high fitting precision and a good predicting ability .The research can be used practically and theoretically for the development of convention and exhibition industry (C&E industry for short).

Keywords: industry cluster, convention and exhibition industry cluster, system dynamics, evolvement mechanism.

1 Introduction

The method of system dynamics (SD) was established by Professor Jay W. Forrester of MIT in the 1950s. Being an economic mathematics method, it is very effective way to analyze the feedback behavior of complex systems. Based on the inner structure and general function of system, the main focus of SD method is on the dynamic change and causal influence on the system[1].

2 SD Theory and the Systematical Analysis of Convention and Exhibition Industry Cluster

2.1 The Principles and Application of SD

Being different from the traditional method which views the research objects as separated parts, SD analysis emphasis the interaction of system components. Roberts (1978) proposed two basic rules for SD. Firstly, organization behavior originates from organization structure (here structure not only means the physical structure related to

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 167–172, 2011.
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manufacturing process, but also refers to policy and conventions which actually influence the decision making of the organization). Secondly, while analyzing organization, the analysis should take the various potential elements or "flows" into account, such as personnel, capital, material goods, equipment, information and so on. Instead of being restricted within the boundary of organization departments, we can find out the nonlinear causal relationship among variables by flow path[2].

The CEIC is an open system, which exchange substance, technology and information incessantly with external system, such as manufacturing industry, relevant supportive service industry, government etc. According to the core concepts of SD, the agglomeration effect of the CEIC relies on the circulation of system elements, namely the circulation of 'flows' of the system form the feedback paths, connecting the key variables and other variables, and thus the structure of the system is shown.

2.2 The Composition of CEIC

The CEIC cluster refers to the C&E industry and other supportive service industry and agencies agglomerate in one region to provide the related service.The author summarized the 7 compositions and the whole structure of CEIC (as shown in Fig.1).

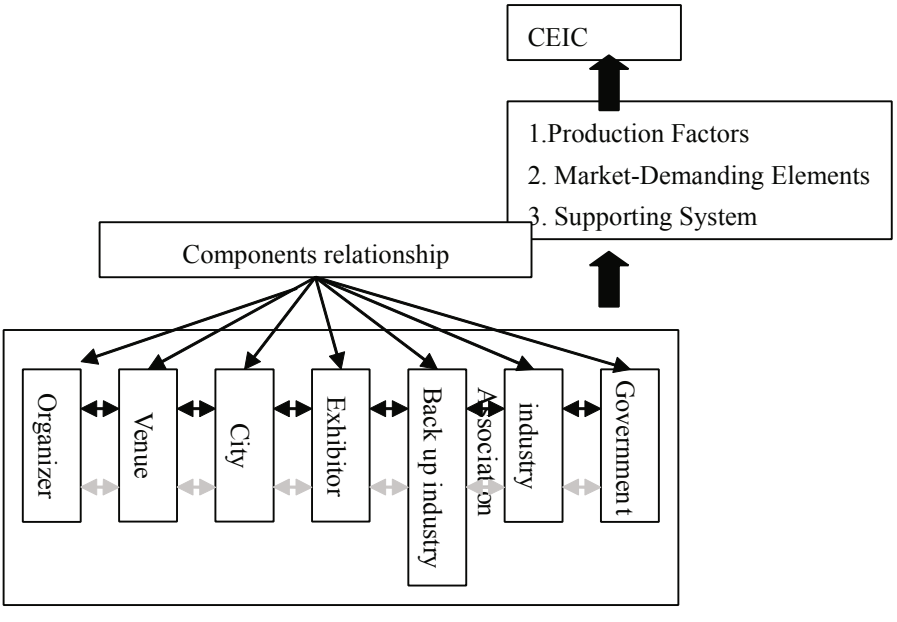


Fig. 1. CEIC composition model

3 Systematic Analysis of CEIC

One of major characteristic of CEIC is the strong cross-industrial connection, to be more exactly, it is a complex coupling of internal system (self-functional system) and external environmental system[3].

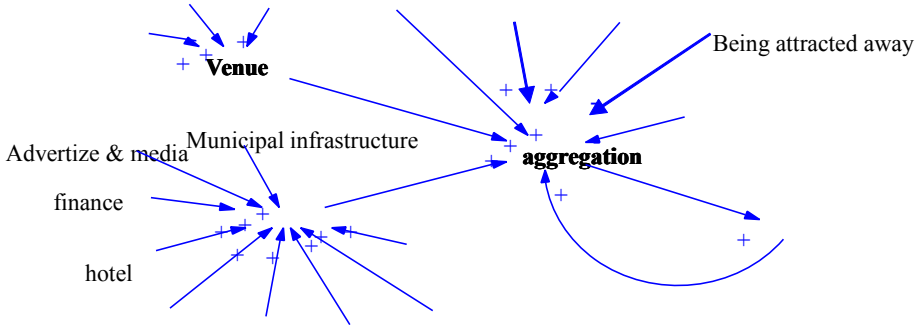


Fig. 2. Causal loop diagram of Main influencing factors of CEIC

Figure 2 shows the Influencing factors of the internal system and the external system, and the cause-effect feedback to CEIC.

4 The Construction and Analysis of CEIC Model

Any model has boundaries and hypothesis, however, the relationship among things in real world is enormous and complicated, not being able to quantify all of them[4]. For C&E industry, it is barely possible to have all factors included. Through correlation analysis, the author summarizes 7 correlated factors: basic industry, industry policy,

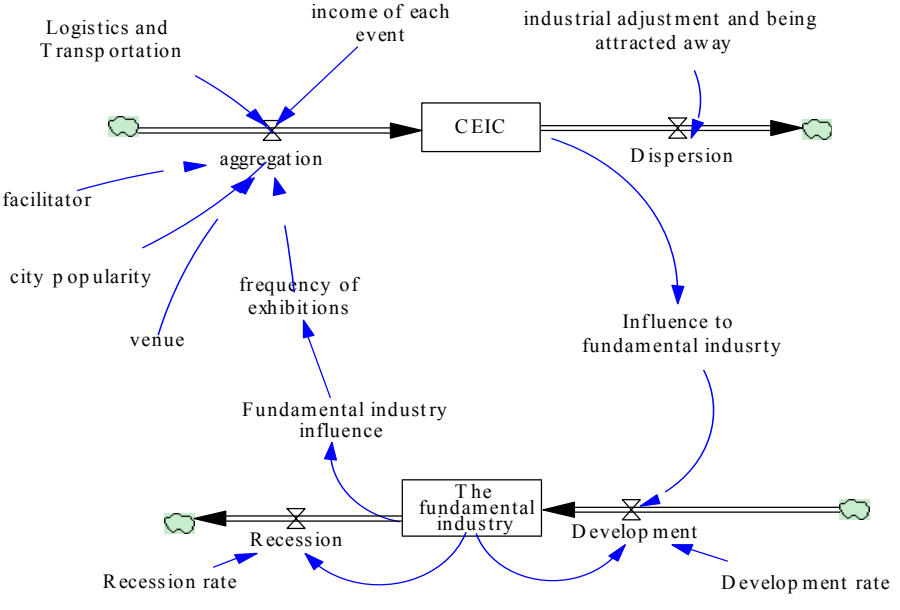


Fig. 3. Stock and Flow Diagram of CEIC

city environment, venue, market and products, logistics and facilitators. Based on the correlation, establish the stock and flow diagram(as shown in Fig. 3).

5 Simulation and Application of the Model

5.1 The Parameter Value the Model

While building the system simulation model of CEIC, the author mainly takes the following parameters into account.

aggregation = income of each event * frequency of exhibitions * city popularity * influence value of logistics & transportation * venue * facilitator
The frequency of exhibitions = INITIAL * Industrial effect
CEIC = INITIAL VALUE + (aggregation - Dispersion) * DT
The fundamental industry = INITIAL VALUE + (Development - Recession) *DT

The initial value of each variable represents the initial status of CEIC system, and Shanghai is chosen as the example to set up the model. Annual Report on China's Convention & Exhibition economy (2008) provide relevant data, auxiliary variable data haven been converged into relative value between 1-100 to show the degree of influence, the bigger the value is, the more obvious the influence is.

5.2 Analog Simulation of the Model

To simulate the model for 35 years, we get the following results (as shown in Fig.4).

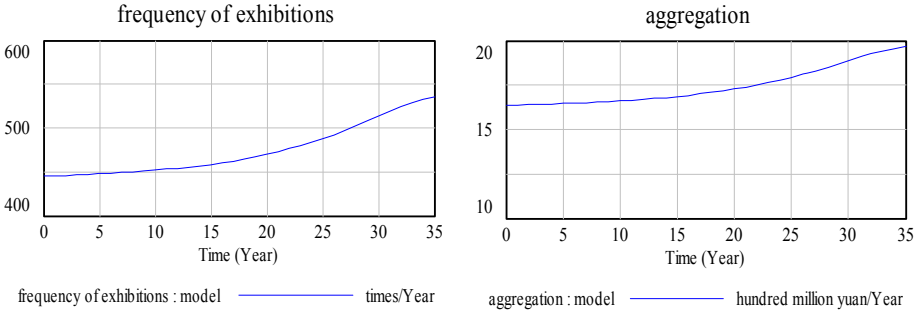


Fig. 4. Analog Simulation Diagram of Cluster Effect of CEIC

Through the diagrams, we can find that the aggregation curve is an easy S curve, which shows the output of CEIC is accumulated growth, thus the aggregation change is not obvious. If we compare the frequency of conventions and exhibitions held each year with the changing of aggregation effect each year, we can find the aggregation speed of C&E industry is increasing slowly first, and then speed up, the curve slope is enlarging gradually along with the time. The result shows that with the development of

CEIC, the cluster effect is enlarging along with time, The result also shows the evolvement of CEIC is a three-staged process with different developing speed. During the beginning period of aggregation cluster grows slowly. However, if the positive feedback system is established, the whole industry works in a really 'clustered' way, the CEIC grows faster and jumps onto the second stage and then further onto the third stage. The growth of CEIC depends on the two combined strengths, one strength is the market demand which comes from the external system, the other strength is the supply capability which comes from the internal system.

5.3 The Application of the Model

The application of the model manifests itself in two ways. One is to observe the developing phases of industry cluster by getting the accurate parameters from the historical statistics[5].The other is to analyze the sensitivity of variables in the process of forming industry cluster[6]. The suggested way is to design several different combinations of variables related to policy making, simulating with the initial value, and compare the results to find out which is the best way to provide positive feedback to the CEIC, which could be helpful to policy maker to make a better decision.

For example, under the condition of keeping the other factors fixed, if we change the data of venue(as in shown in Fig. 5).

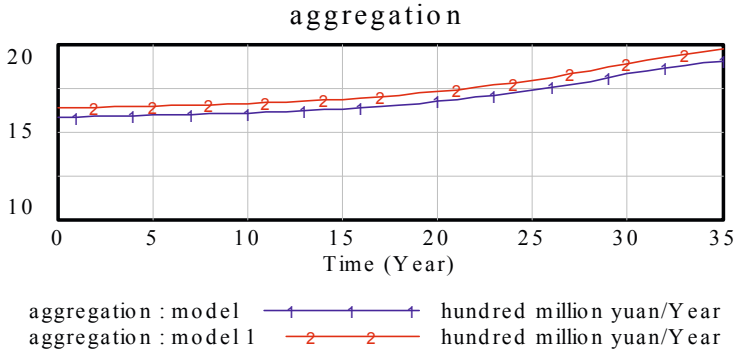


Fig. 5. The Application Simulation Model

According to the above model, current 1 shows the aggregation of C&E industry with the original initial value. Current 2 shows aggregation statutes under the condition of improving the venue. Similarly, we can change the other factors or the combination of factor to see how they influence the CEIC, to choose the optimal plan.

6 Conclusion

CEIC is a complex, dynamic and non-linier system. With SD Model, the research shows that, under the condition that C&E Industry getting continuous positive feedback

from the external and internal system, the effect of CEIC is an enlarging process along with time. The evolving process depends on the two combined strengths, one strength is the market demand which comes from the external system, the other strength is the supply capability which comes from the internal system.

From the viewpoint of policy making, the research helps to identify the key influential factors, especially negative factors and threaten factors to the C&E industry, thus helps to avoid slow-developing and weak-performance cluster caused by redundant construction and haphazard investment.

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Economic Observation in 3Q E-business Fight — According to Analysis of Resource Allocation and Contract

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Abstract. Based on relation of resource allocation and marginal benefit of e-commence provider, both of origin and essence of the 3Q e-business fight were analyzed; and then contents of the contract between e-business company and users were elaborated. Moreover, liability for Qihoo's breach of the contract in 3Q e-business fight was discussed. Analysis of the contract indicated that blame of infringing on privacy of users from public, media or even a law professor for Tengxun Company is not exactly justicial. Some controversial rules which are not fit for usual practices in the QQ contract such as narrow definition of privacy were found out, whose reason lies in no relevant e-business standards or rules in our country. In the end, this passage points out that actions of government who intervened in market operations of Tengxun Company and QQ Company are inappropriate and unnecessary. Thus, responsibility for facing up to incomplete market rules of e-commence lies with government and government should strengthen market supervision by legislation so as to guide healthy development of e-business market, which is a key lesson we learn from the 3Q e-business fight.

Keywords: e-business fight; marginal benefit; contract; the Coase theorem; delineation of right; privacy.

QQ is the most widely-used instance messaging technology in china, and 360 is a fail-safe software which is generally used in china. They belong to Tengxun Company in Shenzhen and Qihoo Company in Beijing respectively. Tengxun Company is the first largest desktop client e-commence providers and Qihoo Company is the second largest one. It is said that the number of users for these two companies are about 0.6 billion and about 0.3 million separately. Since Qihoo in Beijing (The software 360 is its product.) noticed that Tengxun developed products like "QQ Doctor" and "QQ Computer Manager", a huge e-business fight between these two companies began slowly. The 3Q e-business fight which happened recently aggravated the situation between them. Qihoo recommended his product named koukou Safeguard to users so that users could get rid of garbage files from the QQ software, which triggered current dispute. The Qihoo action severely affected Tengxun's source of income. Therefore, Tengxun used extreme measure and asked his users to make choices as follows: if the users wanted to continue using QQ software, they had to unload the 360 software, and

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 173–180, 2011.
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if its users wanted to use the 360 software, they could not employ the QQ software.[1] The analysis of things about 360 software and QQ software mostly focused on abuse of dominance position of Tengxun and suspected violation of Anti-monopoly Law for Tengxun. In fact, this analysis is not right. This passage will start on resource allocation and marginal benefit of e-commence providers to understand 3Q e-business fight and base discussion of the 3Q e-business fight on contract.

1 Insight into Essence of the 3Q E-business Fight by Analyzing Relation of Resource Allocation and Marginal Benefit of E-commence Providers

Figure 1 below shows us effect of provider's resource allocation on marginal benefit to understand the 3Q e-business fight.

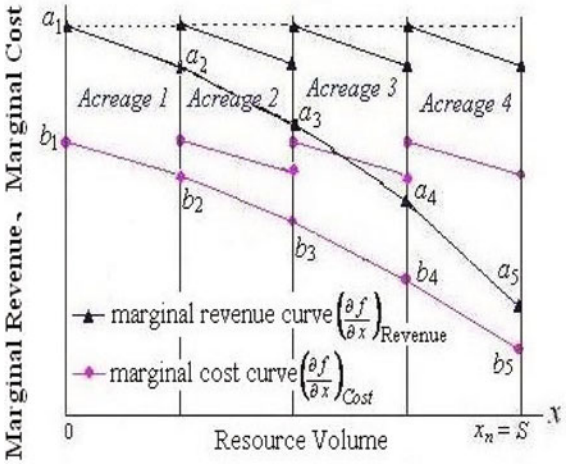


Fig. 1. Analysis of rosour allocation — marginal benefit of an e-bussinese provide

In the figure, abscissa denotes resource volumes owned by an e-commence provider and ordinate denotes marginal revenue and marginal cost of e-business. Besides that, the curve named $a_1a_2a_3a_4a_5$ means a marginal revenue curve marked $\left(\frac{\partial f}{\partial x}\right)_{\text{Revenue}}$ and the curve named $b_1b_2b_3b_4b_5$ means a marginal cost curve marked $\left(\frac{\partial f}{\partial x}\right)_{Cost}$. Now let us form a hypothesis that resource volumes owned by a provider reaches S. Based on hypothesis, the marginal benefits of a provider are analyzed as follows: when there is only one user, which is a extreme case, the marginal benefits equal to an area marked Acreage ($a_1\ a_5\ b_5\ b_1$) which is bounded by a marginal revenue curve and a marginal cost curve; when there are four users in equilibrium condition, meaning the resource volume leased by every user is S/4, the provider's total marginal benefits are calculated as below.

Acreage 1+ Acreage 2+ Acreage 3+ Acreage 4
= 4 Acreage 1。
From Fig. 1 it is thus clear:
Acreage ($a_4a_5b_5b_4$) < Acreage 4(=Acreage 1),
Acreage ($a_3a_4b_4b_3$) < Acreage 3(=Acreage 1),
Acreage ($a_2a_3b_3b_2$) < Acreage 2(=Acreage 1),
Acreage ($a_1a_2b_2b_1$) = Acreage 1;
Moreover, Acreage ($a_1a_5b_5b_1$) = Acreage ($a_1a_2b_2b_1$) +Acreage ($a_2a_3b_3b_2$) + Acreage ($a_3a_4b_4b_3$) + Acreage ($a_4a_5b_5b_4$) < 4 Acreage 1

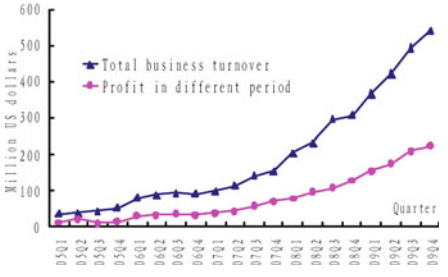


Fig. 2. The Tengxun's total business turnover and profit in different period of 2005-2009 years



Fig. 3. The growth condition of the QQ's on line customer count in the meantime

When there are four users, marginal benefits of a provider (4 Acreage 1) are more than marginal benefits of a provider (Acreage a_1 a_5 b_5 b_1) when there is only one user. Thus, as the number of users marked n is increasing, marginal benefits of a provider are higher and accumulated marginal costs are rising too. Accumulated marginal costs will stop rising until capitals of a provider and users' equity approach extreme.

From analysis above, it is proved that increasing marginal benefits are correlated positively with increasing number of users, which is reflected in several annual reports of Tengxun Company. Now, please look at Fig.2 and Fig.3 (The disparities between a turnover curve and a marginal benefit curve widen as time goes on, reflected in Fig. 2.Therefore, marginal costs do not equal to nor are close to zero and form the curve in Fig. 1.).

Therefore, e-commence providers like Tengxun, yahoo, baidu companies consider maximizing number of users as priority before situation is in extreme case. Based on that, it is easy to understand why Tengxun responded strongly when Qihoo Company affected its reputation and might lead to decreasing number of users.

2 Contract Relation between E-business Company and Users

Contract, also called agreement, is a promise of exchange for right and is that also for property. There are several legal features for standard clauses of a contract. First legal feature is that a contract based on standard clauses is widely-used,

permanent and specific. Second one is that one party can make a decision first. Third one is that rights and duties of two parties must be clearly written in a contract. Fourth one is that one party has absolute advantages in terms of economy and can force another party to use predetermined standard clauses so that two party are in no need to negotiate for standard clauses of a contract.

First let us look at the contract of Tengxun and users. Tengxun as a e-commence company makes definite contracts with its users who use QQ (The users here mean free users opposite to users who pay for network vaule-added services, hereinafter the same). When users install QQ software, contracts are done for users and Tengxun. Contents of a contract are detailed from QQ 2010 Setup License Contract. This contract includes four legal features of standard clauses mentioned above.

According to the Coase theorem, the delineation of right is an essential prelude to market transactions.[2-4]Essence of contract is the result of negotiation for market transaction (it mainly means exchange of property rights) of two party. Basing on that, firstly let us find out whether QQ contracts make clear definitions of private property rights among Tengxun and users. It is said that Tengxun owns the droit of QQ software and users own terminals of their private computers, time used on sustaining QQ advertising platform and so on in the contract. More than that, according to the contracts, Tengxun transfers the usufruct of QQ software to users so that users can use QQ products for free and users not only provide their computers for business activities of Tengxun such as advertising but also increase click—through rate in the form of ideal money — time and energy for QQ.com. Because of actions of the users, QQ becomes one of famous medium for advertising and gain a large amount of advertising revenue. It is fair and square that Tengxun exchanges the usufructs of QQ software for leasing private computers and ideal moneys of the users. Thus, on one hand, Tengxun obtains serious advertising revenue and on the other hand, the users enjoy the QQ services. From analysis above, it is inferred that QQ services are not free of charge for users as company claims their products to be — which incurs illusions of some users. In accord with the article 3.12 of QQ 2010 Setup License Contract, Tengxun is authorized to put different kinds of advertising and publicizing information into private computers of the users provided with QQ services of Tengxun. And advertising may appear in the form of system messages or popup window, which is also specified in this article. Furthermore, the article 4.1.1 says that it is allowed to make use of the users' computers, which means in order to get the profit of servings provided by Tengxun, the users should allow Tengxun to take advantage of processors and broadband possessed by users. According to these contracts, the users of QQ servings can communicate with other kinds of users like advertisers who also make use of QQ products for limited purpose.

All the contracts above declare that the users must pay a price by providing their private computers and ideal money which support Tengxun's business activities for what they get from Tengxun.

Qihoo in Beijing also signed less complicated "360 contracts" with users than Tengxun does, but essences of these contracts are almost the same for the two companies. Therefore, we will not discuss the contracts signed by Qihoo and users.

3 A Rustic Opinion about Qihoo's Default in 3Q E-business Fight

Let us put aside problems about Tengxun. It is obvious that Qihoo could not evade responsibility as this company breached contracts in 3Q e-business fight. When "koukou Safeguard" software was recommended to users, Qihoo did not prohibited users from using 360 and QQ products at the same (As customary rule, it was allowed.). But once the "koukou Safeguard" ran, it set up some barriers that access to QQ products was restricted without any notice. As we know, essence of a contract is that both parties give certain rights promise to perform some duties. According to the operation of 360 products, rights of the users were infringed when they fulfilled their obligations. This situation is similar to the following example. When a customer buys socks from a hosier, the hosier finds out there are some problems with the customer's shoes bought from a shoemaker and he keeps asking the customer to throw away the shoes. In fact, if the hosier really thinks for his customer, he shall advise the customer to claim against the shoemaker for compensation or report to government departments who are in charge of quality issues of the shoemaker. According to reasoning mentioned just now, even though "koukou Safeguard" noticeed QQ products infringed users` privacy when the users employed them, it would be not allowed to interfere with operation of QQ products. Thus, if foul play of QQ products really happens, it is more reasonable that Qihoo would denounce Tengxun to the departments like Ministry of industry and information technology so as to protect the users' rights.

4 What Kinds of Responsibilities of Default in 3Q E-business Fight Should Tengxun Company Took?

Recalling how Tengxun asked users to uninstall 360 software, we can draw a run-of-mill conclusion that Tengxun was the party in breach of contract. It has been well known that QQ products had been compatible with running the products of Qihoo like "360 Security Guard" for a long time. Thus, it is no doubt that Tengxun had been allowing users to use QQ products and 360 products at the same time. But when 3Q e-business fight arose, Tengxun forced the users to make choices between QQ products and 360 products and decided on its own to terminate contracts with the users who also use 360 products. This situation is similar to a story that a long-stay patient already paying hospital is required to quit being taken his bad tooth out at clinic without any reasons one day, otherwise hospital would have decided unilaterally not to go on treating this patient and make compensation for this patient.

However, it is not simple as we thought of. If we review the QQ 2010 Setup License Contract made by Tengxun, some users who claimed their rights were infringed on by Tengxun in 3Q e-business fight might not win the case when they sued Tengxun. Now please look at clauses in the contract as follow:

Subject to Clause 2.1, Customers are not allowed to use any kind of derivative works of this software, no matter whether they are attached or are created. Derivative works of this software include but not limited to plug-in units or unauthorized tools or services from the third party connected to this software and relevant system. In addition, subject to Clause 3.4 and Item 3.4.1, users have no right to do following things, including but not limited to using plug-in and tag-on software developed, authorized or authenticated by other companies, which are hostile to products and services of Tengxun.

Hence, Tengxun Company drummed in the point that the "koukou Safeguard" of Oihoo Company being an add-on software was hostile to Tengxun and put up all sorts of obstacles to the software and service of Tengxun. Basing on this point and the clauses in the contract above, Tengxun could terminate contracts with part of the users who made synchronously use of QQ and 360 products. We can not deny this view Tengxun claimed, because some users breached the contracts and it was no more than Tengxun's doing everything by rule. And it was not long before Qihoo who was the troublemaker of 3Q e-business fight declared to stop users from using "koukou Safeguard". Based on analysis, we can sum up that it is not absolutely right for censuring Tengxun company and Qihoo company that public, including media and common people one-sidedly blamed Tengxun Company and Qihoo company for their actions, required them to apology to public and made up for losses of users.

Some media even claimed that relevant companies damaged interests of public. That was a mistake, because contracts signed by relevant companies and users indicate that they exchange private properties with each other. The subject involved with the exchange are private properties and not public properties, which mean other people are entitled to have interests from relevant companies as media alleged because they didn't pay for private properties written in the contracts. Public opinions indeed including that from a law professor at a famous university in China were biased. He said action of Tengxun Company broke the Law on Protection of the Rights and Interests of Consumers and deprived users of their options. But in fact, users already made their choices before signing contracts. Therefore, there were no any reasons for users to make second choices.

It is obvious that users, who did not set up the "koukou Safeguard" and used QQ and 360 products at the same time, were intimidated by Tengxun Company, suffered losses for no reason and could confidently asked for apology and compensation because Tengxun Company broke unilaterally the contracts.

5 Did Tengxun Company Infringe on Users` Privacy?

Back to the beginning of 3Q e-business fight, whether rights of users` privacy were infringed on for terminals of private computers had been a major bone of contention between two companies for a time. It was also a key that Tengxun Company was blamed by public. But was it true that Tengxun Company infringed on right of users` privacy according to contract?

In accord with Clause 3.9 of QQ 2010 Setup License Contract, information of individual privacy confirmed by users denotes private information of identification and communication, including username, identification card code, mobile phone number, IP address, E-mail address. As for information of impersonal privacy, it means basically recorded information which is definitely and objectively reflected in server-side of Tengxun Company, such as users` operational states and usage patterns, and common information excluding all information of individual privacy above.

It is the equivalent statement of this clause that privacy in the contract excludes habit of surfing net, chat log, personal photos, data transmission, even private account key and so on. And explanation is added to the article 3.9.1 in the contract as follows:

generally, Tengxun Company makes use of information from users according to following reasons …· (5) all kind of impersonal privacy data would be used for commercial purpose including but not limited to providing services or products such as value added service, advertisement, targeted advertisement, marketing, other joint registered service, sales promotion and so on (commercial activities in general) for third party. Some argued that these articles about privacy are not reasonable, but it is another pair of shoes, and there are some reasons for them to be existed. One of the reasons is that there are no country or industry standards about privacy and if both party of a contract agree on privacy, both sides must follow the rule. Therefore, intrusion of privacy did not happen because articles are written in contract and users confirmed these articles.

6 Lessons from the 3Q E-business Fight

The 3Q e-business fight finally was stopped by government department ─ Ministry of industry and information technology who played hardball on this issue. However, e-business fights of contending for users will never end among internet e-commence service providers because of key marginal benefits mentioned in the first part and impossibility of absolute monopoly in fierce competition nowadays. Of course, these open e-business fights will be turned into veiled struggle.

As a matter of fact, it is not right that Ministry of industry and information technology commanded that products of two companies must be compatible with each other. There are two reasons. The first reason is that it is market behavior that whether a product of one company is compatible with other products of other companies because products are not public properties and any others including government department has no right to interfere with these properties. This case is similar to an example about bowl and chopsticks. They are both necessities for public. Government has no right to ask a factory of bowls to have them be matched with chopsticks produced by other factory, no matter what kinds of aspects, styles or sizes of the products are asked to be matched with each other. The second one is that if two companies want to maximize number of users, they are bound to allow their products to be compatible with each other. Compatibility of products will become reality sooner or later, so it is no need for intervention. It is the same reason for the example above. A factory which tends to survive in the market has to satisfy the need of market.

Now, the most important thing is that what lesson we can learn from 3Q e-business fight.

Firstly, the users must bear some responsibilities. According to survey, most users do not care what are in contracts and tick appropriate box in the contracts, which means both sides approve contents in the contracts, before they set up QQ software. The 3Q e-business fight warns users of remaining alert to contents of contracts.

Secondly, we have to admit that articles in the contract are not in conformity with tradition consuetude such as narrow definition of privacy. The reason lies in that there are no rules or standards for this aspect in our country.

Thus, some measures need to be carried out by government at once. Firstly, for some e-business rules or matters like privacy people concern, national or industrious standards should be laid down, or else disorder phenomena will last for long time. Moreover, government should strengthen supervision of market by legislation so as to guide healthy development of e-business market, which is a key for solving problems above.

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Investigation on Color Quantization Algorithm of Color Image

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Abstract. Color quantization is a basic and important technology in digital image processing. Through research on the color quantization algorithm based on segmentation and clustering, this paper proposes a new color quantization algorithm based on K-means clustering. Firstly, classify the pixel of image according to hue. Then, based on K-means clustering do color quantization processing for each sub-class. Through compared with the commonly quantization algorithm, the quantization effect and execution time of the proposed algorithm both have better performance.

Keywords: HSI color space; Color quantization; K-means clustering.

1 Introduction

The so-called color quantization, it needs to get some color by artificial or under a particular rule, then, to form a new color palette. Lastly, the image will be reconstructed according to the new color palette. The quality of color quantization plays a vital role in image compression, image segmentation or object recognition. It is a basic and very important technology in digital image processing.

Currently, there are many quantization algorithms. Generally, they are divided into two categories. One is based on segmentation; the other is based on clustering algorithm[1]. The quantization algorithms based on segmentation will divide color space according to the distribution of image color. According to the different segmentation methods, they are divided into uniform quantization method[2], with a median segmentation method[3], octree algorithm[4], etc. The quantization algorithms based on clustering will cluster different color according to the similarity of color. Then, the new palette will be formed by using clustering center. Commonly clustering algorithm includes K-means algorithm[5], SCA algorithm[6] and FCM clustering algorithm[7], etc.

By analyzed the effectiveness and efficiency of color quantization, two types of color quantization algorithm have their own advantages and disadvantages. The color

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G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 181–187, 2011.
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quantization algorithms based on segmentation usually have better execution speed, but often can not guarantee a better quantization result. The color quantization algorithms based on clustering are opposite. Although it meets the quantization result, ignore execution speed. So, there is not a satisfactory color quantization algorithm which has a good execution speed and quantization result.

Therefore, in order to obtain better quantization result and efficiency, this paper studies on the color quantization algorithm based on segmentation or clustering. A new color quantization algorithm is proposed.

2 The Common Color Quantization Algorithms

2.1 Uniform Quantization Method

The uniform quantization is one of a color quantization algorithm based on segmentation. In the quantization process, it will divide the color space directly. Such as, the common RGB color space is divided into 256. Firstly, according to the sensitivity of human eye to different color, the red, green and blue components are divided into three planes, three planes and two planes. So, red, green and blue components will have 8, 8 and 4 colors. Thus, the new palette will have 8 * 8 * 4 = 256 colors. Finally, a new image will be reconstructed according to the color similarity. The uniform quantization method is simple and fast, etc. But compared with the original image, the reconstructed image have a different in color, it can not accurately describe the layering of the original image.

2.2 Octree Algorithm

Octree quantization algorithm is one of common quantization algorithms, which not only has a good quantization results, but also the efficiency of the algorithm is also very high. The key of octree algorithm is to build the octree, which includes octree encoding, octree insertion and octree merging[8].

The so-called octree encoding, is to convert the R, G and B component to binary. So the binary number of each layer will form a new value, and the range of the value is from 0 to 7. Then, each new value will be inserted into the corresponding layers of the octree. So, the insertion process is completed. When the number of leaf nodes is bigger than the quantization number, octree merging is need. Octree merging is complying with the following two principles:

(1) The principle of maximum depth: With deeper the level of leaf node, its impact on color is less. Therefore, in the merging process, it always happens in the deepest leaf node.

(2) The principle of minimum frequency: in the deepest octree, those leaf nodes which have the Minimum frequency will be merged firstly.

For the final octree, each leaf node value will be extracted to build the color palette. Finally, the new image will be reconstructed according to the new palette. Then, the quantization process is completed.

The algorithm has a satisfactory result in quantization effect, storage space and time, etc. However, the principle of minimum frequency was used in merging process. So, some color will be lost.

3 The Proposed Algorithm

In order to get both the quantization effect and efficiency of quantization algorithm, in this paper, combining with each characteristics of quantization algorithm based on segmentation and clustering, we propose a new color quantization algorithm based on K-means clustering.

Suppose the number of pixels in the original image is *N*, the original image is needed to be clustered to *M* class. The specific step of algorithm in this paper is as follows:

Step 1. The original image is transformed from the RGB color space into HSI color space. The pixels of the image are roughly classified according to hue. Meanwhile, count the number of pixels of each subclass, denoted by N_i.

For the hue H in HSI color space, because of its range is 0 ~ 360 °, and different degrees represent different colors. When do the coarse clustering on the color of the original image using H, H should not be divided too small .Here, H is divided much smaller, although the details of the image is maintained good, but the layering of image will be weakened.

Step 2. With the number of pixels of the subclass, the number of initial cluster centers that the subclass should include is computed. In order to ensure that the reconstructed image has better detail, as long as the number of pixels that the subclass should include is bigger than 0, it will be assigned the initial cluster centers.

Assign methods are as follows: First, check the number of pixels in the subclass. Count the number of subclass in which the number of pixels is bigger than 0, it is denoted by *n*. Then, each subclass, in which the number of pixels is bigger than 0, will be assigned an initial cluster center. Then, the rest of the *M*-*n* initial cluster centers are assigned according to the proportion. The entire assign process can be expressed as follows:

$$ClusterNum[i] = (M - n) \times N_i / N + 1 \tag{1}$$

Step 3. Make statistics of brightness I and saturation S of all the pixels of each subclass, Combined with the number of initial cluster center $ClusterNum[i]$, calculate the initial cluster centers. Specific methods are as follows:

First, make statistics of the maximum and minimum value of intensity and saturation in each subclass. Secondly, the intensity and saturation are respectively divided equally into *x* parts. *x* is equal to $(\text{int})\sqrt{ClusterNum[i]} + 1$. So, each subclass will be divided into *x* * *x* cluster centers (the number of cluster centers is bigger than the number of initial assign). Then, with the principle of color similarity and the cluster center of subclass, do the clustering processing for the color point of each subclass, to form the sub-cluster family and the initial cluster centers of each subclass. This article will use the Euclidean distance to determine the color similarity, formula is as follows:

$$D = \sqrt{(I_i - I_j)^2 + (S_i - S_j)^2} \tag{2}$$

Where I_i and S_i represent intensity and saturation of the pixels, I_i and S_i represent intensity and saturation of the clustering center. Finally, when clustering is completed, take the mean of R, G and B as the initial cluster center.

Step 4. Merging cluster centers. Because the value of x is equal to $(\text{int})\sqrt{ClusterNum[i]}+1$. Therefore, the number of cluster centers may be bigger than $ClusterNum[i]$. Then, it needs to merge the cluster centers. The specific process is as follows:

Calculate the Euclidean distance between each cluster centers. Two cluster centers which have the minimum distance will be merged. After the merger, the new cluster center is expressed as follows:

$$(R, G, B) = (\frac{R_x + R_y}{2}, \frac{G_x + G_y}{2}, \frac{B_x + B_y}{2}) \tag{3}$$

Repeat the operation above, until the number of cluster centers is equal to $ClusterNum[i]$.

Step 5. Splitting cluster center. In step3, not all of the initial cluster centers are effective, invalid cluster centers will be discarded. So, effective cluster centers may be less than the number assigned. At this time, it needs to split the cluster centers. The splitting process will combine with the volatility of each sub-cluster family. The specific method is as follows.

First, check the volatility of each sub-cluster family. Here, the standard deviation of sub-cluster family is used to measure its volatility. The formula of standard deviation is as follows:

$$S = \sqrt{\frac{1}{n}\sum_{i=0}^{n}(G_i - \overline{G})^2} \tag{4}$$

G_i represent the gray of each color. Sub-cluster family with the biggest volatility will be divided into two sub-cluster families. Two new cluster centers can be expressed as follows:

$$(R_1, G_1, B_1) = (\overline{R} + S_r, \overline{G} + S_g, \overline{B} + S_b) \tag{5}$$

and

$$(R_2, G_2, B_2) = (\overline{R} - S_r, \overline{G} - S_g, \overline{B} - S_b) \tag{6}$$

Where $\overline{R}$、$\overline{G}$、$\overline{B}$ respectively are the mean of R, G, B in sub-cluster family, S_r、S_g、S_b respectively are the standard deviation of R, G, B in sub-cluster family.

Step 6 Each sub-cluster family will be calculated again according to the final initial cluster centers. Then the new cluster centers are compared with the original cluster centers. If the cluster centers no longer change, the loop ends. Otherwise, repeat the clustering calculation.

Step 7. With the new color palette formed by the final cluster centers, reconstruct the original image.

4 Experimental Results and Analysis

4.1 The Relationship between Coarse Clustering and Quantization Result

Through research on the proposed algorithm, we found that there is a close relationship between coarse clustering and time and quantization effect. When the number of coarse clustering is equal to 1, the algorithm is equivalent to the traditional K-means algorithm. Then, the quantization effect is the best, but the time is longest. With the number of coarse clustering increasing, the time of the proposed algorithm will reduce, but the quantization effect will decline. See fig1 and 2.

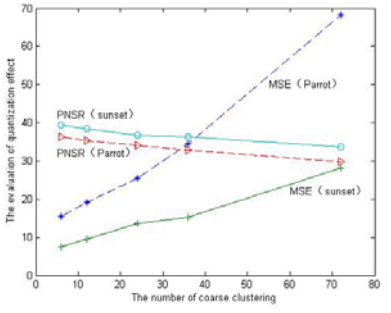


Fig. 1. The relationship between coarse clustering and quantization effect

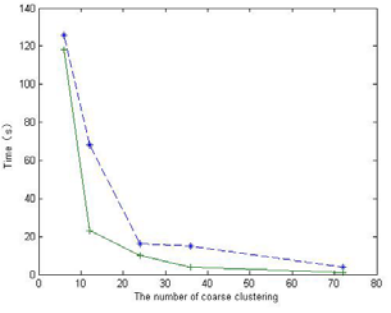


Fig. 2. The relationship between coarse clustering and time

4.2 Effectiveness of the Algorithm

In order to test the effectiveness of this algorithm, here, the proposed algorithm will compare with the common quantization algorithm. Currently, there are many common evaluation criteria. Such as:

1. MSE (the mean square error)

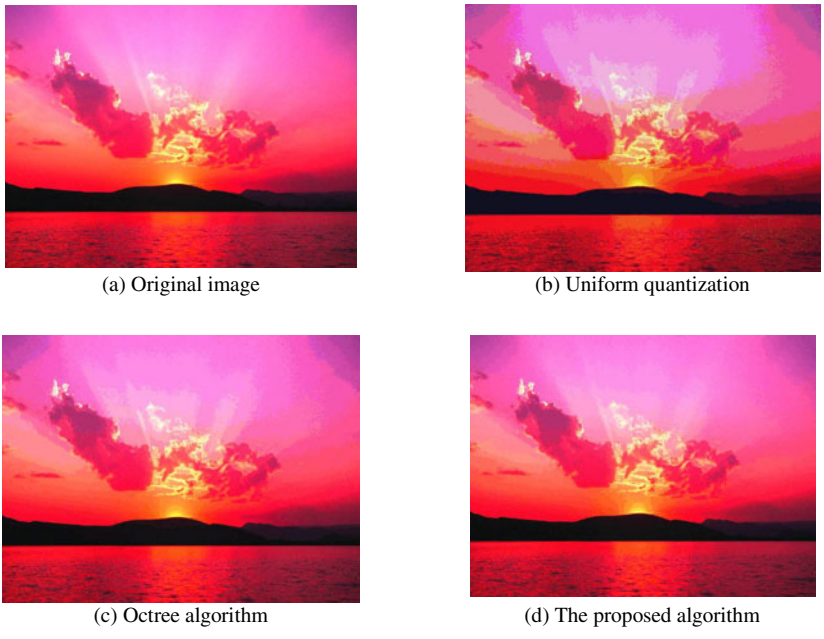
$$MSE = \frac{1}{HW} \sum_{y=0}^{H-1} \sum_{x=0}^{W-1} [I(x, y) - Q(x, y)]^2 \tag{7}$$

2. PSNR(the peak signal to-noise ration)

$$PSNR = 10\log_{10} [\frac{W \times H \times 255^2}{\sum_{y=0}^{H-1} \sum_{x=0}^{W-1} [I(x, y) - Q(x, y)]^2}] \tag{8}$$

Where 'W' is the width of image, 'H' is the height of image, $I(x, y)$ is the original image, $Q(x, y)$ is the quantized image.

There are two images used to test the effectiveness of the algorithm in the experiment. One is 'Sunset', its size is 630 * 472. The other is 'Parrot', its size is 501 * 400. The number of coarse cluster is 12. Quantization effect is as follows.



(a) Original image (b) Uniform quantization

(c) Octree algorithm (d) The proposed algorithm

Fig. 3. Sunset experiment results



(a) Original image (b) Uniform quantization (c) Octree algorithm (d) The proposed algorithm

Fig. 4. Parrot experiment results

From the quantization results, uniform quantization is the worst. It can not reflect the layering of image. Octree quantization method is better, but it also can not reflect the layering of image very well. The proposed algorithm not only can obtain better detail, but also the layering of image is better. Evaluation data of various algorithms is shown in table 1.

Table 1. Evaluation data of various algorithms

Image	Evaluation criteria	Uniform quantization	Octree	The proposed algorithm
Sunset	MSE	60.155915	9.098776	7.531598
	PSNR	30.338020	38.540974	39.361932
Parrot	MSE	86.497685	18.882006	15.394242
	PSNR	28.760759	35.370322	36.257221

In table 1, the smaller the value of MSE is, the smaller the distortion of image is. For PSNR, the bigger its value is, the better the quantization effect is. Therefore, from the data in table, we can get that the proposed algorithm has better effect.

5 Conclusion

Combine with the characteristics of color quantization algorithm based on segmentation and clustering, this paper proposes a new color quantization algorithm based on clustering. Firstly, cluster for color image with hue. Then, do color quantization for each sub-cluster family based on K-means clustering. Experiments show that the new algorithm have better performance on quantization effect and execution time, when selecting appropriate number of coarse clustering.

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Study on the Method for Removing Boundary Burr Based on Relevance of Chain Code

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Abstract. To the problem that how to remove the boundary burr, the property of Freeman chain code was researched, and define the correlation of the chain code based on relevance of chain code. With the feature that the correlation between the direction chain codes of point in and out of the end pixel of burr is the least, a new algorithm which is used for removing the burr by judging the correlation of Freeman chain codes is proposed. Experiment results show that the algorithm is accurate and effective.

Keywords: Image processing; Freeman chain code; Burr; Relevance.

1 Introduction

With the development of computer and artificial intelligence, pattern recognition is used widely in digital image processing, such as the wide range of application in character recognition (OCR)[1]. The quantitative descriptor of the target in pattern recognition, such as shape, perimeter and area, is its important basis for theory criterion[2]. These quantitative descriptors are usually calculated combined with the boundary chain code of the target region, such as calculating the area of target region based on chain code[3]. Therefore, the accuracy of target contour extracting directly affects the discrimination of target type.

In the process of contour extracting for the target image, there are a lot of interferences. Among them boundary burr is one of the most common interference. The presence of boundary burr can change the structure of original image, make mistake in feature extracting, and cause recognition errors. Therefore, boundary burr must be removed before the target feature extracting.

Currently, the study on burr removing method is so much. Burr removal based on morphology is an earlier burr removing method. The reference [4][5] give the improved method of skeleton burr removing which is based on the morphology. The reference [6]

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G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 188–194, 2011.
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proposed an image skeleton burr removing method based on PCNN. Because of the complexity of burr interference, currently, each removing method for burr interference has its limitation. In order to remove the burr interference on the target contour effectively, this paper proposes a boundary burr removing method based on relevance of boundary chain code, and the accuracy and effectiveness of the method is verified by experiment.

2 Freeman Chain Code and Its Property

In order to remove the burr interference on target contour. First, the boundaries of the target region need to be encoded (Freeman code will be used here.). Then, Judge whether there is burr interference on the current boundary with the relevance of the Freeman chain code. Finally, remove the boundary burr interference.

2.1 Freeman Chain Code

Chain code is a commonly used coding technique of region boundary in image processing. It was first proposed in 1961 by the Freeman. It is divided into four -direction Freeman chain code and eight -direction Freeman chain code. This article will use the eight-direction Freeman chain code, which is shown in fig 1.

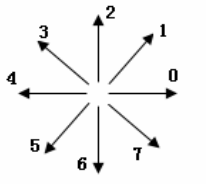
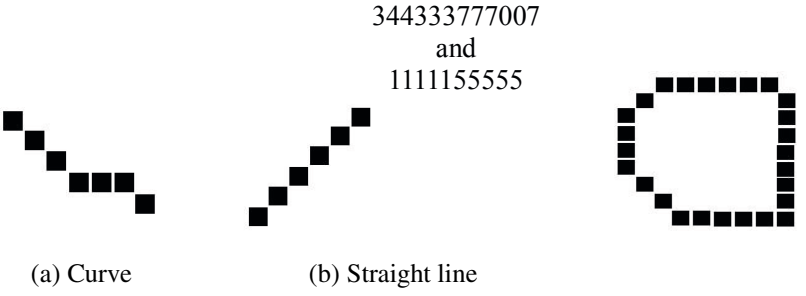


Fig. 1. Eight-direction chain code

In fig 1, the eight directions are pointing to the eight neighborhood pixels of the target pixel, the eight directions are denoted by 0,1,2,3,4,5,6,7 in the encoding process. That is, different chain code indicates different direction. Encoding process is as follows:

First, select a point on the target boundary as a starting point for coding (It usually is the boundary point on the lower left corner), Then, travel according to a prescript direction along the target boundary pixels. Also, note the direction between the adjacent pixels, until return to starting point. In this way, the recorded one-dimensional direction sequence is the Freeman chain code. Assuming that the Freeman chain code of the target contour is $S = \{a_1 ... a_n\}$, in which $a_i \in \{0,1,2,3,4,5,6,7\}$, which is direction chain code from pixel i to pixel $i+1$ of target contour.

To sum up, the Freeman chain codes of two single-pixel lines in fig 2 are as follows (The lowest point is the starting point of boundary tracking):



(a) Curve (b) Straight line

Fig. 2. Single-pixel lines **Fig. 3.** Enclosed regions

The Freeman chain code for enclosed region in fig 3 is (The lowest point is the starting point of boundary tracking):

33322211000007666666644444

2.2 The Property of Freeman Chain Code

When target region was being boundary tracked, it could be found that Freeman chain code of the target contour is only determined by the shape of the target contour. At the same time, Freeman chain code can fully reflect the contour shape of the target region. Therefore, it can be said that there is a certain correspondence between Freeman chain code and the shape of the target contour.

Through observation and research, to a line formed by a single pixel, whether it is a straight line or a Curve, and whether it is horizontal, vertical, or inclined, as long as start boundary tracking from its contour point, it has the following properties:

Property 1
Whether the number of pixels which constitute a single pixel line is odd number or even, the total n of Freeman chain code must be even;

Proof. Based on the principle of Freeman chain code. For single-pixel lines, any two adjacent pixels on the contour will have two Freeman chain codes which point to each other. Total number of pixels *N* which constitutes a single pixel line is an integer bigger than 0. It may be odd, and it could be an even. However, whether *N* is odd or even, *2 (N-1)* will be even. Therefore, total number of Freeman chain code *n* must be even.

Property 2
Divide chain code into two parts, and replace the first part with its corresponding chain code (that is the chain code in the opposite direction). After replacement, Freeman chain code will be symmetric about the middle. Mathematical expression is as follows:

$$| a_{\frac{n}{2}-i} - a_{\frac{n}{2}+i+1} |= 4 \qquad i = 0...\frac{n}{2}-1 \tag{1}$$

$a_{\frac{n}{2}-i}$ and $a_{\frac{n}{2}+i+1}$ represent the angle between two directions, the angle θ =180 °.

Proof. Obtained by the property 1, total number of Freeman chain codes n must be even. And based on the particularity of a single pixel line, each pixel will be traversed twice in Freeman coding. As a result, the former $n/2$ chain code is the direction chain code from the starting point (one endpoint of the line) to the end point (the other endpoint of the line). The latter $n/2$ chain code is the direction chain code of the return line. For any two adjacent pixels A and B (as fig 4 shows), the direction from A to B and from B to A are just opposite, that is the direction angle $\theta = 180°$. Again to figure 1, we can know, as long as the direction angle between any two directions is 180 °, which indicates the difference between the direction chain codes of the two directions is equal to 4. Accordingly, we can know property 2 is correct.



Fig. 4. Direction chain codes of the adjacent pixels

In fig 2, the total number of Freeman chain codes of Line a and line b respectively is 12 and 10, and 7-3=4, 4-0=4, 5-1=4。 It is consistent with the character of Freeman chain code of the single-pixel lines. But Freeman chain code of the enclosed region can not meet the above two properties at the same time, for example, the Freeman chain code of the enclosed region (show in fig 3), although meet the property 1, but it can not meet the property 2. Therefore, we can judge whether there is burr interference on the boundary of the enclosed region, and can easily remove the burr interference.

3 Judging and Removing Burr Interference

3.1 Analysis of Chain Code Relevance

According to Freeman coding theory, any boundary pixel has two direction chain code pointed out and in. We can get some properties of the current boundary pixels by analyzing the relationship between the two direction chain codes. In the calculating the area of region, we determine a point is left boundary point or right boundary point, combined with the relationship between in and out direction chain code of a point. In this article, that whether there is burr interference on the boundary is determined by the relationship between the two direction chain codes. In order to get better expression and understanding, describe as follows:

In the Freeman coding process, different direction represents different chain code. So-called the relevance of the chain codes is the relationship between two chain codes, usually determined by the relationship between the directions that chain code represent. As a result, it can be defined as follows:

Definition. Proximity between the directions that the two chain codes represent is called the correlation of two chain codes, denoted by *D*. Correlation is the mathematical expression of relevance. It can measure the size of the relevance.

Assume. If both directions that the two chain codes represent point to the same direction, Then the relevance of the two direction chain codes is the largest. Correlation is denoted by 1. If both directions that the two chain codes represent point to the opposite direction, then the relevance of the two direction chain codes is the smallest, Correlation is denoted by 0. (See fig 5).



(a) The largest relevance (b) The smallest relevance

Fig. 5. Relevance example

The mathematical expression of correlation is as follows:

$$D = \frac{\left||x-y|-4\right|}{4} \tag{2}$$

x and *y* represent two adjacent chain code.

3.2 Judging Boundary Burr

According to the properties of Freeman chain code and the definition of chain code correlation. If there is burr interference on the contour of target region, so, in Freeman chain codes, there are two adjacent chain codes whose correlation is equal to 0. The specific judging steps are as follows:

Step 1. Firstly, do segmentation or extraction for the target region on the image. Then, do the contour extracting for target region. Finally, encode for the target contour.

Step 2. Calculate the correlation for the Freeman chain codes *S*. it is as follows:

$$D_{i+1} = \frac{\| a_i - a_{i+1} | -4 |}{4} \qquad i = 1...n-1 \tag{3}$$

In which the direction correlation of the starting point is as follows:

$$D_1 = \frac{\| a_n - a_1 | -4 |}{4} \tag{4}$$

Step 3. When the correlation of direction chain code a_i and a_{i+1} is equal to zero, the pixel $i+1$ is the end pixel of boundary burr. That is to say, there is burr interference on the target contour.

In step1, sometimes, there is non-single-pixel lines burr interference (see fig 6) on the target contour. For such interference, after dilation, erosion, and thinning, it can be converted to burr interference of single pixel lines.



Fig. 6. Burr interference of non-single-pixel line

3.3 Removing Boundary Burr

The so-called boundary burr removing is to remove the boundary pixels whose chain code correlation is equal to zero. The specific removing steps are as follows:

Step 1. When encoding the contour of target region, the vertical and horizontal coordinates (*x, y*) of the starting point need to write down.

Step 2. This step is to do the calculation and judging of chain code correlation. When chain code correlation $D_{i+1} = 0$, delete a_i and a_{i+1} in Freeman chain code *S*. At the same time, move the pointer backward, make it point to chain code a_{i-1}. Then calculate the chain code correlation between a_{i-1} and new a_i. If the correlation is not equal to zero, move the pointer forward. If the correlation is equal to zero, repeat the above operation.

Step 3. When the above operation is completed, it will get a new boundary chain code S_1, and which is boundary chain code being removed burr interference. Then we can calculate area, perimeter and other descriptors of the target contour based on S_1. At last, we can get a new contour without burr interference with starting point coordinates and the new boundary chain code S_1.

4 Experiments

In order to verify the accuracy of algorithm in this paper, the algorithm has been achieved in VC ++6.0 environment. Meanwhile, the experiment has been done with

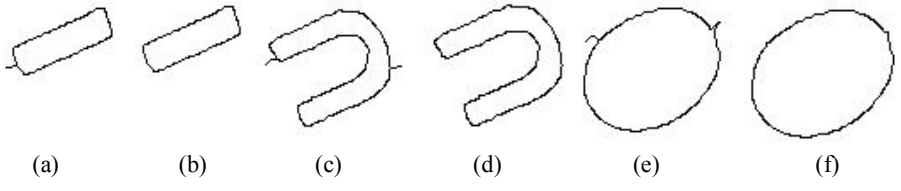


Fig. 7. The effect of removing boundary burr

plenty of pictures. Experiment results show that the algorithm is accurate and effective to remove the boundary burr. Some experiment results are shown in fig 7.

In fig 7, (a) and (c) is boundary burr of single pixel line. There are boundary burr of single-pixel line and boundary burr of non-single-pixel line in (e). (b), (d) and (f) are result of them. From the result, whatever the kind of boundary burr interference is, the algorithm is accurate and effective.

5 Conclusion

In this paper, the property of Freeman chain code of single-pixel lines is researched. And a boundary burr removing algorithm is proposed based on boundary chain code correlation. Compared with the traditional algorithm, this algorithm has the following advantages:

(1) When removing burr interference, there is little effect on structural characteristics of the target region.

(2) It has a high accuracy for judging and removing boundary burr interference of target contour.

The only disadvantage of this algorithm is that it only can deal with the boundary burr interference of closed contour. How to remove boundary burr of non-closed contour will be the next focus.

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Investigation and Application of Feature Extraction Based on Rough Set Theory

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Abstract. With the rapid development of computer technologies and a broad spectrum of applications of database management systems, the accumulated data in modern life are far beyond our normal capabilities in analyzing and understanding them without the use of automated analysis technologies. Rough Sets and Fuzzy Sets theories can be used to investigate imprecise and incomplete information, and to observe, test and reason data. This work applies degree of connection in sets pair analysis to Rough Sets Theory, and explores the relationship between rough-degree of connection and cardinal of rough lower/upper approximation.

Keywords: Rough set; Feature Extraction; Attribute reduction.

1 Introduction

Knowledge discovery in databasesis one of the most promising directions spanning database and artificial intelligence research. Data mining is a nontrivial extraction of potentially significant facts from data. The methodology of rough sets offers some framework to study data mining problems. Using the rough set approach to discovery of strong rules in stock market data is very interesting as indicated in papers. It is necessary to make some discretization of continuous attributes, before generation of rules.

In this paper, reducing the condition attributes based on fuzzy theory and rough set method, calculating the importance to the decision attribute for each condition attribute after reduction, and data mining the relevant rules based on the reduced attributes, extension relevant function is used to depict quality of data gather in data mining. Extension data mining has advantage in the decision-making of the enterprise. Extension relevant function can be used to quantitatively depict data gather of data mining. It can effectively solve the problem of the data quality, and provide clear decision-making for the enterprise. It also can provide a new thinking mode and approach for data mining.

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G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 195–200, 2011.
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2 Related Concepts

2.1 Rough Sets

2.1.1 Introduction of Rough Sets Theory

Rough Sets Theory, a mathematical theory for data analysis, was first introduced by Z.Pawlak in 1982. By defining knowledge from a new viewpoint, it can be used to solve uncertain and imprecise problems. The most special characteristic of this theory is that it doesn't need any earlier or additional information to tackle questions besides some necessary data musters. In combination with neural network, expert system, fuzzy theory, evidence theory, or genetic algorithm, Rough Sets Theory is widely used in various fields,[1] such as knowledge acquirement, data mining, pattern recognition, machine learning, and decision support. As an important component of Rough Sets Theory, Reduction of Attributes attracts increasing attention in both theory and application. Reduction of Attributes corresponds to problems on selecting subsets of attributes in machine learning. It can effectively reduce information redundancies, and help people make a correct and concise decision. In Reduction of Attributes of Rough Sets, the reduction of information system is usually not unique. The number of attributes directly affects the length of the coding of decision rules. To acquire the most concise decision rules, a reduction including the least attribute is required. However, Wong and Ziarko[2] have proved that the minimal reduction in an information system is a hard problem, so recently there is no efficient algorithm in finding an optimal reduction[3].

2.1.2 Reduct and Core

From the above definition of equivalence relations, 2 basic concepts in rough set theory, namely, the reduct and the core, can be defined as follows, $Q \subseteq P$ is a reduct of P if Q is independent and if IND (Q) =IND (P), and is denoted by RED (P).The core of P is the set of all indispensable relations in P and is denoted by CORE (P). A reduct of knowledge is its essential part, which is sufficient to define all the basic concepts occurring in the considered knowledge.

2.1.3 Relative Reduct and Relative Core

Let P and Q be 2 equivalence relations on universe U. The"P positive region of Q" denoted by POSp (Q) is a set of objects of U. From the definition of the positive region, $R \in P$ is said to be "Q-dispensable in P", if and only if

$POS_{IND(P)}(IND(Q)) = POS_{IND(P-\{R\})}(IND(Q))$ (1) Otherwise, R is "Q-indispensable in P". If every R in P is"Q-indispensable", then P is "Q-independent".

As a result, the"Q-reduct of P" denoted by S, is the "Q-independent" subfamily of P and $POS_S(Q) = POS_P(Q)$. Accordingly, $CORE_Q(P) = \cap RED_Q(P)$.

2.1.4 Dependence of Attributes

The purpose to discuss Dependence of Attributes is to analyze the inner relation among studied data. In the theory about Rough Sets, the degree of dependence among attributes is measured by $\alpha_R(X)$, defined as below.

2.2 Fuzzy Logic

Fuzzy Logic has rapidly developed into one of the most successful modern technologies in dealing with sophisticated control systems. It resembles human decision-making with an ability to generate precise solutions from either certain or approximate information. Fuzzy Logic also bridges an important gap in engineering design methods left vacant by purely mathematical approaches (e.g. linear control design), and purely logic-based approaches (e.g. expert systems) in the system design. In addition, the other approaches often require accurate equations to model real-world behaviors, while fuzzy design can accommodate the ambiguities of the real-world human language and logic. It provides an intuitive method for a systemic description in human terms and automates the conversion of those systemic specifications into effective models.

Fuzzification (using membership functions to graphically describe a situation). Selection of fuzzy language variables and membership functions by $\frac{f_{j1}^{i}}{R_{j1}} + \frac{f_{j2}^{i}}{R_{j2}} + \cdots + \frac{f_{jl}^{i}}{R_{jl}}$, produces fuzzification information.

Defuzzification (obtaining the crisp or actual results). Following the equation $f_{jk}^{i} = \max(f_{j1}^{i}, f_{j2}^{i}, \cdots f_{jl}^{i}) \qquad 1 \le k \le l$, we can get defuzzification information. Comparisons of crisp sets, fuzzy sets, rough sets are shown in Table 1.

Table 1. Three different sorts of mathematical sets

Compared item	Standard set	Fuzzy set	Rough set
Research objects	Data variables	Linguistic variables	Incomplete information
Model	Mathematics model	Fuzzy mathematics model	Attribute Reduction
Descriptive function	Transfer function	Membership function	Upper/lower approximation set
Descriptive property	Precision	Ambiguity	Imprecise
Range of set	$C_A(x) \in [0,1]$	$\mu_A(x) \in [0,1]$	

2.3 Sets Pair Analysis (SPA)[4]

Sets pair is a pair of two relative sets. SPA is a method to process various uncertainties according to the connecting degree $u = a + bi + cj$. The two relative sets may have three relationships, i.e., identical, different, and contrary, and the connecting degree is an integrated description of these relationships.

$H = (A, B)$ is assumed to be a set pair of two sets A and B. For certain application, H has totally N attributes. S of them is defined as the mutual part of A and B, P of them

are the contrary part, and the residual attributes $F = N - S - P$. Then the connecting degree of H

$$u(\omega) = \frac{S}{N} + \frac{F}{N} i + \frac{P}{N} j = a + bi + cj \tag{1}$$

Where $\frac{S}{N}$ is the identical degree, $\frac{F}{N}$ is the different degree, and $\frac{P}{N}$ is the contrary degree.

Usually, a, b and c are used to denote them respectively, and $a + b + c = 1$.

3 Knowledge Acquisition Approach

China Unicom's current brand has Shijie Feng, Xin Shili and Ruyi Tong, how to tap new customers and how to recommend an appropriate brand to new customers? Their choices are Shijie Feng, Xin Shili, Ruyi Tong, or other?

3.1 Attribute Reduction

There are four factors which affect the choices of the new customers. They contain age, basic call charge, message charge and GRPS charge. Above value of four factors can be acquired from survey of related groups. The paper analyses the data of the brand survey which is from more than 1000 customers, such as Table 2.

Table 2. Data collection

customer	basic call charge(A)	message charge(B)	GRPS charge(C)	Phone model(D)	the brand(E)
1	100	20	50	Nokia	Xin Shili
2	340	2	5	Motorola	Shijie Feng
3	220	18	30	Nokia	Xin Shili
4	1000	5	14	Nokia	Shijie Feng
5	50	20	30	Lenovo	Xin Shili
6	100	5	14	Nokia	Ruyi Tong
7	460	2	5	Motorola	Ruyi Tong
…	…	…	…	…	…
amount to 500 data					

According to Table 2, we define $f_{jk}^{i} = \max(f_{j1}^{i}, f_{j2}^{i}, \cdots f_{jl}^{i}) \qquad 1 \le k \le l$ and derive a new table 3.

Table 3. Customer information after the largest degree of membership

customer	basic call charge(A)	message charge(B)	GRPS charge(C)	Phone model(D)	the brand(E)
1	2	1	1	3	1
2	3	4	3	1	3
3	2	1	2	3	1
4	4	3	2	3	3
5	1	1	2	2	1
6	2	3	2	3	2
7	3	4	3	1	2
…	…	…	..	…	..

$$U/R=\{1,(2,7),3,4,5,6\},\ U/\{R-A\}=\{1,(2,7),3,(4,6),5\}$$
$$U/\{R-B\}=\{1,(2,7),(3,6),4,5\},\quad U/\{R-C\}=\{(1,3),(2,7),4,5,6\}$$
$$U/\{R-D\}=\{1,(2,7),3,4,5,6\},\quad U/S=\{(1,3,5),(2,4),(6,7)\};$$
$$\mu_R(S)=\{1,3,4,5,6\}+\{2,7\}i,\quad \mu_{R-A}(S)=\{1,3,5\}+\{2,4,6,7\}i\neq\mu_R(S)$$
$$\mu_{R-B}(S)=\{1,4,5\}+\{2,3,6,7\}i\neq\mu_R(S),\quad \mu_{R-C}(S)=\{4,5,6\}+\{1,2,3,7\}i\neq\mu_D(S)$$
$$\mu_{R-D}(S)=\{1,3,4,5,6\}+\{2,7\}i=\mu_R(S)$$

So the attribute D can be reduced to derive Table 4.

Table 4. Customer information after attributes reduction

customer	basic call charge(A)	message charge(B)	GRPS charge(C)	the brand(E)
1	2	1	1	1
2	3	4	3	3
3	2	1	2	1
4	4	3	2	3
5	1	1	2	1
6	2	3	2	2
7	3	4	3	2
…	…	…	..	..

3.2 Determination of Weight Coefficient

According to $\alpha_i = \dfrac{\gamma(C,D) - \gamma(C-i,D)}{\sum_{i=1}^{n}(\gamma(C,D) - \gamma(C-i,D))}$ and

$\omega_i = 0.6 \times \alpha_i + 0.4 \times \beta_i$ We get

$U / R = \{1,(2,7),3,4,5,6\}$, $U / \{R - A\} = \{1,(2,7),3,(4,6),5\}$

$U / \{R - B\} = \{1,(2,7),(3,6),4,5\}$, $U / \{R - C\} = \{(1,3),(2,7),4,5,6\}$

$U / S = \{(1,3,5),(2,4),(6,7)\}$, $\mu_R(S) = \{1,3,4,5,6\} + \{2,7\}i$,

$\mu_{R-A}(S) = \{1,3,5\} + \{2,4,6,7\}$, $\mu_{R-B}(S) = \{1,4,5\} + \{2,3,6,7\}i$,

$\mu_{R-C}(S) = \{4,5,6\} + \{1,2,3,7\}$, $k = \gamma(R,D) = 5/7$,

$\gamma(R-a,D) = \gamma(R-b,D) = \gamma(R-c,D) = 3/7$

$\therefore \quad \alpha_a = \alpha_b = \alpha_c = 0.333$

set $\beta_a = 0.4, \beta_b = 0.3, \beta_c = 0.3$, so we get $\omega_a = 0.36, \omega_b = 0.32, \omega_c = 0.32$.

4 Conclusions

Data mining has advantage in the decision-making of the enterprise. Extension relevant function can be used to quantitatively depict data gather of data mining. It can effectively solve the problem of the data quality, and provide clear decision-making for the enterprise. It also can provide a new thinking mode and approach for data mining .So data mining has great reference value.

Acknowledgement

This work is supported by 2010 outstanding youth project of education department of hunan province(project number:10B021)and 2010 science and technology project of hunan provincial science and technology department(project number:2010CK3029).

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Improved ZigBee Network Routing Algorithm Based on LEACH

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Abstract. Energy efficiency design of routing protocol is a kind of the key technologies used to wireless sensor networks. The paper introduces the ZigBee technology, summarizes the current transmitting routing model in wireless sensor networks, and finds that the traditional LEACH protocol can lead to overload of some cluster head nodes. The paper suggested that the existing LEACH agreement was improved and the new algorithm was better than traditional LEACH routing algorithm by the comprasion of simulation. The improved routing algorithm can prolong the networks lifetime and effectively save the scarce energy.

Keywords: LEACH, ZigBee, Wireless Sensor Network, Environmental Monitoring, Cluster head.

1 Introduction

Compared with the traditional network, wireless sensor network is a kind of self-organization wireless networks with data for center. There are some characteristics such as rapid temporary networking, network topology dynamically changing, high survivability and no network infrastructure. With the wireless sensor network technology is applied more and more widely, wireless communication technology is put forward higher requirements. ZigBee technology is a kind of two-way communication technology with short distance, low complexity, low power consumption, low data rate, low cost, mainly suitable for automatic control and remote control. Therefore, ZigBee technology based on wireless sensor network widely used in environmental monitoring, biological population studies, meteorological and geographical research, fire testing which has more advantages than conventional observation system has great scientific significance and applications.

2 ZigBee Wireless Sensor Network

ZigBee technology is a kind of two-way wireless communications technology with a short distance, low complexity, low power, low data rate and low-cost. ZigBee can works in the 2.4GHz ISM band without registration, with the transmision rate of

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 201–206, 2011.
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10-25kbps and the transmission distance more than 100m, with FM and spread spectrum technology, with low data transfer rate, low power consumption, network capacity, security, automated group network, dynamic routing and so on. ZigBee protocol mainly suitable for automatic control, remote control in the field, building security systems and home security systems. And a ZigBee equipment can be connected ZigBee 254 other equipment. Each ZigBee network node is not only the object itself can be monitored directly with data acquisition and monitoring, it can automatically transfer over from other network nodes, data transmission, in addition to each ZigBee network node (FFD) also in the scope of their coverage within the network information with a number of transit does not undertake the task of isolating the child node (RFD) wireless connection. Each ZigBee network node (FFD and RFD) can support up to 31 sensors and controlled devices, each sensor and controlled devices can interface with 8 different ways you can capture and transmit digital and analog.

3 Wireless Sensor Network Routing

ZigBee technology has some shortcomings, such as is not suitable for transmission of large quantities of data, only low-speed data transmission, Although expanded network coverage, but overmuch node will increase the message delays and communication costs, etc.[5] Based on the above consideration, this article chooses LEACH agreement. LEACH agreement in wireless sensor networks is proposed first, followed by stratified routing protocols of layered routing protocols are mostly in its basis, but also exists LEACH agreement with feasible improvement.

LEACH agreement defines "(application)" concept, each round into the stage of establishing a stable and stage. In order to reduce the extra clumps of energy consumption, stable stage far longer than the establishment stage. The plane with more jump routing protocol and static clustering algorithm, can make the sensor network LEACH (death) get a node of 8 times, network life cycle extended by 15%.

The establishment of cluster is forming stage, each node from 0 to 1 in a random number, if this is less than the round set threshold $T(n)$, then the node becomes the first round. $T(n)$ calculated as follows.

$$T(n)=\begin{cases}\dfrac{p}{1-p*(r \bmod 1/p)} & if \quad n\in G \\ 0 & otherwise\end{cases} \tag{1}$$

Eq. 1, $p=k/n$, n expressed the network sensor nodes, p expressed a need for the percentage of cluster head node, k expressed a number of clusters in the network (the number of cluster head node), that the current number of rounds r, G expressed that in the remaining $1/p$ rounds is not a cluster head node set of sensor nodes[2].

Cluster head, to send broadcast information. Other nodes after receiving information, according to the signal strength to choose it to join the cluster, and to join the hair sends tuft. Cluster head after receipt of a request to join the routing table, joints and create a time table, then notify TDMA each the cluster nodes start transmitting data.

In the stable stage of cluster nodes, keep listening state, cluster nodes in the dormant. When the time comes, the distribution of the nodes in the cluster, and will be forwarded to awaken data of cluster nodes. Collect all the nodes in the cluster the data sent after data fusion, will send the base station. In the stable period after period of time, the whole network into the next round working cycle, continuous cycle.

4 The Improved Algorithm Based on LEACH Agreement

The proposed algorithm can run continuously the reconstruction process of the cluster. As shown in figure 1.

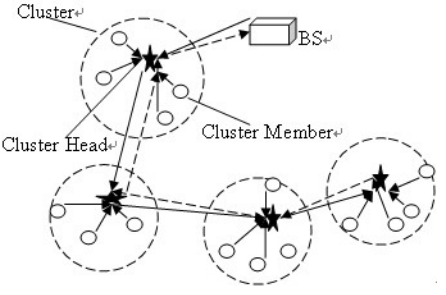


Fig. 1. Based on the more LEACH agreement of data transmission and jump algorithm fusion process

- The establishment phase:

(1) Cluster head elections

LEACH agreement, in a radio to cut in the statement of cluster nodes become signal. And cut in the radio was not necessary; such not only can use a lot of energy, and will cause interference between channels, as long as the guarantee each node can receive near the statement of cluster nodes to send signals. Based on the above reasons, we will cluster head elections are as follows: to modify the surplus energy node in the network into delay, in all nodes become cluster head, waiting for a delay before delay arrived, the priority of cluster nodes become nodes, and its surrounding node becomes the nodes in the cluster, which guarantees each piece in the area of energy optimal node as of cluster nodes, and guarantee of cluster nodes evenly distributed.

$$\Delta t\left(E_{\text{ava}}, N_s\right) = \frac{\tau E_{\min}\left(E_0 - E_{\text{ava}}\right)}{N_s E_{\text{ava}}\left(E_0 - E_{\min}\right)} \tag{2}$$

Eq. 2, the residual energy E_{ava} is node, the node energy E_0 is the initial value, E min is a node can become cluster head of minimum energy threshold for maximum delay, respectively, waiting for the network times. In addition, the scope for E_{ava} [$E_{\min}$, if the node E_0] within the scope of the surplus energy, to become cluster head. Each node with Eq. 2 calculates their waiting time train $\Delta t(E_{\text{ava}}, N_s)$. If the node, the residual energy more time is shorter, and for a long time.

(2) The node becomes more sufficient energy of cluster nodes, sent out radio messages. Other nodes after receiving information, according to the signal strength to choose it to join the cluster, and to join the hair sends tuft. Each cluster nodes will receive more requests for its distribution, add a different time, and will send the information within the cluster nodes. Cluster nodes in the distribution of time after receiving information into hibernation, until the time come when his woke up again.

(3) Cluster nodes to send a cut in the cluster, the network information between node location information to other cluster nodes. Then according to the demand of application of cluster establish the shortest distance between the trees, and find their next hop cluster nodes.

- Data transmission phase:

Cluster nodes in the wake of his time in the data transfer within, to cluster nodes. Cluster nodes after receiving the data is entered, between cluster the data transmission phase, cluster data fusion to then a jump of cluster nodes. For to cluster data fusion, between the cluster nodes from other cluster nodes to receive the data fusion to transmit, otherwise the first direct traffic. This complete data transmission process.

Using the data fusion technology lie on cluster nodes in the distance to the gateway. Fig.2 shows, set d_{data} radius area, 1 ~ n to A node, with A distance of the gateway to transmit packets for d_{data}, length of l.

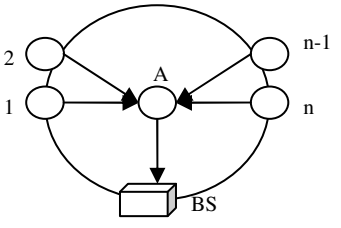


Fig. 2. Data fusion model

Using data fusion, the network energy consumption for:

$$\begin{aligned} E_{\text{nodata}} &= nE_{Tx}(1) + nE_{Rx}(1) + nE_{Tx}(n1) \\ &= n\times\left(1E_{\text{elec}} + 1\varepsilon_{\text{amp}}d^{2}{}_{\text{data}}\right) + n\times 1E_{\text{elec}} + n1E_{\text{elec}} + n1\varepsilon_{\text{amp}}d^{2}{}_{\text{data}} \\ &= 3n1E_{\text{elec}} + 2n1\varepsilon_{\text{amp}}d^{2}{}_{\text{data}} \end{aligned} \tag{3}$$

Using data fusion, choose A node, A data fusion to receive 1 and 2. N node after data, data fusion, again to send data gateway, assuming that node node energy consumption data fusion 1 bit of data fusion, for E_{DA} when the network energy for:

$$\begin{aligned} E_{\text{data}} &= nE_{Tx}(1) + nE_{Rx}(1) + n1E_{DA} + E_{Tx}(n1) \\ &= n\times\left(1E_{\text{elec}} + 1\varepsilon_{\text{amp}}d^{2}{}_{\text{data}}\right) + n\times 1E_{\text{elec}} + n1E_{DA} + n1E_{\text{elec}} + n1\varepsilon_{\text{amp}}d^{2}{}_{\text{data}} \\ &= (2n+1)1E_{\text{elec}} + (n+1)1\varepsilon_{\text{amp}}d^{2}{}_{\text{data}} + n1E_{DA} \end{aligned} \tag{4}$$

Using data fusion to realize data fusion energy than not adopted, must $E_{\text{data}} < E_{\text{nodata}}$, namely $n1E_{DA} < (n-1)1E_{\text{elec}} + (n-1)1\varepsilon_{\text{amp}} d^2_{\text{data}}$, so requirements

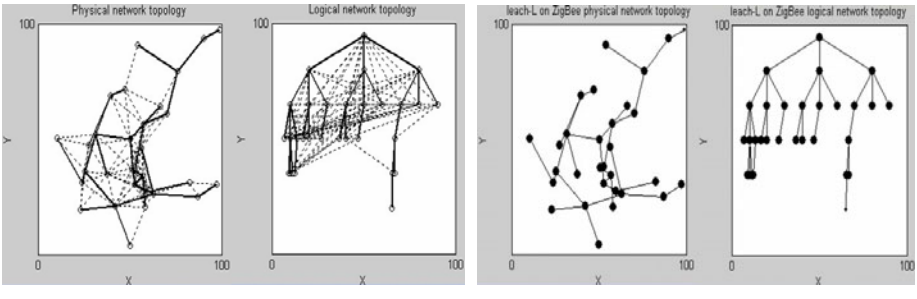
$$d_{\text{data}} > \sqrt{\frac{nE_{DA} - (n-1)E_{elec}}{(n-1)\varepsilon_{amp}}} \tag{5}$$

Means of cluster nodes to a constant value than gateway node d_{data}, using data fusion effect is good.

5 Simulation Experiments

5.1 Simulation Model and Parameter Settings

For 30 sensor node random distribution in the 100 * 100 square area, figure 3 is simulated environment of network topology generation and the application of the algorithm LEACH - L network topology generation.



(a) Simulated environment (b) Application of LEACH - L network

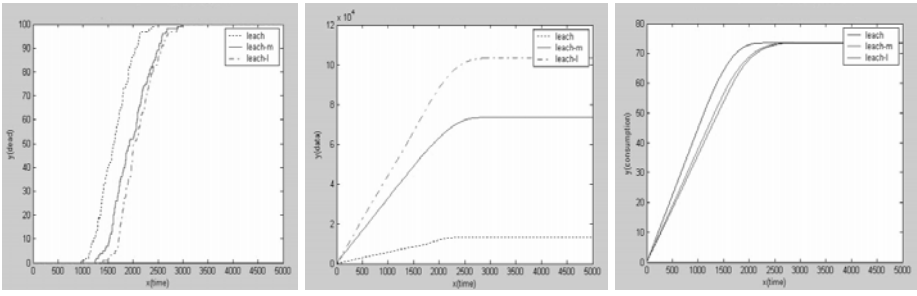
Fig. 3. The network topology

Figure 3, the experimental results show that the 30 nodes randomly generated, application of network topology LEACH - L algorithm effectively eliminates the interference between channel network administrative levels more orderly, clear, can make the data more jump clumps laohutai transmission.

5.2 Simulation Results and Performance Comparison

Hypothesis in 100 * 100 square area even put 100 sensor node, the base position Settings for 50, 50 (50 times), circulation. All nodes, initial energy for the initial value of 0.5 m, can 4000bit packet length for sending and receiving data, the energy consumption for 50nJ/bit.

Figure 4, the experimental results show that the algorithm can effectively balance - L cluster head of energy consumption, energy losses evenly distributed to all nodes, improve the accuracy and efficiency of data transmission, avoid single node premature deaths, prolong the network lifetime.



(a) The life cycle (b) The data comparison (c) The network energy consumption

Fig. 4. The comparison of LEACH, LEACH-M and LEACH-L

6 Conclusion

Based on the traditional LEACH routing algorithm is analyzed, and the improvement is: an improved residual energy will be converted to wait node, the election of cluster delay, 2 in the ideal environment, between cluster data and jump forward more than routing data fusion, consider to whether data fusion technology is adopted to cluster nodes on the distance to the gateway node. Through the simulation results, the improvement of LEACH-L algorithm in network node has balanced energy consumption. This will improve the LEACH - L algorithm to ZigBee network, to make up for the deficiency of LEACH algorithm, single jump from the life span of the extended.

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Fast Monte Carlo Localization for Mobile Robot

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Abstract. For the issue of increased computational complexity to improve the positioning accuracy of robots leaving in the mobile robot localization method, this paper propose a new Monte Carlo localization algorithm. This method combinated the traditional particle filter algorithm with unscented Kalman filter, markovian Monte Carlo and reduced complexities level through dynamically updating the number of particles in particle collection and ensuring the accuracy of mobile robot localization. Simulation results show that the algorithm can not only inhibit the particle degradation and improve the positioning accuracy of the robot, but also in terms of computational complexity has increased significantly.

Keywords: Robot localization, Monte Carlo algorithm, Dynamic update, Particle degradation; Computational complexity.

1 Introduction

The localization is one of the important contents in mobile robot's research, and is the prerequisite to the mobile robot way plan, the guidance, the decision-making and the missions. The location for mobile robot is a process that non-precise sensor information is fused, is also a process that misalignment and non-Gauss condition is estimated online. For the problem of nonlinear and non-Gaussian estimation, the commonly used filtering method is the Monte Carlo particle filter, which has shown great vitality in dealing with the problem of nonlinear non-Gaussian, but there is still lack of accuracy, one of the reasons is the existence of particle degradation. For this problem researchers have made a lot of improvement algorithms, such as Markov - Monte Carlo (MCMC) particle filter robot localization method, which combines the traditional particle filter with the typical MCMC methods. Genetic Monte Carlo Localization method, which introduced the intersection of evolutionary computation and mutation operation to the Monte Carlo algorithm etc. They all can effectively inhibit the degradation of particles. Although these improved algorithms have increased the precision of robot localization, computational complexity is also increased.

To solve this problem, this paper propose a new algorithm, which uses the unscented Kalman filter to produce the proposed distribution and improve the accuracy of initial estimates of the state and uses Markov - Monte Carlo particle to inhibit degradation and maintain the diversity of particle, at the same time can update the number of particles in

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 207–211, 2011.
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the particle collection dynamically according to the case of robot localization, and reduce the complexity of the algorithm in the case of ensuring the accuracy of Mobile Robot Localization being not reduced.

2 Robot Localization Problem

Mobile robot localization can be seen as Bayesian assessment, is through the given input data, observations, movement and perception model, use prediction and update steps to estimate optimization problem of the state of robot pose reliability at the current time.

Suppose the current state of mobile robot is $s_t = (x_t, y_t, \theta_t)$, where (x_t, y_t) is the position of the robot at time t, θ_t is the direction angle at time t. The robot can estimate the current state S_t by estimating the posterior probability density distribution of $p(s_t / z^t)$ to achieve, where $z^t = (z_t, t = 1, 2....N)$ is the measured data stream. $p(s_t / z^t)$ represents the probability when mobile robot position is s, which is in the case of what measurement data is z. According to Bayes rule, we must go through two steps to achieve $p(s_t / z^t)$.

(1) Prediction stage

Through the motion model to predict the state of mobile robot the next time, ie by the following formula to calculate the prior probability density:

$$p(s_t / z^{t-1}) = \int p(s_t / s_{t-1}, u_{t-1}) p(s_{t-1} / z^{t-1}) ds_{t-1} \tag{1}$$

In the formula: $p(s_t / s_{t-1}, u_{t-1})$ is called the motive model.

(2) Update stage

Through the perceptual model to update the state of mobile robot, ie by the following formula to calculate the posterior probability density $p(s_t / z^t)$:

$$p(s_t / z_t) = \frac{p(o_t / s_t) p(s_t / z^{t-1})}{p(o_t / z^{t-1})} \tag{2}$$

In the formula: $p(o_t / s_t)$ is called the observative model.

3 Monte Carlo Localization Algorithm

3.1 Basic Monte Carlo Localization Algorithm

Basic Monte Carlo localization algorithm uses a series of weighted random sample set $s_k = \{s_k^{(i)} =< X_k^{(i)}, w_k^{(i)} \mid i = 1, 2, ..., N >\}$ in the state space to approximate probability density function of the posterior of the system state, each sample $s_k^{(i)}$ is made up of the weight of robot pose $X_k^{(i)} = (x_k, y_k, \theta_k)$ and the composition $w_k^{(i)}$, accuracy can approximate optimal estimation and it can be applied to any state space model represented by nonlinear non-Gaussian system.

Implementation steps of basic Monte Carlo Localization algorithm are as follows:

(1) Initialization: When k = 0, extract N sample points $x_0^{\ i}$ from the prior probability density function, and Set the beginning of the weight $w_0(i) = 1/N, i = 1,2,...N$.

(2) Importance sampling: extract N sample points $x_k^{(i)}$ from the conversion prior density function $p(x_k / x_{k-1}^{(i)})$.

(3) Weight calculation: use the formula $w_k^{(i)} = w_{k-1}^{(i)} p(z_k / x_k^{(i)})$ calculate the weight, and use the formula $\overline{w}_k^{(i)} = w_k^{(i)} / \sum_{i=1}^{N} w_k^{(i)}$ to normalize the weight.

(4) Resampling: choose the sampling points of large weight, eliminate the sampling points of low weight, and use residual sampling method to generate multiple sub-samples from the higher weight samples while total number of samples are maintained for the N. And give it the weight. Then repeat (2), (3), (4) steps, until the end positioning.

3.2 Improved Monte Carlo Localization Algorithm

In order to overcome the problem of lack of particle and particle degradation existing in the global positioning about the basic Monte Carlo localization algorithm and reduce the complexity of the algorithm and improve processing speed at the same time, this article will introduce the UKF and the MCMC algorithm to the Monte Carlo method. In the sampling stage, use UFK algorithm to generate the importance proposal distribution so that the sampling points are close to the actual distribution, and solve the problem of particle degradation better; In the re-sampling stage, introduce MCMC algorithm, solve the problem of lack of particles. And update the number of particles in the particle collection dynamically at the same time. Specific steps are as follows:

(1) Initialization: same as the basic Monte Carlo method.

(2) Sampling stage: Obtain $x_k^{(i)}$, $p_k^{(i)}$ with the non-mark Kalman filtering renewal in each time for the first sampling point $x_{k-1}^{(i)}$,so the proposal distribution function is.

$$q(x_k^{(i)} / x_{k-1}^{(i)}, z_{1:k}) = N(x_k^{(-i)}, p_k^{(i)}) \tag{3}$$

It takes full advantage of the new observation information.

(3) Weight calculation: the same as the basic Monte Carlo method.

(4) Resampling:

1) Intelligent re-sampling: resample only it is needed so that it can reduce the number of resampling and significantly reduce the risk that a good sample is removed, then further improve the performance of the algorithm. By the formula $N_{eff} = 1/\sum_{i=1}^{N} (w_k^{(i)})^2$, determine when to sample. When N_{eff} is less than a given threshold N/ 2, it resamples.

2) MCMC sample: Re-sampling will occur the phenomenon that particles deprivate in extreme cases, it can be solved by increasing the number of particles, but the calculation would increase. Use MCMC method to sample, and simulate the process of Markov Monte Carlo, take the MH sample for each particle after weight sample from

the obtained collection, then the importance weight of each particle is assigned to 1/N, and then repeat steps (2),(3),(4) until the end positioning.

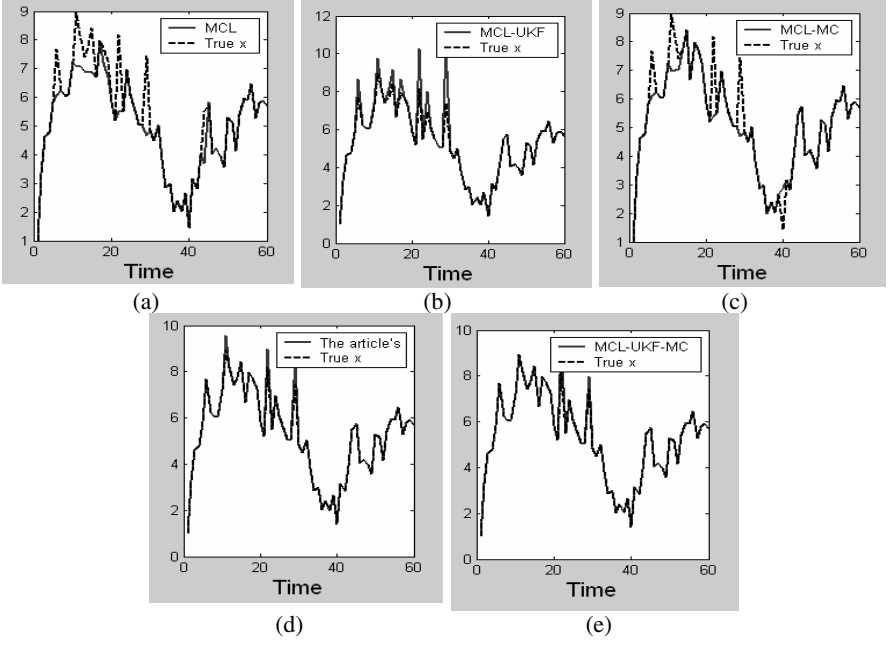
4 Simulation Results and Analysis

In this paper, we verify the proposed algorithm by simulation experiments. This experiment compare the algorithm with Basic MCL algorithm, MCL_UPF algorithm, MCL_MCMC algorithm and MCL_UPF_MCMC algorithm.

By the following equation of state:

$$\begin{cases} x_t = 1 + \cos\left((4 * e - 2) * pi * x * t\right) + 0.5 * x + u_{t-1} \\ y_t = \begin{cases} x_t^2 / 5 + v_t & t \le 30 \\ -2 + x/2 + v_t & t > 30 \end{cases} \end{cases} \tag{4}$$

Where u_{t-1} is the system noise, it is a random variable obeyed the gamma distribution. v_t is a Gaussian random variable. According to the formula, carry out 50 experiments



(a) MCL algorithm is compared with the actual location
(b) MCL-UKF algorithm is compared with the actual location
(c) MCL-MC algorithm is compared with the actual location
(d) MCL-UKF-MC algorithm is compared with the actual location
(e) The article's algorithm Compared with the actual location

Fig. 1. Compared with the actual location of various algorithms

Table 1. Performance comparison table

Algorithm	Mean	Variance	Single Time
MCL	0.51531	0.028134	0.9011
MCL-UKF	0.28584	0.007302	3.9442
MCL-MC	0.49408	0.038129	1.9917
MCL-UKF-MC	0.07653	0.008372	11.875
The article's algorithm	0.07890	0.005237	7.6833

by using 100 particles for 5 methods, and simulation time is T=60; The results of several algorithms are shown in Figure 1, the comparation of the mean and variance about 50 algorithms is shown in Table 1.

As can be seen from Table 1,the mean of the algorithm is only higher by 0.002 than MCL-UKF-MC algorithm, but the variance is lower than the MCL-UKF-MC algorithm and simulation time is much shorter than the other. Ensuring the accuracy of this algorithm can be seen the same situation, improve the efficiency. Requirements have been the result of paper.

5 Conclusion

For robot localization of the nonlinear, dynamic system of non-Gaussian state estimation, use the UKF algorithm, MCMC algorithm and intelligent re-sampling algorithm etc integrately based on the basic MCL algorithm, and then propose the algorithm in this paper. And through simulation experiment, reduce the complexity of the algorithm in the case of ensuring the same accuracy of Mobile robot positioning. But if it is online and adjust the particle number immediately, algorithm will further improve the computation time and this is the future direction of further study.

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Neural Network Expert System in the Application of Tower Fault Diagnosis

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Abstract. For the corresponding fuzzy relationship between the fault symptoms and the fault causes in the process of tower crane operation, this paper puts forward a kind of rapid new method of fast detection and diagnosis for common fault based on neural network expert system. This paper makes full use of expert system and neural network advantages, and briefly introduces the structure, function, algorithm and realization of the adopted system. Results show that the new algorithm is feasible and can achieve rapid faults diagnosis.

Keywords: tower crane, neural network, expert system, fault diagnosis.

1 Introduction

In recent years, with the speed of socialist economic construction and the expansion of construction project year after year, the tower crane and other cranes are demanded more and more in the field of engineering construction. Tower crane plays a very important role during the building and hoisting assignment, so the reducing of the accident and the improvement of safety performance has been the major problems concerned. But once it fails, the product quality was affected, what's the worst, production accident occurred, which both cause unrecoverable loss. Therefore, common oxided fault diagnosis for the important institution of tower crane is very necessary.

This paper puts forward a kind of expert system and neural network combined with neural network expert system used in the common faults diagnosis, speed greatly improves the speed and accuracy of diagnosis, and the result is satisfactory.

2 The System Structure and Function

This system design of neural network, expert system mainly consists of data input module structure, input/output rules conversion module, neural network inference module and user interface module, diagram shown in Figure1.

Each state data by installing data preprocessing, from data input module into the system, and then in real-time dynamic database for system used at any time.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 212–217, 2011.
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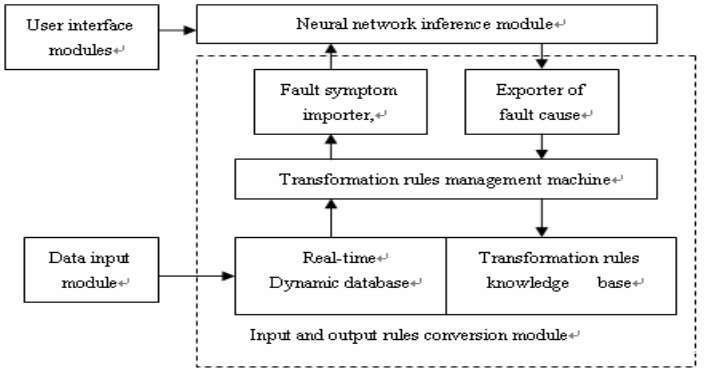


Fig. 1. Neural network expert system chart

Input and output rules for conversion modules, including real-time dynamic database, transformation rules knowledge base, transformation rules management machine, fault symptom importer, exporter of fault cause five parts. Real-time dynamic database stores the real-time operating status information, and the transformation rules management judges whether the system failure symptoms are appear, and what kind of fault symptoms. Two sets of production rules stored in the knowledge base of transformation rules[6]: a set is used to express the relationship between real-time dynamic information and the[4]: tower crane fault symptoms; the other one is used to express the causality of fault symptoms and neural network input layer, fault cause and neural network output layer. Conversion rule management uses real-time dynamic database and information in the transformation rules knowledge base to complete the transformation from logic information of expert system to input and output numerical information, finally. Fault symptom importer assign value to every node which in input layer of the neural network. Exporter of fault cause extractes the value of the node which in input layer of the neural network.

Neural network inference module is the core of neural network expert system, essentially which is the knowledge base of the entire system. Ultimately, it realizes the nonlinear mapping from failure symptom space to the space of fault cause, using the knowledge storaged in network connection weights matrix. The input layer: receive a variety of tower failure information from System to, coding for: $x_{1,}x_2,\cdots x_n$, after the normalized processing, the failure characteristic value for: Y=($y_1, y_2,\cdots y_n$). The hidden layer: Internal learn and process the fault information received from the input layer, through the weights and threshold connecting input and output layer, convert it to solution specific to the input information.

The output layer: nodes in the output layer are n, the total number of failure modes in the tower crane monitoring system, if output of the q mode is: o_q =[00,000,010,$\cdots$000], namely output of the q node is 1, the other outputs are 0, show the q fault existing. If the output is all 0, If the output is all 0, it indicates that no failure mode, also in the normal operating mode.

With user interface module, tower operator can exchange information with system experts timely, prompting the problem solving, failure analysis and the fault location.

3 System Principle and Realization

To obtain the power, collecting on weight lifting rotation speed, torque and speed and jack-up range and speed, the lifting speed and pressure data normalized operation state, provide neural network fault symptoms of learning and expert system for fault symptoms.

This system uses BP neural network. BP algorithm is using the input to the hidden and implicit layers to output layer connection weight matrix realization fault symptoms to the failure of the nonlinear mapping. If at the times of *n*, which output of iteration of the first *j* units id $y_j(n)$, this unit error signal is: $e_{j(n)} = d_l(n) - y_{j(n)}$; definition of unit j square error is: $\frac{1}{2}e_j^2(n)$, the instantaneous of the output total square error is: $E(n) = \frac{1}{2}\sum_{j\in c} e_j^2(n)$, The output of c includes all samples, the unit for training on total N, the mean square error is: $E_{av} = \frac{1}{N}\sum_{n=1}^{N} E(n)$, E_{AV} is the learning objective function, the purpose of learning is to let E_{AV} reaches the minimum. E_{AV} is the network ownership and threshold value and function of the input signal.

The learning process of the BP algorithm in computer [3]:

(1)Initialization, select a rational structure of the network, and set the connection weights and threshold for uniform distribution of smaller values.

(2)Compute each input of sample as follows:

1)Prior to the calculation

On the first layer of the j unit, $v_j^{(l)}(n) = \sum \omega_{ji}^{(l)}(n) y_l^{l-1}(n)$ and $y_l^{l-1}(n)$ is the before layer(1-1)of unit j received working pressure, and(if j=0, set $y_0^{l-1} = -1$, $\omega_{l0}^{l}(n) = \theta_j^l(n)$).

2)Reverse calculation δ

Unit of output:

$$\delta_l^l(n) = e_j^L(n) x_j(n) O_j(n)(1 - O_j(n)) \tag{1}$$

Hidden units:

$$\delta_j^{(l)}(n) = y_j^L(n)[1 - y_j^{(l)}(n)] \sum_k \delta_k^{(l+1)}(n) \omega_{kj}^{(l+1)}(n) \tag{2}$$

3)Fixed the connection weights accordance with the formula below:

$$\omega_{jk}^{(l)}(n+1) = \omega_{jl}^L(n) + \eta \delta_j^{(l)}(n) y_j^{(l-1)}(n) \tag{3}$$

4)n=n+1 input new samples until the E_{AV} get to reserve requirements.

Based on Kolmogorov theorem, this system uses a network of N*2N+1*M three layers BP network, and the N express: the power, lifting weight, lifting torque, rotary speed, luffing speed, jack-up speed, hoisting speed(rate =2), jack-up pressure, eight feature vector; M express the normal state(0,0), lifting torque fault(0,1), rotary speed fault(1,0), luffing speed fault(1,1)Four diagnostic state.

4 Simulation Results

Take the state datas when the tower is normal work, lifting torque fault, rotary speed fault and luffing speed fault. As shown in table l, table 2, table 3, table 4.

Table 1. Normal work data

Sample number	The power /kw	Lifting weight /t	Lifting torque /kN.m	Rotary speed /r/min	Luffing speed /m/min	Jack-up speed /m/min	Hoisting speed (rate=2) /m/min	Jack-up pressure /Mpa
1	21.7	4	400	0.7	24	0.6	45	18
2	21.5	3.8	387	0.75	26	0.62	61	20
3	21.6	2.7	390	0.65	31	0.58	76	19
4	21.4	3.7	398	0.68	28	0.61	50	17
5	21.8	3.9	399	0.72	27	0.56	62	18

Table 2. Lifting torque fault data

Sample number	The power /kw	Lifting weight /t	Lifting torque /kN.m	Rotary speed /r/min	Luffing speed /m/min	Jack-up speed /m/min	Hoisting speed (rate=2) /m/min	Jack-up pressure /Mpa
1	21.8	3.9	408	0.68	27	0.56	62	18
2	21.7	4	410	0.7	19	0.6	61	20
3	21.9	3.6	425	0.56	21	0.51	60	17
4	21.5	3.8	421	0.61	26	0.42	61	12
5	21.6	3.9	417	0.64	24	0.55	62	16

Table 3. Rotary speed fault data

Sample number	The power /kw	Lifting weight /t	Lifting torque /kN.m	Rotary speed /r/min	Luffing speed /m/min	Jack-up speed /m/min	Hoisting speed (rate=2) /m/min	Jack-up pressure /Mpa
1	21.4	3.7	398	0.81	28	0.57	16	20
2	21.7	4	400	2.9	31	0.6	6	18
3	21.5	3.8	375	1.78	26	0.48	61	15
4	21.9	3.6	385	2.72	21	0.53	60	16
5	21.6	4.1	350	1.65	30	0.58	10	17

Table 4. Luffing speed fault state

Sample number	The power /kw	Lifting weight /t	Lifting torque /kN.m	Rotary speed /r/min	Luffing speed /m/min	Jack-up speed /m/min	Hoisting speed (rate=2) /m/min	Jack-up pressure /Mpa
1	21.5	3.7	324	0.65	33	0.57	60	20
2	21.6	4	400	0.7	38	0.6	56	18
3	21.7	3.8	394	0.51	36	0.58	8	7
4	21.5	3.2	387	0.62	40	0.43	20	14
5	21.4	3.7	381	0.69	35	0.58	30	19

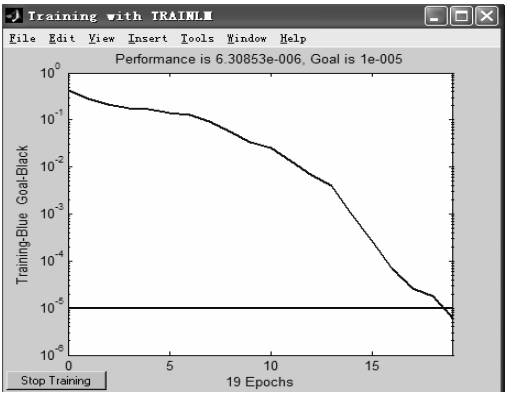


Fig. 2. Neural network training

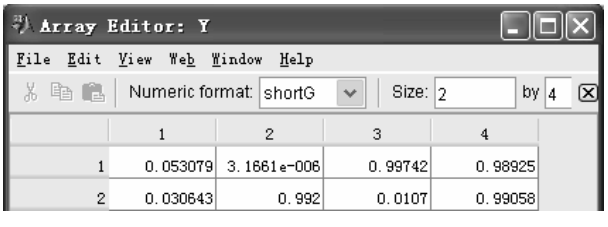


Fig. 3. Test result

Take the data of form 1 to form 4 to a turn, for each table from 1 to 3 as a specimen sample order for the nerve network training, then the network training result, as in figure 2.

Figure 2 shows 0.00001 for error, training cycling times for 50, visible through 19 times after training, network error get to the setted minimum value.

Orderly take the samples without trainnde from form table 1to table 4 to test, and the testing result with Y, the output shown in figure 3.

Test results show that the test specimen 1 is(0,0), belongs to the normal state, Sample 2 is(0,1), belongs to lifting torque fault, Samples 3 is(1,0), belongs to rotary speed fault, Sample 4 is(1,1), belongs to luffing speed fault.

5 Conclusion

Based on artificial neural network to build a "core" intelligent system, combining neural network is the core of the system module, make full use of the neural network in pattern recognition of strong and fast computing power, avoid tedious mathematical modeling process. Meanwhile, a neural network with expert system, data input and output, and explain user-oriented, give full play to its symbolic logic processing capability is strong, The system will be added and expand the proper, can be applied to various categories of tower, growing in the fleet in fault diagnosis of its value.

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An Improved Circuit Design for PFC Based on One-Cycle Control

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Abstract. Power factor is an important parameter for electron and electric power technology, which should be corrected in order to make electronic equipments work stably and safely. This paper is about how to use one-cycle control to correct power factor and make the traditional correcting circuit better. The simulating result shows the method is feasible.

Keywords: one-cycle control, power factor correction (PFC), Boost Converter.

1 Introduction

The pollution of harmonic wave is the important problem to have an affect on power quality for power network. Loads without PF being 1 would make some problems, which would make power network resonate and destroy its stability and would make protecting equipments for relay act wrong in power network and so on. So, harmonic wave should be controlled and PF should be increased. There are two typical methods. One is passive method, which makes harmonic wave compensation to power network by filtering without power or power filtering with power to clear up harmonic wave. The other is initiative method, which improves equipments of the electronic and power, such as rectifier. In practice, it is difficult to product compensation current by the former method. So the latter is a better method. There are some controlling methods for the latter, such as, DCM, CCM, DCM, MCM and one-cycle control technology and so on [1]. Compared, one-cycle control technology is applied to PFC rectifier to make current distortion low and PF high, which does not use multiplier in traditional controlling method and makes the complication of controlling circuit low.

2 One-Cycle Control Technology

One-cycle control technology is given by Keyue M. Smedley in 1991, which is about PWM controlling theory with nonlinear and big signal. The theory is based on the duty cycle of controlling switch on real time, which makes the average value of the

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 218–223, 2011.
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outputting impulse waveform by switching rectifiable diode in each cycle just be equal to or be in direct proportion to the controlling reference parameters, and makes the inputting current on average follow reference current without being controlled by load current and without distortion, even if the load current has big harmonic wave. The characteristic of the theory is to control average current or voltage to the reference value in one switching cycle and the switching error in each cycle is not taken to the next cycle [1].

Fig.1 is the principle diagram for step-down converter by one-cycle control.

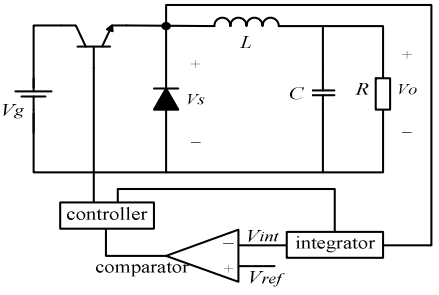


Fig. 1. Principle diagram for Buck converter by one-cycle control

Controller uses impulse with stable frequency and cuts up the switching tube and triggers the integrator. The integrated voltage value of the diode is compared with the controlling reference volumes. If the integrated voltage value is equal to the controlling reference volumes, the switching tube is cut off and the integrator is reset to zero.

In a switching cycle, the voltage value of the diode on average is equal to the variable controlling reference volumes. So is the outputting voltage. Fig.2 is about that the value of controlling reference volumes is changed during every step, and the integrated value of the diode follows the controlling reference volumes immediately. The duty cycle d is decided by the following formula:

$$\frac{1}{T_s}\int_0^{dT_s} v_g dt = V_{ref} \tag{1}$$

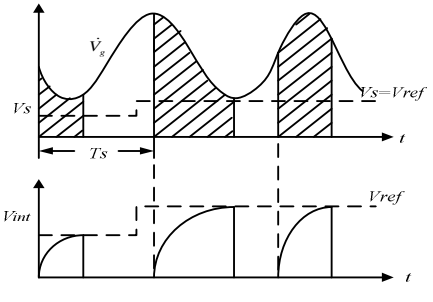


Fig. 2. Working waveform of the Buck converter controlled by one-cycle control technology

Formula (1) is the nonlinear function for inputting voltage and the controlling reference volumes. If the theory is realized practically, the instantaneous progress of the voltage value of the diode on average is finished in a switching cycle. This is the one-cycle control theory.

3 Improved Circuit for the Boost PFC Based on One-Cycle Control

3.1 Main Circuit of the Improved Circuit for the Boost PFC

The traditional single phase PFC circuit is step-up Boost circuit mostly, which is simple and easy to realize. But, if the PFC circuit has big power, there are some problems [1], such as current shock made by diode recovering reversely and the ripple noise. They are relative to each other. The sharp ripple noise is caused by parasitic lead inductance and big di/dt produced when diode recovers reversely. So, a capacitor is parallel to the switching tube in order to control the sharp ripple noise by diode recovering reversely. Fig.3 is about the main circuit of the improved Boost PFC circuit.

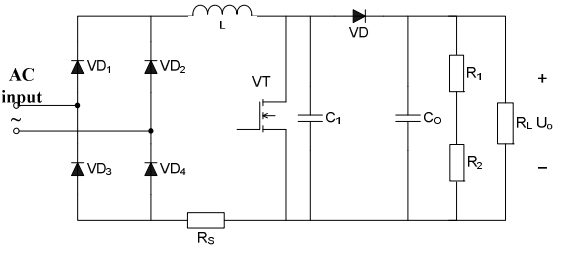


Fig. 3. The main circuit of the improved Boost PFC circuit

3.2 Control Circuit Design

The control circuit applies one-cycle control, which includes integral circuit, integral reset circuit、comparator and RS trigger and so on. The theory diagram is showed by Fig.4.

By the definition of the PF, to correct PF has to be content with that $U = \mathrm{R}_e I$, in which R_e is the impedance of the output terminal of the converter. If R_e should be a pure resistance equivalently in any switching cycle, PF $\lambda = 1$[2].

In a switching cycle, the relation of input and output of the converter is:

$$U_o = \frac{U_i}{1-D} \tag{2}$$

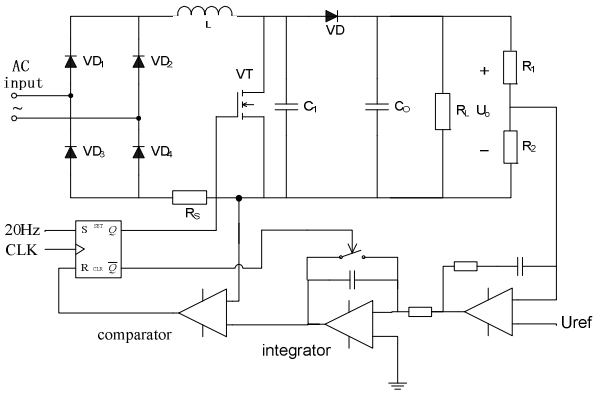


Fig. 4. The theory diagram for the improved control circuit based on one-cycle control

Making $U_m = U_o R_s / \mathrm{R_e}$, in which R_s is the sampling resistance equivalently, so,

$$R_s I_i = \frac{U_m U_i}{U_o} \tag{3}$$

When outputting capacity C for filtering is big enough, U_o should be regard as the constant. From formula (3), in a switching cycle. U_i should be regard as constant. So, I_i always following U_i, the impedance of the input terminal of the converter is a pure resistance equivalently to correct PF. The controlling aim is that:

$$U_m - I_i R_s = DU_m \tag{4}$$

4 Simulating Result

Boost convert controlled by current and voltage is simulated. The parameters are: input voltage 220V, output voltage 300V, switching frequency 20KHz, output capacitance 2200uF and step-up inductance 0.6mH.

The Boost PFC circuit controlled by one-cycle is simulated before improved.

Fig.5 is the waveforms of the input voltage and current of the Boost circuit controlled by one-cycle before improved. The current has big distortion.

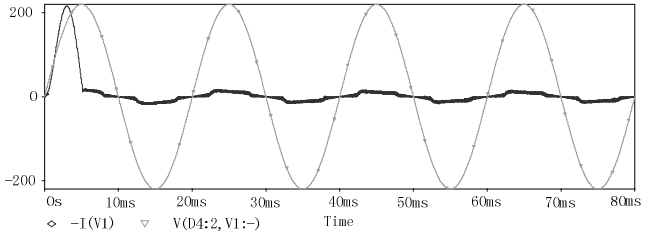


Fig. 5. Waveforms of the input voltage and current before improved

The improved circuit is to parallel a capacitor with 2uF to the switching tube. Fig.6 is about the main controlling waveforms of the Boost circuit based on one-cycle control after improved. From the up to the down, the signals are individually time signal、PWM signal、output signal from the integrator and the amplified signal from detecting resistance.

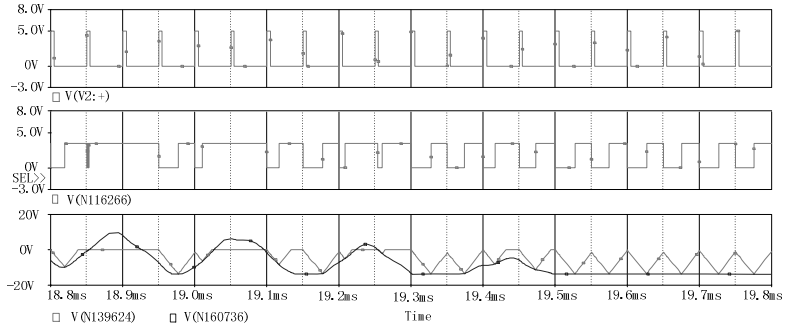


Fig. 6. Waveforms of the each pots in control circuit after improved

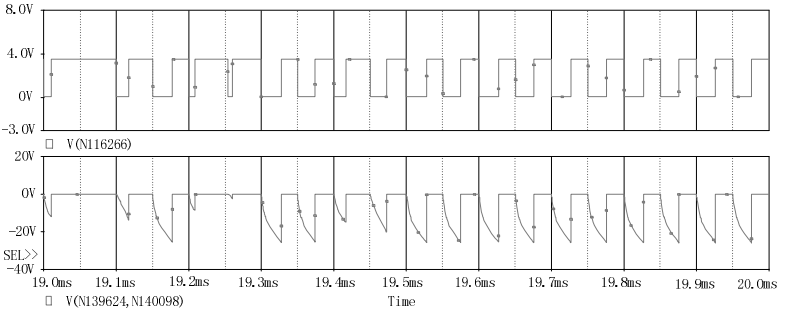


Fig. 7. PWM signal and capacitance voltage

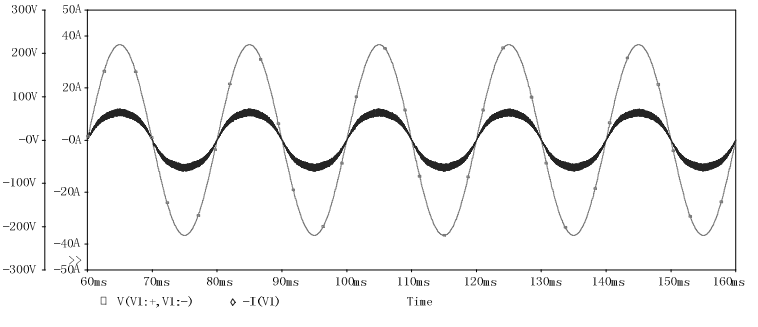


Fig. 8. Input current and input voltage

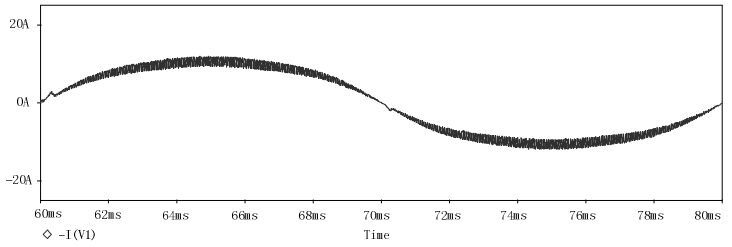


Fig. 9. Waveform of input current in detail

In Fig.7, the upper is PWM signal called $\bar{Q}$ from the output of the basic RS trigger, which controls the switch to close and open directly and the down is the voltage of the capacitance of the integrator. When PWM signal is low level, the switch is open and the capacitor charges. When PWM signal is high level, the switch is close and the integrated capacitor is short, and the capacitance voltage is released immediately.

Fig.8 is the waveforms of the input voltage and current and Fig.9 is the current waveform in detail after improved. From the current waveform, the input current is the sine signal with the same phase to that of the input voltage mainly, which realizes PF to be corrected.

5 Conclusion

In order to make full use of power energy, PFC technology should be applied in rectifier. The paper is about how to use one-cycle control technology into single phase PFC circuit and improve the traditional one. The simulating result shows that one-cycle control technology could correct the PF with fast response, reliability, stability and simple control circuit and so on.

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Research of Rough Cognitive Map Model

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Abstract. Under the circumstance of inheriting the advantages of fuzzy cognitive map, considering that cognitive map (CM) and fuzzy cognitive map (FCM) fails to represent the diversity of the relations of concepts, the dynamic dependency between the relation measures and the state value of concepts, and the measures of uncertain causal relationships, thought of rough set is introduced to solve those problems, and rough cognitive map (RCM) is presented. RCM abstracts a comprehensive relationship between two concepts and gives a comprehensive weight to complete causal reasoning. So the simulating capability of FCM is extended. Finally, RCM is more flexible and robust than FCM; it can simulate the real world better.

Keywords: cognitive map; rough set; rough cognitive map.

1 Introduction

Cognitive maps (cognitive map, CM) [1] is the graph model that represents and reasons causal relationships between the concepts in system. It was proposed by Tloman first in 1948, kelly introduced it into the qualitative analysis of causal relationship in 1955, then Axelord applied it into politics in 1976. The nodes and edges in Cognitive map represent concepts and the causal relations between concepts respectively. Concepts (indicated by the node) can represent the system moves, causes, results, goals, feelings, tendencies, trends and so on, they reflect the system property, performance quality and state. The relations between the concepts indicate the links between the concepts and effect relationship (indicated by arcs with arrows, the direction of the arrow indicates the direction of the link and effect), the strength of the association is indicated by numerical right value [2]. The contents, properties and the strength of the association of the problem are showed in view of "Aerial type" in cognitive map. It can express the dynamic causal systems with feedback which expressed by Tree structure, Bayes networks and Markov difficultly. Kosko introduced the fuzzy measure into the causal relations between concepts in Axelord's cognitive map in 1986, extended the three values logic {-1,0,1} between concepts to the interval [-1,1],proposed fuzzy cognitive map (fuzzy cognitive map, FCM) [3] for expressing and reasoning the fuzzy causal relations between concepts. Fuzzy logic can carry more information than three-valued logic clearly, its power of knowledge Expression

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G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 224–229, 2011.
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and reasoning is stronger. Recently, FCM theory has been widely applied [3,4] in the political, economic, medical, military, social relations and information systems, network management, fault analysis, multi-Agent systems, industrial control, virtual reality and other fields. China scholars Luo xiangFeng [5] proposed Probabilistic Fuzzy Cognitive Map model by introduced conditional probability measure into causal relationship between concepts the first time in 2003. The model not only can express the qualitative and fuzzy causal relationship between concepts, but also the conditional probability causal relationship between concepts, and it can degenerate into fuzzy cognitive maps. Probabilistic Fuzzy Cognitive Map model is simple, robustness good and practical, it has a more realistic simulation skill for real-world than the FCM model.

However, fuzzy cognitive map and probabilistic fuzzy cognitive map consider that the relation between the concepts is unique, and often reflected by a fixed fuzzy measure which subjectively determined by experts. But in reality, the relations between the two concepts are often diverse, and have corresponding properties. Therefore, there will be numbers of edges used to express the relations between the concepts, and each edge has a different attribute weights which change as time changes and the developments of events. In analyzing the issue, the divisions of the relations class change with the awareness ability and the specific requirements, and it involves the classification of knowledge and the representation of the problems, this is the rough problem in the uncertainty. Therefore, this article will introduce rough sets [6] ideas into the cognitive map, and propose rough cognitive maps (Rough Cognitive Map, RCM) model. Rough cognitive map can solve the edge rough problems in cognitive map, and RCM abstracts a comprehensive relationship between two concepts and gives a comprehensive weight to complete causal reasoning and applied research.

2 Rough Cognitive Maps

2.1 Definition of Rough Cognitive Maps

Definition 1. Given a set $G=\{e_1,e_2,..e_m\}$,a Vertex set $V=\{v_1,v_2,\ldots v_n\}$,calls $<v_i,v_j>$ as the vertex attribute, here $v_i \in V$, $v_j \in V$,the element $e_k \in G$ is called edge, if e_k is given vertex attributes $<v_i,v_j>, e_k = e_k < v_i, v_j >$.

Definition 2. Given a set $G=\{e_1,e_2,..e_m\}$, a Vertex set $V=\{v_1,v_2,\ldots v_n\}$. If the edges which given the vertex attributes compose the set $E=\bigcup e_k < v_i, v_j >$, Calls E is the edge set of G . $G=(V,E)$ is a graph, in which $|V|=n$ and $|E|=m$ are the number of vertices and edges respectively.

Definition 3. Given $U=\{e_1,e_2,\ldots e_{|U|}\}$ is discourse, $\Re=\{r_1,r_2,\ldots r_{|R|}\}$ is attribute set of U , and $\Re$ contains Vertex attributes $<v_i,v_j>$, $v_i \in V$, $v_j \in V$, $V=\{v_1,v_2,..v_n\}$. $E=\bigcup e_k <v_i,v_j>$ is the edge set of V , $W=\{w_{ij}(k)\}$, $w_{ij}(k)$ is the

weight of the kth directed arcs between the nodes v_i and v_j, shows the relations and influence on the kth relation that node c_i to node c_j. Said $U=(V,E,W)$ is the domain cognitive map. For any attributes set $R\in\Re$ of E ,Elements (or edge) in E can be divided into different equivalence classes $[e]_R$ according to R. Take any subgraph $T=(M,X,W)$ in cognitive maps, $M\subseteq V$, $X\subseteq E$, When X can be expressed as the union of some $[e]_R$, T is R-accurate cognitive map, or T is R-rough cognitive map. R-rough cognitive map can be defined approximately by two accurate cognitive maps $\underline{R}(T)=(M,\underline{R}(X))$ and $\overline{R}(T)=(M,\overline{R}(X))$, in which

$$\underline{R}(X)=\{e\in E\mid [E]_k\subseteq X\}$$
$$\overline{R}(X)=\{e\in E\mid [E]_k\cap X\neq\phi\}$$

$\underline{R}(T)$ and $\overline{R}(T)$ are the R-lower approximation and R-upper approximation cognitive map respectively, $(\underline{R}(T),\overline{R}(T))$ is called rough cognitive maps of graph T.

Set $bn_R(X)=\overline{R}(X)-\underline{R}(X)$ is called R boundary region of edge set X of graph T, $pos_R(X)=\underline{R}(X)$ is the R Positive region of edge set X, $neg_R(X)=U-\overline{R}(X)$ is the R negative region of edge set X.

2.2 The Determination of the Weights between Concepts in Rough Cognitive Map

Definition 4. Given a rough cognitive map, $a_R(T)$ is called the edge precision about R of T, meanwhile $a_R(T)=\dfrac{|\underline{R}(X)|}{|\overline{R}(X)|}$,here $X\neq\phi$, $|A|$ is the base number of set A.

The edge precision $a_R(T)$ is used to reflect the level of the understanding about the knowledge of edge set in rough cognitive map T.

From the definition of rough Cognitive map above, there are limited numbers of edges between the two concepts, and each edge has a property value. Based on the application of cognitive maps, we must abstract a comprehensive relationship between two concepts and gives a comprehensive weight to complete causal reasoning. So, we define

$$w_{ij}(k)=\begin{cases}1, e_k<v_i,v_j>\in pos_R(X)\\ \lambda, e_k<v_i,v_j>\in bn_R(X)\\ 0, e_k<v_i,v_j>\in neg_R(X)\end{cases},\quad \lambda\in(0,1)$$

Given the comprehensive weight between two concepts: $\rho_{ij} = \frac{|\underline{R}(X)|}{|\overline{R}(X)|} \cdot 1 + \frac{|bn_R(X)|}{|\overline{R}(X)|} \cdot \lambda$

Through the relation of the boundary region and the upper and lower approximation, $\rho_{ij} = \lambda + (1-\lambda)a_R(T)$.

3 The Model of Rough Cognitive Map

3.1 Rough Cognitive Map Time Model

The theory of cognitive map and fuzzy cognitive map can be seen in references [7~9]. It can be seen from these references, although the FCM has more advantages, it fails to represent the diversity of the relations of concepts, the dynamic dependency between the relation measures and the state value of concepts, and the measures of uncertain causal relationships. As shown in Figure 1, the relations between the concept 1 and 2 are diverse, the state of the concept is changing, and the relations between concepts are changing too. Therefore, the results and the extent of impact will surely be different. Considering the relations between concepts from the perspective of fuzzy cognitive map is incompatible with the analysis of reality.

Eugene (1994) proved that if add the direction of time in the loop, the concepts of the ring will not interdependent. Stylios introduced time variables in Kosko's Fuzzy cognitive map model, this laid a theoretical foundation for rough cognitive map.

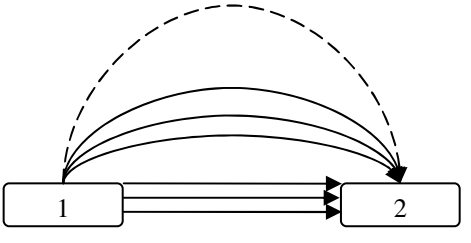


Fig. 1.

The FCM with the state of time and memory which Stylios proposed can be expressed as

$$V_{c_j}(t) = f\left[\sum_{\substack{i=1 \\ i\neq j}}^{N} V_{c_i}(t)w_{ij} + \gamma V_{c_j}(t-1)\right] \tag{1}$$

$V_{c_j}(t)$ is the state value that concept c_j at time t, γ is the impact factor that state value of the last time to the state value of the next time.

If using the approximate accuracy ρ_{ij} to instead w_{ij} in equation (1), that is the rough cognitive map time model with memory function and dynamic properties:

$$V_{c_j}(t)=f\left[\sum_{\substack{i=1\\ i\neq j}}^{N} V_{c_i}(t)\rho_{ij}(t)+\gamma W_{c_j}(t-1)\right] \tag{2}$$

The equivalence classes divided by Equivalence R_{ij} may change over time in the formula, ρ_{ij} changes accordingly to reflect the degree of influence between the two concepts.

For figure 1, using ρ_{ij} can resolve the problems which exist when using FCM easily. Since the introduction of time items ρ_{ij}, $\rho_{ij}(t)$ not only to show the certainty-uncertainty causal relations between the "concept 1" and "concept 2", but also show the dynamic nature of this causal relations. It is determined by the different relation set X. Through calculation, we receive different values $\rho_{ij}(t)$. Therefore, RCMTM not only inherited the advantages of FCM, but also extend the application fields and the ability to simulate the relations between concepts of FCM.

3.2 Rough Cognitive Map Space-Time Model

Rough cognitive map time model sets up a time-dependent dynamic causal relation. In fact, the relations between concepts not only change over time, but also have connection with the state of the concepts in space. If we consider the time characteristics of causality, further considering the spatial characteristics of causality, we can get the Rough Cognitive Map Space-Time Model. The mathematical model is:

$$V_{c_j}(t)=f\left[\sum_{\substack{i=1\\ i\neq j}}^{N} V_{c_i}(t)(\rho_{ij}(t)\,|\,V_{c_i}(t),V_{c_m}(t),..)+\gamma W_{c_j}(t-1)\right] \tag{3}$$

This method in equation (3) not only can solve the defects in FCM to make cognitive maps handle the uncertainty of relation measure, but also integrate the causal relations space-time links between concepts. As in figure 1, the impact that "Concept 1" to "concept 2" not only have connection with the state of "Concept 1", but also have to do with the accumulation of "Concept 1", performance as time characteristics. At the same time the influence degree has to do with the state of concepts in space, showing as the spatial characteristics. Thus, we can fit the uncertainty of relation measure and the space-time characteristics of links into rough cognitive map, further expanse the rough cognitive map.

4 Conclusion

In order to overcome the deficiency of cognitive map and fuzzy cognitive map, this paper proposes a rough cognitive maps model based on rough set theory. It has the following three contributions: a) Certain the diversity of the relations between the two

concepts in cognitive map, making simulate the real life problems better. b) Not only can determine the certainty-uncertainty of relations between concepts, but also demonstrate the dynamic nature of relations. C) Integrate the time and space connection between the concepts effectively. d) For the defect that given weight subjectively in cognitive map and cognitive rough map, integrating precision edge between two concepts give an objective comprehensive weight, makes rough cognitive map reduce computational complexity compared with cognitive map.

The next step is to improve the main model presented in this paper. Research on the rough cognitive maps is still in the exploratory stage, it has not yet formed the corresponding theoretical system and design method. There are still many problems to be research and exploration.

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Development and Analysis of Unified Simulation Model for Space Vector PWM Strategies

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Abstract. SVPWM (Space Vector PWM) is widely used in many kinds of fields because it can provide the electronic source with the variable frequency and amplitude. After introducing the principle and classification of SVPWM, the paper discusses the method to build a unified computer simulation model for the SVPWM strategies. The development procedure and the key technique are presented. Finally several SVPWM strategies are analyzed based on the developed simulation model. The simulation results are consistent with the theoretical and experimental results in the literature.

Keywords: Space Vector PWM, simulation model, three-phase inverter, discontinuous SVPWM, random SVPWM.

1 Introduction

PWM (Pulse Width Modulation) has been used in many fields because it can provide the electronic source with the variable frequency and amplitude [1,2]. PWM is the fundamental of the inverter. In AC motor control applications, the two-level three-phase inverter is widely utilized because of the simple structure. Many modulation strategies have been presented and discussed in detail [1-10]. Two kinds of strategies-SPWM (Sinusoidal PWM) and SVPWM (Space Vector PWM)-have been extensively analyzed. Because of easy implementation in digital control system, excellent performance and high DC voltage utilization ratio, SVPWM is widely used, and the typical application is motor control. Considering the inverter and motor as a whole, SVPWM makes use of the float neutral point of the motor with star connection. The implicit modulation wave of SVPWM is not sinusoidal, and the float neutral point makes the zero-sequence component injection possible. Almost the difference between all the SVPWM strategies comes from the injected zero-sequence components except the random switching frequency SVPWM. It is the zero-sequence component that improves the DC voltage utilization ratio. The maximum modulation index is only 1 for SPWM, while about 1.154 for SVPWM. Based on voltage-second balance, the harmonic waves are inevitable besides the required fundamental. The theoretical expressions of the output voltage are discussed in [3, 4], but the formulas are always complicated and the current spectra highly depend on the load characteristics. So the

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 230–235, 2011.
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computer simulation is a powerful tool to analyze SVPWM and its application. The simulation model is separately provided in much software, such as Psim and MATLAB. The paper discusses the method to build a unified simulation model for several SVPWM strategies commonly used, and gives the key procedures.

2 Fundamental of SVPWM

The principle of SVPWM has been extensively reported in plenty of literature [1-4], and is introduced in brief here. The classical VSI inverter circuit diagram and the eight basic voltage vectors are shown in Fig.1. An arbitrary voltage vector with the amplitude U_S and phase angle θ can be generated through the adjacent two (active) vectors and the zero (inactive) vectors based on time average in a PWM period T_s, as shown in Fig.1b) in the first sector. The duration time of the two active vectors and the zero vectors are T_1, T_2, T_0 respectively. The working sequence in the Fig.2a) is always adopted because of less commutation number, better harmonic performance, and so on. There are infinite sequences that satisfy the voltage-second balance principle. As a whole, the SVPWM strategies can be divided into types of strategies.

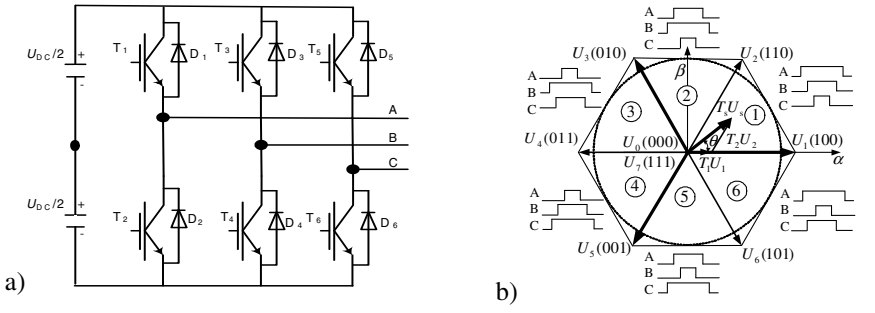


Fig. 1. Circuit diagram and the space-vector diagram of the three-phase inverter

(1)Deterministic SVPWM. The deterministic SVPWM includes CSVPWM (Continuous SVPWM) and DSVPWM (Discontinuous SVPWM). The traditional SVPWM with the symmetrical control signal wave and equal working time of the two zero vector is belong to CSVPWM. The commonly used and extensively discussed DSVPWM includes DPWMMAX, DPWMMIN, DPWM0, DPWM1, DPWM2, and DPWM3 [1, 2, 4], and the corresponding zero vector partitioning method is shown in Fig.2. b). In the figure, the partitioning ratios are defined as $\varepsilon_0 = T_{00}/T_0$, $\varepsilon_7 = T_{07}/T_0$, and T_{00}, T_{07} are the working time of the zero vector U_0 and U_7.

SVPWM is an intrinsically regular sampled process [4]. The ratio is 0.5 for the traditional SVPWM, and 0 or 1 for the discontinuous SVPWM. In SPWM, the ratio is not constant and depends on the modulation index and phase angle. Because the ratio is either 1 or 0, either the phase with the smallest pulse width or the phase with the

longest pulse would be clamped to negative potential or negative potential, and the switching losses automatically go down to approx. 2/3 of the CSVPWM [7].

(2)RSVPWM(Random SVPWM). RSVPWM includes RSFSVPWM (Random Switching Frequency SVPWM), RPPSVPWM (Random Pulse Position SVPWM), RZDSVPWM (Random Zero-vector Distribution SVPWM), and RHSVPWM (Random Hybrid SVPWM).

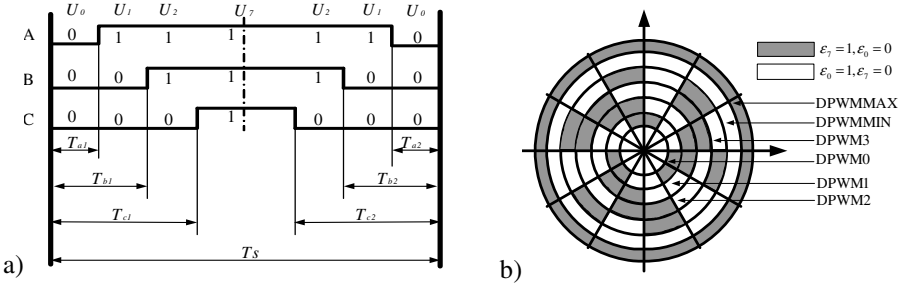


Fig. 2. Zero vector partitioning method

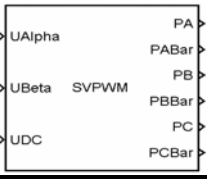
3 Key Components and Technique for Simulation Platform

3.1 Functions and Parameters

Many simulation software packages provide the inverter bridge model. For example, the block *Universal Bridge* in *MATLAB/Simulnik* can be used to simulate the inverter. The gate input for the controlled switch devices is required for the universal bridge. So the main task of the SVPWM model is to generate the six gate signals based on the SVPWM strategy. The parameters, the inputs and outputs are shown in Table 1.

Table 1. Simulation parameters and ports of the SVPWM simulation model

PWM type	Sub-type	Parameters	Inputs	Outputs
CSVPWM	Traditional SVPWM	T_s, dead time T_{dead}	DC voltage, reference voltage vector	Gate signals: PA,PB, PC, PABar, PBBar, PCBar
DSVPWM	DPWMMAX,MIN, DPWM0-3	T_s, T_{dead}		
	Other DPWM	T_s, T_{dead}, phase angle		
RSVPWM	RSFSVPWM	distribution law, T_{dead}, T_s, range		
	RPPSVPWM RZDSVPWM	T_{dead}, T_s, distribution law		
	RHSVPWM	T_{dead}, distribution law, or T_s range,		



3.2 Development Procedure

The *Embedded MATLAB Function* block in *MATLAB/Simulink* is used to build the simulation model. In order to store some values for the next simulation step, the Persistent Variable is used. The procedure can be expressed as follows.

Step 1. Check if the persistent variables are empty using the function isempty. If empty, the initial values must be given.

Step 2. If a new switching period does not begin, go to Step 3; else

(1) If the reference voltage vector exceeds the linear modulation zone, it must be truncated into the linear modulation zone.

(2) If RSVPWM is set and the switching frequency is random, generate a switching period based on the user-set distribution law and frequency/period range.

(3) Compute the working time of the basic voltage vectors T_1, T_2, T_0.

(4) Judge the sector where the reference voltage vector resides.

(5) The zero vector partitioning ratios are determined based on the user-set modulation strategy, which is discussed in Section 3.4 in detail.

(6) Compute the theoretical switching instants $T_{a1}, T_{a2}, T_{b1}, T_{b2}, T_{c1}, T_{c2}$.

Step 3. According to the dead time and the theoretical switching instants, the gate control signals are generated using the codes in Section 3.3.

Step 4. Handle persistent variables values that will be used in the next simulation step.

3.3 Consideration of Dead Time and Minimum Pulse Width Restriction

Because of the on/off time of power switches, the dead (blank) time should be set to avoid the short circuit on the two switches of one phase [10]. To protect the hardware of the driving system and the inverter, the minimum pulse width should be omitted.

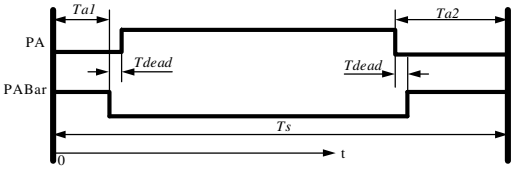


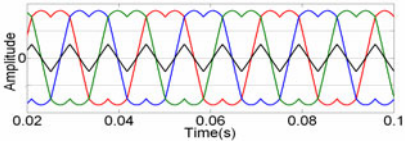
Fig. 3. Gate control signal wave and dead time

3.4 Zero Vectors Partitioning Ratio Determination

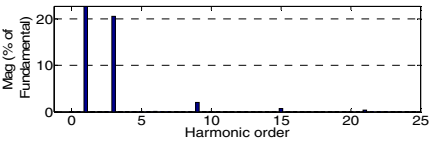
The partitioning ratio is 0.5 in all sectors for SVPWM. The partitioning ratio can be determined after the phase angle of the reference voltage vector is computed for the DSVPWM shown in Fig.2 b). For the RZDSVPWM, a random number between 0 and 1 should be generated. MATLAB provides many pseudorandom number functions, such as rand for the standard uniform distribution, randn for the standard normal distribution. Other distributions can be derived from the standard uniform distribution.

4 Simulation Results and Analysis

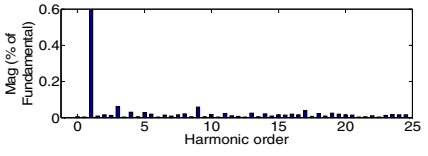
Several SVPWM strategies are simulated and results are shown in Fig.4 ~Fig.6. In the figures, the fundamental amplitudes are truncated. The results are consistent with the analysis presented in literature [3,4]. In SVPWM, the zero-sequence component is composed of segment of sinewaves, and consists of only triple harmonics. As can be seen from Fig. 4 b) and c), there exists prominent third, ninth harmonic amplitude in phase voltage, but these harmonics disappear in line-line voltage. The spectra show pronounced maxima at the pulse frequency and its multiples, as shown in Fig.4 d).



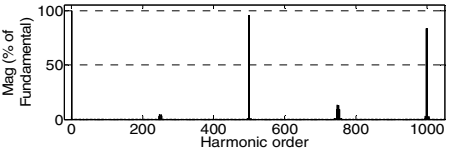
a) Modulation and zero sequence waves



b) Phase voltage spectra(low frequency)

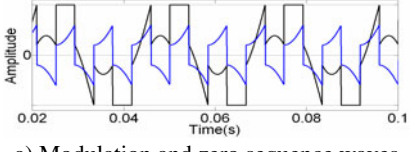


c) Line-line voltage spectra(low frequency)

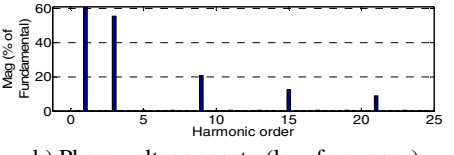


d) Line-line voltage spectra

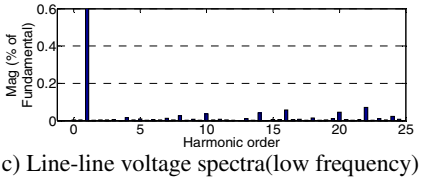
Fig. 4. Simulation results for the traditional SVPWM (fundamental:40Hz,M=0.2, fs=10000Hz)



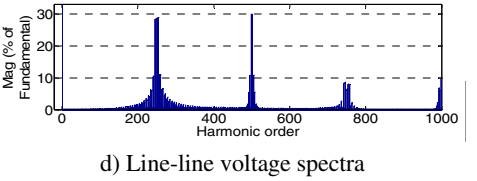
a) Modulation and zero sequence waves



b) Phase voltage spectra(low frequency)

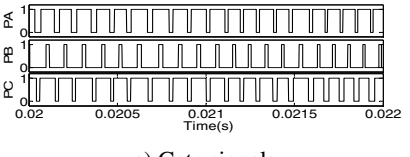


c) Line-line voltage spectra(low frequency)

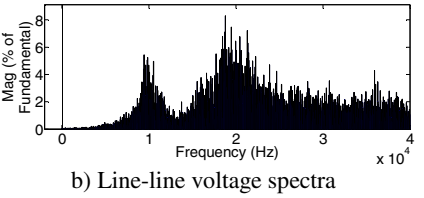


d) Line-line voltage spectra

Fig. 5. Simulation results for DPWM2 (fundamental: 40Hz,M=0.8, fs=10000Hz)



a) Gate signals



b) Line-line voltage spectra

Fig. 6. RSFSVPWM Simulation results (fundamental:40Hz M=0.8, Ts=[0.000075,0.000125]s)

The modulation waves and zero-sequence component are discontinuous functions. The phase modulation wave has two segments which are clamped to the positive or negative rail for $\pi/3$ for each segment in one fundamental period. The injected zero-sequence component consists of only triple harmonics. As can be seen from Fig.5.The switching period is variable with time in RSFSVPWM, which can spread the clustered spectra of the deterministic SVPWM and the pronounced maxima at the pulse frequency and its multiples are reduced significantly (Fig.6 b)).

5 Conclusions

Based on SVPWM principle, a unified simulation model is developed. The paper gives the development procedure and key techniques. Several SVPWM strategies are analyzed using the simulation model and the results are consistent with the theoretical and experimental analysis in the published literature. The simulation model is a powerful tool for the SVPWM learning to the beginner and motor control research.

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A Clock Fingerprints-Based Approach for Wireless Transmitter Identification

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Abstract. Cognitive radio (CR) was proposed as one of the promising solutions for low spectrum utilization. However, security problems such as the primary user emulation (PUE) attack severely limit its applications. In this paper, we propose a clock fingerprints-based authentication approach to prevent PUE attacks in CR networks with the help of curve fitting and classifier. An experimental setup was constructed using the WLAN cards and software radio devices, and the corresponding results show that satisfied identification can be achieved for wireless transmitters.

Keywords: PUE, clock fingerprints, transmitter identification, WLAN card, SDR.

1 Introduction

Cognitive radio (CR) technology [1] was proposed as one of the promising options to solve the problem of low spectrum utilization. Through spectrum sensing, CR technology uses free spectrum resources temporally and spatially to provide wireless communication services, thereby improving the wireless spectrum utilization.

In order to guarantee the normal communication and security of cognitive radio networks (CRN), the malicious users have to be identified. Such users may introduce wrong spectrum information, launch the primary user emulation (PUE) attack and perform other malicious activities such as network jamming. Due to the highly reconfigurable ability and software based architecture of CR users, the CR networks would face PUE [2, 3] attack.

To achieve the wireless transmitter identification, previous studies mainly focus on radar signal identification by means of the signal envelop analysis or carrier frequency estimation. As for the modulated signal, modulation parameters extraction and wavelet decomposition are often applied. To avoid interfering the primary user in cognitive radio networks, the clock fingerprint is used to identify wireless devices, to detect PUE attack and to improve the security for wireless networks. The proposed approach has uniqueness and short-time invariance performance compared with former approaches. As for the PUE attacks, we extract the clock fingerprints of different devices by using curve fitting and classifier.

The rest of this paper is organized as follows: Section 2 gives an overview of the proposed clock fingerprints approach. In Section 3 the experiment results are given. Finally, conclusions follow.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 236–240, 2011.
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2 Proposed Approach

Clock jitter [4] shows timing variations of a set of signal edges from their ideal values. Usually, Jitters are caused by disturbances in the system, which include thermal noise, power supply variations, loading conditions, device noise, and interference coupled from nearby circuits. Hence, we could take advantage of the "clock fingerprints" to identify the transmitters. The basic idea is to extract the bit synchronization component in the signal. The spectrum of bit synchronization includes both discrete the continuous component close to the code rate. These two components can be obtained by PSD analysis after certain code delay. If the delay is equal to half of the code interval, the strongest bit synchronization is reached which is defined as temporary "clock fingerprints". It results in another approach to identify the transmitters.

Three steps are followed for extracting the clock fingerprints of the transmitters:

Step 1: delay the sampled data half of the code cycle in the time domain, and then multiply it by the original data.

Step 2: extract the line spectrum close to the symbol rate.

Step 3: analyze the line spectrum (we call it the clock fingerprint).

3 Experiment and Results

Here, we consider that the malicious SU transmitters (PUE attackers) would emulate the signal of primary user to achieve self-fish aims. Due to the different frequency resolution, the proposed approach is verified in two experiment schemes, which are the WLAN card identification system and the software radio device system. In the former system, the spectrum resolution reaches about 700 KHz and the latter one approximates 1Hz.

3.1 WLAN Card Identification

In the proposed scheme, as shown in Fig.1, we build an 802.11b WLAN signal acquisition system. Two USB WLAN cards are installed in two PCs (PC1 and PC2) respectively to send and receive the 2.4GHz signal with symbol rate of 11Mbps. The distance between the two PCs is about 5 meters. In this experiment, the Agilent Infiniium DSA91304A high-performance oscilloscope is employed.

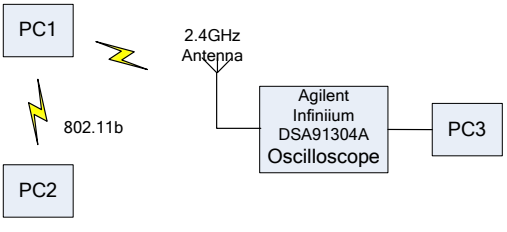
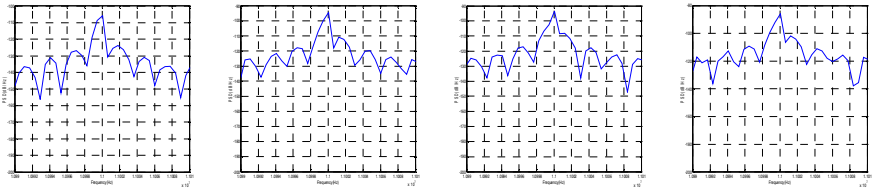


Fig. 1. 802.11b WLAN signal acquisition system

Based on the setup described above, the experiments are carried out with four different types of USB WLAN card. For each card, the experiment is conducted ten times for collecting the required WLAN signals. The four different cards are D-link DWL-G122, ipTIME G200U, Mercury MW54U and Tplink TL-WN321G. The sampled data are delayed half of the code interval and multiplied by the original signal. Thus the PSD is obtained by the periodic diagram method. For the same WLAN card, it performs good consistence, while the distinctions among different brands are obvious. The clock fingerprints of different cards are shown in figure 2(a) ~ (d). The central frequency is 11MHz and the span is 20 KHz.



(a) D-link DWL-G122 (b) ipTIME G200U (c) Mercury MW54U (d) Tplink WN321G

Fig. 2. The clock fingerprints of the different types of WLAN cards

In order to extract the feature of each card to accomplish the classification, an IIR filter is used. The function of the filter can be written as:

$$H(z)=\frac{B(z)}{A(z)}=\frac{b_1+b_2z^{-1}+b_3z^{-2}+b_4z^{-3}+b_5z^{-4}}{a_1+a_2z^{-1}+a_3z^{-2}} \tag{1}$$

Where, b and a are row vectors of $n+1$ and $m+1$ respectively, representing the coefficients of the IIR filter and these coefficients are ordered descendingly. Thus, we combined the fitted coefficients as a vector group for each card at certain time.

Then, the vector group for each card passes the SVM classifier. For each card, we chose 100 samples and separate the samples into two equal parts: one half for training and the other for identification. The identification results are shown in Table 1.

As can be seen in table 1, for TPlinkUSB card we could obtain a high identification rate at 98% and for Mercury card at 72%. Due to the low frequency resolution confined by the experiment device and the CSMA/CA mechanism in 802.11b specification, however, the separation of Dlink and G200U card is not satisfied.

Table 1. Identification Results of the SVM Classifier

	Dlink	G200U	Mercury	TPlinkUSB	Identification Rate
Dlink	25	17	6	2	0.5
G200U	7	30	8	5	0.6
Mercury	8	0	36	5	0.72
TPlinkUSB	0	0	2	48	0.98

3.2 Software-Defined Radio Device Identification

A software-defined radio system, or SDR, is a radio communication system which is mainly implemented by using software with PC or imbedded devices [5] instead of the traditional used hardware (e.g. mixers, filters, amplifiers, modulators/ demodulators, detectors, etc.). The Direct Digital Synthesizer (DDS) is a type of frequency synthesizer used for creating arbitrary waveforms using a single, fixed-frequency reference clock. It also plays an important role in the SDR platform. Any interference induced in the DDS could influence the clock fingerprints of the transmitters. We implement our experiment on the SDR platform to verify the proposed approach and realize the transmitter identification. The diagram of the experiment is shown in Fig. 3.

The DQPSK modulated signal of 32 SDR devices (No.: STR001 ~ STR032) is collected at different interval. The symbol rate is 1Mbps. It is multiplied by the half cycle delayed data and the clock spectrum around 1MHz is obtained. Fig.4 shows the clock fingerprints for four SDR devices. The central frequency is 1MHz and the span is 4 KHz.

In Fig. 4 the blue line represents the clock spectrum and the red one represents the extracted discrete spectrum. Preliminary experimental results show that there exists small clock timing deviation for each SDR device. For the same one, the clock fingerprints are identical while for different ones they are significantly different.

Then, we plot the frequency values of the discrete spectrum for each case and calculate the Euclidean distances between each two SDR devices.

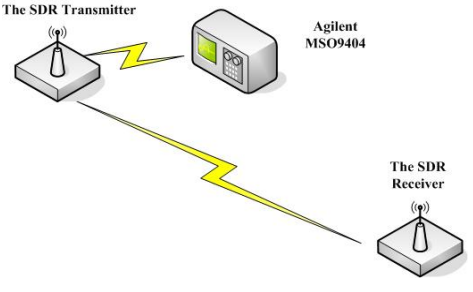
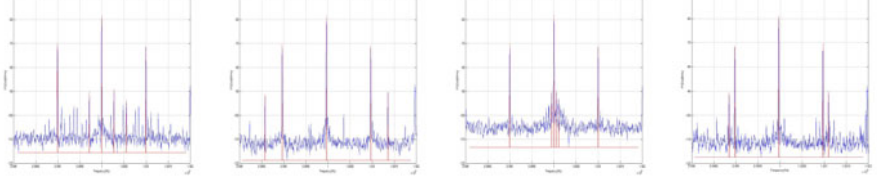


Fig. 3. The software defined radio experiment platform



(a) STR001 (b) STR002 (c) STR006 (d) STR022

Fig. 4. The clock fingerprints of the SDR kits

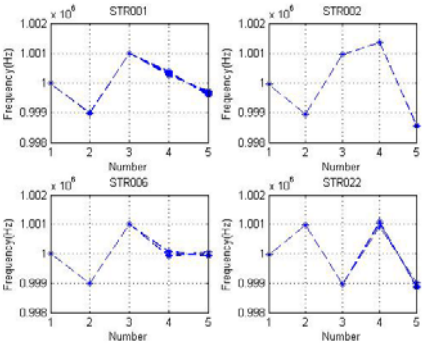


Fig. 5. The frequency value of the four SDR devices

From Fig. 5, a favorable convergence for the same SDR device appears and the distinction between different ones is obvious. Thus, 100% identification of the SDR devices can be obtained which is also demonstrated by experiments.

4 Conclusion

In this paper, the security issues for CR networks are discussed and a novel clock fingerprints based approach is proposed to prevent PUE attacks. The clock fingerprint is employed to extract the distinction of different wireless transmitters. Two cases for WLAN and SDR devices are analyzed and the corresponding experiments verify the efficiency of the proposed approach. For further research, more features will be extracted using advanced algorithms such as neural network techniques. Also the application in mobile terminal scenario will be considered.

Acknowledgments. This research was supported by Tsinghua-Qualcomm joint research fund.

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Analysis on Realization of Sequential Queue

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Abstract. Analyzed and introduced the sequential storage structure of the queue, detailed analyzed several specific methods for the circular queue to resolve the "false overflow", gave the algorithm descriptions in C of the corresponding basic operations of the queue, compared and analyzed each algorithm the time complexity and the space complexity, so as to complement and play a guiding role in the relevant chapters in “Data Structure” curriculum.

Keywords: Circular queue; False overflow; Time complexity; Space complexity.

1 Introduction

Queue, known as FIFO (First In First Out) linear list [1-3], is widely used in various software systems.

The positions of insertion and deletion in queue are restricted, but the logical structure of queue is linear, so it can use the same storage structures as linear list, that is the sequential storage structure and the linked storage structure. If you choose the sequential storage structure, the approach to resolve the “false overflow” is needed. This paper detailed introduced several different approaches to resolve the "false overflow" appeared in sequential queue.

2 Definition of the Sequential Queue

The logical structure of queue only allow of insertion in the rear and deletion from the head, so it requires both the head location and the tail location of the queue. In addition to a contiguous memory locations (one-dimensional array in C programming language) used to store the elements of the sequential queue, a *front* indicator and a *rear* indicator are attached to indicate respectively the head element and the tail element of the queue [1-3]. The type of sequential queue can be defined in C as follow:

```
#define MAX 100
typedef struct{
ElemType queue[MAX];  int front,rear;  }SeQueue[2,3];
```

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 241–246, 2011.
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Member *queue* is the vector space of the queue, which is used to store the elements. Member *front* and *rear* are vector subscript indicators. The former indicates the head location, while the latter indicates the tail.

3 The Agreement of the Specific Locations of *Q.front* and *Q.rear*

For describing easily, we use the agreement that both *Q.front* and *Q.rear* point to "0" subscript unit when the queue is initialized in C[1]. The specific locations pointed by *Q.front* and *Q.rear* may have several different agreements.

3.1 The First Agreement about Specific Locations

This agreement agrees that *Q.front* indicates the first element and *Q.rear* indicates the last one [4].

According to the agreement mentioned before, both *Q.front* and *Q.rear* point to "0" subscript unit when the queue is empty. To enqueue the first element, you can place it directly into the location indicated by *Q.rear* ("0" subscript unit), but the indicator *Q.front* also indicates the same location, thus the status of an empty queue and that of a queue has only one element are the same, so the dequeueing operation becomes complex for determining what the situation is to make the appropriate treatment. In view of this, the agreement about queue initialization can be changed to both *Q.front* and *Q.rear* point to "-1" subscript unit. Thus, when enqueueing the first element, both *Q.front* and *Q.rear* plus one and then point to the "0" subscript unit. After that, when enqueueing another, the only indicator needs to be modified is *Q.rear*, let *Q.rear* plus 1, and then place the new element into the location indicated by *Q.rear*. When dequeueing an element, the only indicator need to be modified is *Q.front*, but if there left only one element in the queue, both *Q.front* and *Q.rear* must be redirected to the "-1" subscript unit.

Obviously, this agreement brings enqueueing and dequeueing some unnecessary troubles. The most important is that you should treat separately the operations of enqueueing the first element or dequeueing the last one.

3.2 The Second Agreement about Specific Locations

This agreement agrees that *Q.front* indicates the first element and *Q.rear* indicates the next location of the last element[4].

Most of the materials use this agreement, and according to the initial agreements mentioned before, *Q.front* and *Q.rear* point to "0" subscript unit when the queue is empty. To enqueue a new element, you can place it directly into the location indicated by *Q.rear*, and then augment *Q.rear* by 1. To dequeue an element, augment *Q.front* by 1. In this agreement, the queue is empty when *Q.front* equals *Q.rear*.

3.3 The Third Agreement about Specific Locations

This agreement agrees that *Q.front* indicates the location before the first element and *Q.rear* indicates the last element[4].

Similarly, according to the initial agreements mentioned before, both *Q.front* and *Q.rear* point to "0" subscript unit when the queue is empty. To enqueue a new element, augment *Q.rear* by 1 at first, and then put the new element into the location indicated by *Q.rear*. To dequeue an element, just augment *Q.front* by 1.

As aforementioned, the queue is empty when *Q.front* equals *Q.rear*. This agreement is consistent with the store idea of the linked queue, which has an additional head node, and thus it is easier to understand and accept. The following algorithms are all base on it.

4 The "False Overflow" and Its Solution

If *Q.front* has reached the maximum subscript such as *MAX*-1 at the time enqueueing, dequeueing might have already been done, so there are some free spaces in the head of the queue. Since enqueueing is permitted only at the tail, the idle locations in the front of the queue cannot be used effectively. We call this phenomenon "false overflow"[2-4].

To take full advantage of the storage space of queue, we can take some necessary measures to avoid the "false overflow".

4.1 Modify the Dequeueing Operation

The idea of this approach is as follow:

To avoid "false overflow" appears in enqueueing, all the subsequent elements in turn move forward one unit after dequeueing an element.

The improved dequeueing algorithm can be described below in C:

```
int DeQueue_1(SeQueue *Q, ElemType *e)
{ int i;
  if(Q->front==Q->rear)          //Empty queue underflow
  {  printf("Underflow!\n"); return 0; }//End_if
  *e=Q->elem[Q->front+1];     //Dequeue the head element
  for(i=1;i<Q->rear;i++)   //Rest elements move forwards
       Q->elem[i]=Q->elem[i+1];
  Q->rear-=1;  return 1;  } //End
```

4.2 Modify the Eequeueing Operation

The idea of this approach is as follow:

If "false overflow" appears in enqueueing operation, move all the existing elements forward to the continuous units beginning from the head of the queue, and then insert the new element in the tail.

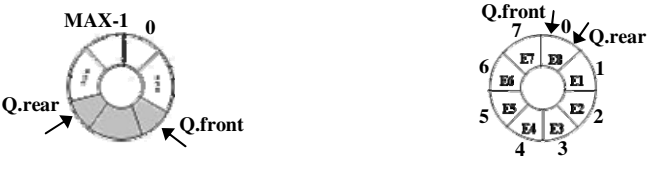
The type of sequential queue and the specific locations about *Q.front* and *Q.rear* are the same as before, and the improved enqueueing algorithm can be described below in C:

```
int EnQueue_1(SeQueue *Q, ElemType e)
{ int i;
  if(Q->rear<MAX-1)            //The queue is not empty.
  {  Q->rear+=1; Q->elem[Q->rear]=e; return 1;   }
  else if(Q->front>0)           //False overflow appears
  {  for(i=1;i<=Q->rear-Q->front;i++)    //Move elements
        Q->elem[i]=Q->elem[i+Q->front];
     Q->front=0; Q->rear=i-1;      //Redirect indicators
     Q->rear+=1;Q->elem[Q->rear]=e;return 1; }
  else { printf("Overflow!\n"); return 0; } //overflow
}
```

4.3 Circular Queue Method

The idea of this approach is as follow:

Assume the sequential queue to be a ring with both ends linked (shown in Fig.1(a)), then the successor to the last unit is the first unit. Therefore, when *Q.front* or *Q.rear* reaches the maximum location of the available space of the sequential queue, they will point to "0" subscript unit when added a further 1. In order to reach this purpose, the easiest way is through mathematics remainder operation. That is whenever the indicators are increased by 1, we find the remainders of the results divided by the total number of the available space. Thus, the change of *Q.rear* can be described in C as *Q.rear*=(*Q.rear*+1)%*MAX*; when enqueueing, and the change of *Q.front* can be described in C as *Q.front*=(*Q.front*+1)%*MAX*; when dequeueing.



(a) Shaded part is occupied by the elements (b) An empty or full Circular queue

Fig. 1. Circular queue diagram

The type of circular queue is the same with that of the sequential queue, and the specific locations about *Q.front* and *Q.rear* are get rid of the same as before. When enqueueing and dequeueing have been implemented for a period get rid of, *Q.front* equals *Q.rear* again. The status shown in Fig.1(b) indicates it to be both a full queue that enqueued all the elements *E1~E8*, and an empty queue that dequeued all the elements.

Therefore, *Q.front* equals *Q.rear* alone cannot determine the queue is "empty" or "full". In order to solve the problem of circular queue determining whether the queue is empty or full, we can use the methods introduced below.

Use an Additional Counter Variable. Add a variable in the calling function to count the number of the elements in the queue. The specific steps are as follow:

1. Initialize an empty queue, and set the counter variable to "0";
2. Augment the counter variable by 1 while each element enters the queue when the calling function calls the enqueueing operation;

3. Subtract 1 from the counter variable while the calling function calls the dequeueing operation;
4. The queue is full when the count variable equals *MAX*; while it is empty when the count variable equals 0 [5].

Use an Additional Sign. Add an additional sign (*tag*) to mark the queue is "empty" or "full". The specific steps are as follow:

1. Initialize an empty queue, and set *tag* to "*false*";
2. Set *tag* to "*true*" when the calling function calls the enqueueing operation;
3. Set *tag* to "*false*" when the calling function calls the dequeueing operation;
4. The queue is full when *tag* equals "*true*" and *Q.front* equals *Q.rear*; while the queue is empty when *Q.front* equals *Q.rear* but *tag* equals "*false*"[2,5].

Disable One Unit. Distinguish "empty" status from "full" status by disabling one unit of a circular queue, so the circular queue is "empty" when *Q.front* equals *Q.rear*, and it is full when the result of the expression (*Q.rear*+1)*%MAX* equals *Q.front*[2,5].

The type of circular queue and the specific locations about *Q.front* and *Q.rear* are the same as before, and the enqueueing and dequeueing algorithm of circular queue can be described below in C:

```
int EnQueue_2(SeQueue *Q, ElemType e)
{ if((Q->rear+1)%MAX>=Q->front)                //Overflow
  {  printf("Overflow!\n");  return 0;  }
  Q->rear=(Q->rear+1)%MAX;Q->elem[Q->rear]=e;
  return 1; }          //Enqueue element "e" and return

int DeQueue_2(SeQueue *Q, ElemType *e)
{ if(Q->front==Q->rear)            //The queue is empty.
  {  printf("Underflow!\n"); return 0; }
  Q->front=(Q->front+1)%MAX; *e=Q->elem[Q->front];
    return 1;  }   //Dequeue the head element and return
```

5 Algorithm Performance Evaluation

The evaluation about the algorithms mentioned above is mainly from the two aspects of time complexity and space complexity. Regarding *n*, the number of the elements in the queue, as the scale of the problem, and then we discuss them respectively below.

The core statement of function *DeQueue_1( )* is the *for* loop statement, and its basic statement is that all the remaining elements will in turn move forward after dequeueing an element. Therefore, whenever the function is called, the execution frequencies of the basic statement is linearly proportional to the number of elements, so the algorithm average time complexity is linear order, that is *T(n)=O(n)*. On the other hand, in addition to the space used by the algorithm itself, this function introduces only one auxiliary space (variable *i*) to control the loop, so the algorithm space complexity is constant order, that is *S(n)=O(1)*.

The core statement of function *EnQueue_1( )* is the *if* statement, where there is a *for* loop statement in the part of *else-if*. Thus, all the remaining elements will in turn move forward to the beginning of the queue space unit only when a "false overflow"

appears. At this point, the execution frequencies of the loop body of the *for* statement is linearly proportional to the number of elements. Therefore, the time complexity of this algorithm in the worst case is a linear order, that is $T(n)=O(n)$. The same as before, in addition to the space used by the algorithm itself, this function introduces only one auxiliary space (variable *i*) to control the loop, so the algorithm space complexity is constant order, that is $S(n)=O(1)$.

Function *EnQueue_2( )* and *DeQueue_2( )* are all consist of simple sequential statements, so each statement is executed only once during each calling. Thus, the average time complexity of the two algorithms have the same constant order, that is $T(n)=O(C)$. There is no auxiliary space was introduced in the two algorithms in addition to the space used by the algorithms themselves, so the space complexity of the two algorithms are constant order, that is $S(n)=O(1)$.

6 Conclusion

After analyzing comparatively the time complexity and space complexity of all the algorithms, we can see that the most suitable storage structure to solve "false overflow" is the circular queue, and the most suitable agreement to identify the queue is "empty" or "full" is disabling one unit.

This paper aims to research and conclude the sequential queue and the basic operations based on its storage structure, so as to playing a guiding role in teaching the relevant chapters in “Data Structure” curriculum.

Acknowledgments. This work is supported by Research Fund of Weinan Teachers University (No. 11YKS014).

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Estimation of Low Efficiency Circulation Layers by Fuzzy Comprehensive Judgment Method

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Abstract. In this paper, the influence factors of forming high capacity channel and its development characters have been analyzed, and the judging indices of low efficiency circulation well have been determined. Low efficiency wells have been elementary selected by using the method of fuzzy judgment. By the contrast of static data of each layer and sedimentary facies, and the contrast of correlativity between oil wells and water wells, layers with low efficiency circle have been made out ultimately. Using the compiled software based on this method, data of North-Sandong dong block in Daqing Oilfield have been studied. The coincidence rate of results between the software and artificial choice was 81.7%. This method is feasible, and it can improve the work efficiency and veracity.

Keywords: sandstone reservoir; fuzzy comprehensive judgment; low efficiency circulation; high capacity channel.

1 Introduction

Daqing placanticline oilfield has been in the production period of super high water cut. The measure of profile control or water shut off in low efficiency layers must be taken in order to improve the injection effect, and the key problem is to identify the low efficiency layers, quickly and accurately.

At present, low efficiency circulation layers are mainly judged by injecting trace, applying well test data, the fuzzy recognition of expert system, and directly or indirectly applying for logging interpretation material [1-5]. High permeability zones between oil and water wells and parameters of high capacity channel can be calculated by injecting trace, but its test-cost is high, workload is heavy, and real-time monitoring can not be achieved. High permeability zone wells and layers can be identified by using current well test measures, but we need to shut in to measure pressure and this affects production. More judgments are done through directly or indirectly applying logging interpretation material, but due to its test condition limitations, it cannot meet the need of oilfield production. Based on the fuzzy recognition of expert system to track and recognize high capacity channels, the considered index is mainly logging interpretation material including static data and entry profile etc.

At present oil-field often use dynamic and static data analysis combined with dynamic characteristics logging data of oil and water wells to artificially estimate low efficiency circulation layers, which is heavy workload, long period and low efficiency.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 247–252, 2011.
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2 Oil and Water Wells Determination Methods of Low Efficiency Circulation Band

2.1 The Parameter Selection

According to the influence factors and characteristics of the formation of high capacity channel, select the following parameters to determine oil and water wells of low efficiency circulation band: Static parameters: the average permeability, effective thickness, heterogeneity factors; Injection wells dynamic parameters: daily water injection rate, injection tubing pressure, apparent water injectivity index, the cumulative injection of unit thickness; Production well dynamic parameters: daily fluid production rate, water cut, bottom hole producing pressure, cumulative liquid production of unit thickness.

2.2 Optimization of Low Efficiency Circulation Oil and Water Wells by Fuzzy Comprehensive Judgment Method

Comprehensive evaluation is first made according to seven static and dynamic data indices, which are divided into two categories. The evaluation results are used as the son matrix of next level fuzzy matrix, which is made based on weights of various static and dynamic data, to make up two-level similar matrix. Specific comprehensive evaluation steps are as follows:

(1) Determine the comments set v={ineffective circling, low effective circulation, normal production}.

(2) Factor sets u={u1, u2, u3, u4, u5, u6, u7}

If the wells to be evaluated are injection wells, each factor u1 is effective thickness, average permeability, heterogeneity coefficient, daily water injection rate, injection tube pressure, apparent water injectivity index, cumulative water injection volume per unit thickness in turn. If the wells to be evaluated are production wells, each factor u1 is effective thickness, average permeability, heterogeneity coefficient, daily fluid production rate, water cut, bottom hole producing pressure, cumulative liquid production per unit thickness in turn.

(3) Determine degree of membership

Analysis of field data shows that each indicator approximately obeys normal distribution regularity. Thus the following membership function is choosed

$$u_y(x) = e^{-[(x-a)/b]^2},$$

where x denotes the evaluation factors, y the comments level, and a,b the index parameters. If upper and lower limit of parameter x_i is d_{upper} and d_{down}, then

$$a = \frac{d_{upper} + d_{down}}{2} b = \frac{|d_{upper} - d_{down}|}{2\sqrt{\ln 2}}.$$

Then calculate the fuzzy relation matrix elements

$$r_{ij} = e^{-((x_i - a_{ij})/b_{ij})^2}.$$

where x_i denotes the evaluation factors, a_{ij}, b_{ij} denotes the a,b values in comments level.

In this paper index number of oil wells is equal to water wells, so they can be expressed with the same mathematical model, the fuzzy similar matrixes are

$$R_1 = \begin{bmatrix} r_{11}r_{12}r_{13} \\ r_{21}r_{22}r_{23} \\ r_{31}r_{32}r_{33} \end{bmatrix} \quad R_2 = \begin{bmatrix} r_{11}r_{12}r_{13} \\ r_{21}r_{22}r_{23} \\ r_{41}r_{42}r_{43} \end{bmatrix},$$

where R_1 denotes the static index evaluation matrix and R_2 denotes the dynamic index evaluation matrix.

(4) Determin weight sets.

Oil and water wells weight allocation of each indicator is obtained by expert scoring method according to the role of dynamic and static index of oil and water wells in high capacity channel formation and evaluation. Assume x_i as weight value of u_i, if wells to be evaluated are injection wells and then

$$A_1 = \{x_1, x_2, x_3\} = \{0.3, 0.4, 0.3\}, \quad A_2 = \{x_4, x_5, x_6, x_7\} = \{0.2, 0.15, 0.25, 0.4\};$$

If wells to be evaluated s are production wells, then

$$A_1 = \{x_1, x_2, x_3\} = \{0.3, 0.4, 0.3\}, \quad A_2 = \{x_4, x_5, x_6, x_7\} = \{0.3, 0.3, 0.15, 0.25\}.$$

Total index weight set A={Static index, Dynamic index}=$\{0.4, 0.6\}$.

(5) Combining each index weight, B_i is calculated by using formula $B_i = A_i \times R_i$ (matrix multiply)

(6) Confirming final evaluation results by secondary fuzzy comprehensive evaluation. First level evaluation can build fuzzy similar matrix: $R = \begin{bmatrix} B_1 \\ B_2 \end{bmatrix}$. Finally, according to the weight of oil and water wells static and dynamic indicators, the final evaluation results are obtained by using the fuzzy transform operations of M(•,+) model: $B = \{b_1, b_2, b_3\}$. The invalid or low effective circulation of oil and water wells is estimated according to the maximum degree of membership principles.

3 Determine Low Effective Circulation Layer

After determining the ineffective and low effective circulation oil and water well, the low effective circulation channel should be determined, for the purpose of thoroughly understanding the distribution of high capacity channel and proposing next harness measures. Factors contributing to the geology and exploitation of high capacity channel are as follows: the type and connection relationship of subzone sand between water and oil wells, the well spacing between oil and water well and static parameter of water and oil well. The bigger effective thickness and permeability of the open interval in the oil and water wells, the better connection between oil and water well and the smaller well spacing between oil and water wells, the more high capacity channel. Each parameter weight is shown in Table 1.

Table 1. Weight of low effective circulation well and layer

Connection level	0.3			
well spacing between water and oil well	0.3			
Static factor	0.4	Oil well	0.5	effective thickness 0.4m
				Permeability 0.6μm^2
		Water well	0.5	effective thickness 0.4m
				Permeability 0.6μm^2

The flow of injected water in the oil layers is controlled by the microfacies. The microfacies is the main factor influencing the formation of high capacity channel in the oil layers. According to the property of oil layers, the small sand body is divided into four types: channel sand, main thin sand layer, non-main sand layer, untabulated sand. Digitizing the microfacies phase diagram, according to the microfacies situation of oil and water wells, membership degree of connect level between oil and water wells is determined. If the connect type between oil and water wells is channel sand-channel sand, the value 1 is recommended. For main thin sand layer-channel sand, channel sand-main thin sand layer, main thin sand layer-main thin sand layer, non-main thin sand layer-channel sand, channel sand–non-main thin sand layer and other type, the value 0.8, 0.6, 0.5, 0.4, 0.3, 0 is recommended respectively.

Membership degree of the effective thickness and permeability for the small sand layer is represented with half-ascent-trapezoid distribution, the function of membership degree is showed as follows

$$U(x) = \begin{cases} 0, 0 \le x < a_1 \\ \frac{x-a_1}{a_2-a_1}, a_1 \le x < a_2 \\ 1, x \ge a_2 \end{cases} .$$

If x is the effective thickness of small layer, then a1 is 1m and a2 is 3m. If x is permeability, then a1 is 100μm^2 and a2 is 600μm^2. The membership degree of the effective thickness and permeability for the small sand layer is represented with half-descent-trapezoid distribution

$$U(x) = \begin{cases} 1, 0 \le x \le 200 \\ \frac{500-x}{300}, 200 < x \le 500 \\ 0, x > 500 \end{cases} .$$

Using the each above index weight, select M(•,+) model to do vague commutative operation. The permeability and effective thickness of small layer in the oil and water wells are made to do the first judgement of fuzzy comprehensive judge. With the computed result as the membership degree of water-oil well, the second judgement of fuzzy comprehensive judge is made. The third judgement of fuzzy comprehensive judge is made, combining with connect situation and distance of oil-water wells. The effective circulation layer is determined with the ultimated judgement result.

4 Field Application

With the actual data of oil and water wells in the east block of bensandong of Daqing oilfield being analyzed, the low effective circulation classification interval of water injection and oil production well table is obtained.

Table 2. The low effective circulation classification interval of water injection well

Level	Ineffective circulation	low effective circulation	Normal production
Effective thickness (m)	25-60	13-25	0-13
Average permeability (μm^2)	0.4-0.7	0.27-0.4	0-0.27
Heterogeneity factor	2.6-4.5	2.0-2.6	0-2.0
Daily water-injectedate (m^3)	200-500	100-200	0-100
Oil pressure of waterinjected (Mpa)	4-8	8-10	10-15
apparent water injectivity indices (m^3/Mpa)	20-50	10-20	0-10
cumulative water injection volume per unit thickness (10^4m^3/m)	12-40	5-12	0-5

For example the water injection well B2-1-096, its each parameter is {9,0.136,2.65,97.06,7.8,12.44,21.19}. Combining the above low effective circulation classification intervals to do well selection calculation, B is {0.44,0.25, 0.31}. According to max membership principle, we can define the well as an ineffective circulation well. After deciding low efficiency circulation layers, select low efficiency circulation stripes in the small layer P15+6 between this well and low efficiency circulation oil production well B2-1-95.

Using the compiled software based on this method, 489 wells (213 water wells and 276 oil wells) of North-Sandong dong block in Daqing Oilfield have been calculated. 15 water injection wells and 20 oil production wells have been selected in low efficiency circulation layer. The coincidence rate of results between the software and artificial choice was 81.7%.

Table 3. The low efficiency circulation classification interval of oil production well

Level	Ineffective circulation	low effective circulation	Normal production
Effective thickness (m)	25-70	16-25	0-16
Average permeability (μm^2)	0.45-0.7	0.3-0.45	0-0.3
Heterogeneity factor	2.8-5.5	2.2-2.8	0-2.2
Daily output (t)	120-600	60-120	0-600
Water cut (%)	95-100	90-95	0-900
Bottom hole flowing pressure (Mpa)	8-10	6-8	0-6
Cumulative liquid production volume per unit thickness(10^4m^3/m)	7-30	3-7	0-3

5 Conclusions

(1) Through analyzing the development characters in the low efficiency circulation layers and the reasons for influencing the formation of high capacity channel, the judging index of low efficiency circulation layer is determined. The static indices include the permeability of all wells, effective thickness, Heterogeneity factor. Dynamic indices of water wells include daily water-injected rate, oil pressure of water-injected, apparent water injectivity indices, cumulative water injection volume of unit thickness. Dynamic indices of water wells include daily fluid production rate, water cut, Bottom hole flowing pressure and cumulative liquid volume of unit thickness.

(2) The method of judging low efficiency circulation layers with fuzzy comprehensive evaluation is feasible. This method can be compiled to software. Compared with other methods, it is easy, practical and efficient.

(3) Weight and classification interval parameters can be adjusted according to the different production status of different blocks, this method is of widely adaptable.

Acknowledgments. This work is supported in part by National Science Foundation of China under Grant No.50634020.

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Set Pair Social Network Analysis Model and Information Mining

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Abstract. In this paper, finding that there was uncertainty existed in the incidence relationship of individuals by analyzed social networks theory. This paper constructed a set pair social network analysis model based on uncertainty of the social network to better learning social network relationship. This simple social network analysis model was applied in a relationship of friend to discover who is most significant.

Keywords: Social networks, set pair analysis, set pair social network analysis, information mining.

1 Introduction

Social networks, also known as social networks, are the relative steady relationship networks comprised by certain groups (people, businesses, organizations)[1]. As a new data mining technology, social network have applied in management, criminal organizations, the Internet and other areas. In the perspective of social networks [2-4], the references [2-4] found out the various social relationships existing as a single individual in the network, and the data mining for the social relationships. Zhou Weiguo [5] and other China scholars, find out the friendship between the network users through social network, and find out the shortest path between users through excavating the incidence relation between users at the exploited social network visual platform. Scholar Gao Peng [6] analyzed the timing sequence of chatting data to infer the relationship between users of social networking, and then judged and filtered the noise in the chatting data according to the reflected users' communicative relations in the social network. The references [5, 6] between individuals, exchange of information of some individuals to get the relationships between the individuals. And make use of social networking information excavate some useful information. However, in the process of assessment of the individual relations in the network through the social network, there still exist different and uncertain information elements. And the incidence relation between individuals cannot be reflected totally by using the certain and identical information assessment. Set pair analysis theory, a systematic analysis method to handle the uncertain problems, was put forward by Chinese scholar Zhao Keqing in 1989[7]. So, this article try to put the idea of the set pair analysis into the social network, and put forward the set pair social network analysis model, in order to solve the social network to determine the existence and uncertain problems, and use set pair social networks model of small network of friends to the application.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 253–257, 2011.
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Concrete structure is as follows:

2 Set Pair Social Network Analysis Model

In the social network relationships, the study of the properties of the two sets e_i and e_j, have N attributes (ie, the sum of the two objects' attributes), including S which are the same attribtes in two object properties set, and P are not the same property in two object properties, and F are the uncertain properties in two object properties. Then order:

$$\frac{S}{N} = a, \frac{F}{N} = b, \frac{P}{N} = c$$

As for the complex nodes in social networks, as well as the uncertainty between nodes, we give the following definition:

Definition 2.1: Supposes all the study objects in social network are domain set $U = \{e_1, e_2, \cdots e_n\}$, which e_k and e_s has the attribute set: $A(e_k) = \{x_{k_1}, x_{k_2}, \cdots, x_{k_n}\}$ and $A(e_s) = \{x_{s_1}, x_{s_2}, \cdots, x_{s_m}\}$, then the relation degree between e_k and e_s in the network at a time is:

$$\rho(e_k, e_s)(t) = a(t) + b(t)i + c(t)j \tag{1}$$

Where $e_k(t) \in U$ and $e_s(t) \in U$, a is the ration of the same properties and mutual properties in two objects; b is the ration of the uncertain properties and mutual properties in two objects; c is the ratio of the different properties and mutual properties in two objects; i is the different markers in the interval depending on the different circumstances on the values of $[-1,1]$, j only acts as tag and valued -1.

Definition 2.2: Assuming matrices $R = (\rho(e_k, e_s))_{m \times n}$, R is set on the connection matrix, where $\rho(e_k, e_s)$ is the element on the connection matrix set, $R = (\rho(e_k, e_s))_{m \times n}$ matrix is the relational matrix which study the relation between object e_k and e_s, or the relation degree of every study object of a set of relational matrix confirmed in networks. This matrix is:

$$R = \begin{Bmatrix} \rho(e_1, e_1) & \rho(e_1, e_2) & \cdots & \rho(e_1, e_s) \\ \rho(e_2, e_1) & \rho(e_2, e_2) & \cdots & \rho(e_2, e_s \\ \vdots & \vdots & \vdots & \vdots \\ \rho(e_k, e_1) & \rho(e_k, e_2) & \ldots & \rho(e_k, e_s) \end{Bmatrix} \tag{2}$$

We can define the relation degree of set pair social network and network centrad as:

Definition 2.3: For a social network $G = (V, E)$, then the whole set of social networking on the link density is:

$$d = \frac{\sum_{k=1}^{n}\sum_{s=1}^{m}(\rho(e_k, e_1) + \rho(e_k, e_2) + \cdots + \rho(e_k, e_s))}{k \times s} \tag{3}$$

Definition 2.4: The relationship between social network study in any of the links with other subjects and take the maximum degree of any two subjects with the connection degree of difference from the previous maximum value is the central difference in the degree obtained:

$$C = \frac{\sum_{k=1}^{n}[c(\omega) - c(\omega_k)]}{2\max\sum_{k=1}^{m}[c(\omega) - c(\omega_k)]} \quad k \neq s \tag{4}$$

Where:

$$c(\omega) = \max(\sum_{s=1}^{m}\rho(e_1, e_s), \sum_{s=1}^{m}\rho(e_2, e_s), \cdots \sum_{s=1}^{m}\rho(e_k, e_s)),$$

$$c(\omega_k) = \sum_{s=1}^{m}\rho(e_k, e_s).$$

The concentration of network measured by its center degree.

3 Determine the Degree of Contact

Set theory in the development of today's successor is set in the continuous improvement of theory, especially in the value of i, the TRANSACTIONS ON value using homeopathic methods, contrarian value method to calculate the value method and a random sample value method and other methods to solve for i, the specific issues raised should be found in the variation of i, Zhu Bing and other proposed test methods to determine the statistical differences between the new way i uncertain factors, the reasonable value given. However, these methods do not fundamentally sound methods. Tao Li, made by different degrees, respectively, and confrontation with the same degree as the degree of correlation values of i, using the gray theory calculation of the absolute correlation of i to solve it. This method is more able to differences in degree; the same degree of opposition is given a more reasonable degree of value.

4 Information Mining of Centrad

Social network analysis is the effective method to dig social network relationship. However, in the real social network, there exists uncertainty in their relational attributes in the two research objects. Therefore, this paper proposes the set pair social

network analysis model so that network relationship can be decided by their attributes instead of confining by the relationship of 0-1 two-value network. Set pair social network analysis model can be used to calculate the network center measure, the concrete steps as follow:

Step1: In a network relationship, construct the relational attribute set of every research object in the network. In accordance with the various characteristics of the set pair, the same degree, diversity factor and confrontation are be analyzed, and the quantization value of a group of the same degree, diversity factor b and confrontation factor c are obtained;

Step2: Calculation method of the absolute relationship in gray theory is used to calculate the value of i degrees of connection;

Step3: According to the calculated value of i, the degree $\rho(e_i, e_j)(t)$ value of any two subjects in the network is got;

Step4: Used by the relationship degree of any two subjects got in step3, relational matrix R in social network is constructed;

Step5: The key research object is found in the network. Centrality measure C is calculated by the social network relational matrix R;

Step6: Conclusions.

5 Applications

Set pair network model constructed by (Fig.1). Where:

$$A = \{A, B, C\},\ B = \{A, B, C\},$$
$$C = \{A, B, C, D\},\ D = \{C, D, E, F\}$$
$$E = \{D, E, F\},\ F = \{D, E, F\}$$

The relational degree of any two research subjects is $\rho(A, B)(t)$ and $\rho(A, C)(t)$ respectively.

Using the methods of absolute relationship degree in gray theory to obtained $i = 0.770$.

This table displayed that the relational degree of D is the highest, and this showed that D is the core of the simple network. Core degree (C = 0.403).

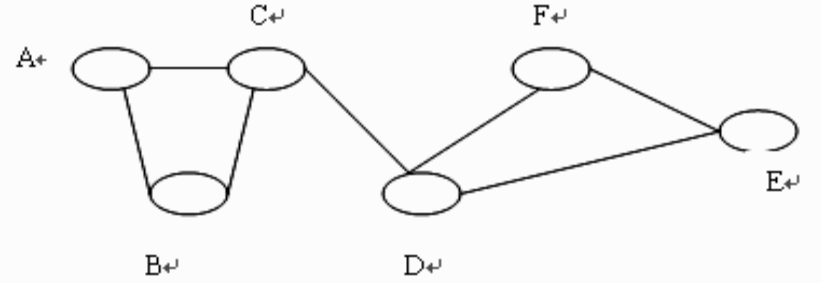


Fig. 1. Set pair network formed by A, B, C, D, E and F

Table 1. Set social network matrix can be constructed

	A	*B*	*C*	*D*	*E*	*F*
A	1	0.885	0.589	−0.641	−1	−1
B	0.885	1	0.589	0.667	−1	−1
C	0.589	0.589	1	−0.333	−0.667	−0.667
D	−0.641	0.667	−0.333	1	0.589	0.589
E	−1	−1	−0.667	0.589	1	1
F	−1	−1	−0.667	0.589	1	1

6 Conclusion

In this paper to better learning social network relationship by constructed a set pair social network analysis model based on uncertainty of the social network. In addition this simple social network analysis model implementation in a friends relationships to found who is most significant. Since the networks are large networks in practice, and the current set pair social network analysis theory is not perfect yet, there will be much work to do in the future work.

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A Privacy Access Control Framework for Web Services Collaboration with Role Mechanisms

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Abstract. With the popularity of Internet technology, web services are becoming the most promising paradigm for distributed computing. This increased use of web services has meant that more and more personal information of consumers is being shared with web service providers, leading to the need to guarantee the privacy of consumers. This paper proposes a role-based privacy access control framework for Web services collaboration, it utilizes roles to specify the privacy privileges of services, and considers the impact on the reputation degree of the historic experience of services in playing roles. Comparing to the traditional privacy access control approaches, this framework can make the fine-grained authorization decision, thus efficiently protecting consumers' privacy.

Keywords: Privacy; Web Services; Role; Reputation.

1 Introduction

Web services are an emerging software engineering paradigm for rapidly developing and deploying Web applications by dynamically integrating independently developed Web service components. When any single web service fails to accomplish service consumer's multiple function requirements, multiple web services need to be dynamically collaborated together to form a web service composition [6]. In a Web services based collaboration application, service consumers often need to disclose personal information to service providers, such as name, income, occupation, and home address. Once personal information is disclosed online, it may be abused or accessed without authorization, thus increasing the risk of illegal collection, usage and disclosure of personal sensitive data [2, 3].

Privacy refers to the ability of individual to control the collection, use, retention, and distribution of information about themselves [7]. In order to accomplish the business goals, a service consumer has to release some private data to support the collaborative work; on the other hand, in order to meet the needs of security, a strict control mechanism is required to protect these private data [1].

Currently, there are many researches about the privacy access control approaches in services collaborations [4, 5]. However, most of them use the method of "all-or-nothing' to make privacy authorization decision. But, in fact, due to the untrustworthy

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 258–263, 2011.
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nature of the Web services, a set of services with the same functions may have different privacy disclosure risks because of their different reputation degrees.

To overcome the above drawbacks and utilize the excellent characteristics of role mechanism in software design and access control [8], this paper presents a role-based privacy access control framework for Web services collaboration, this framework utilizes roles to specify the privacy privileges of services, introduces trust relationships among services into collaboration design, and considers the impact on the reputation degree of the historic experience of services in playing roles. The collaboration makes the decision on privacy authorization according to the reputation degree of the services.

The remainder of this paper is arranged as follows. Section 2 proposes a role-based Web services privacy access control framework. Section 3 analyzes the privacy authorization process. Closely related work and comparison are reported in Section 4. Section 5 concludes the paper with proposals for future work.

2 Role-Based Web Services Privacy Access Control (RBSPAC) Framework

In the above scenario, collaborative services share the private data and request or provide services through sending or receiving messages so as to achieve the common business goal. On the other hand, services request the access privileges of the personal sensitive data in the interacting process. Based on the above analysis, this paper proposes a RBSPAC framework. In this framework, every service has a behavior interface, which consists of a set of operations. The service receives and sends messages through the operations in the interface. Since the services just use a part of functional behaviors in a specific collaboration, it can be stated as that service play role. The roles specify the functional behaviors required by services in a collaborative process [2, 8].

Meanwhile, in order to protect the privacy of the personal data, roles also need to specify the access privileges to the sensitive data of the playing services, which set the reputation thresholds for the sensitive data to be released. Only when the reputation degree of a service is higher than or equal to the reputation threshold of the private data, can it obtain the access authorization.

A service may play a set of roles in a period, but it can play only one role in a services collaboration at a time point. The roles and their playing services form a collaborative group. The set of services makes the service composition in the collaborative group through implementing the function behaviors specified by the roles. They share the data and make coordinated efforts to finish the business goal [8].

Based on the above discussions, the relevant definitions of the RBSPAC framework are as follows:

Definition 1: Message. A message is defined as $msg ::= <id, v_m, O_m>$, where

- id is the identification of the message;
- v_m is the pattern of the message, specifying the types, sequence and the number of parameters; and

- O_m is an ordered set of data objects taken as the parameters with the message pattern v_m.

Definition 2: Role. A role is the specification to the function behavior and privacy policy of its playing service. It is defined as $r ::= <id, s, M_r, OP_r, O_r, T_r, p_r, f_{pm}>$, where:

- id is the identification of the role;
- s is the playing service of the role;
- M_r is a finite set of messages of the role;
- OP_r is a finite set of operations of the role;
- O_r is a finite set of privacy data objects that can be accessed by the playing service;
- T_r is a finite set of privacy policy types that can be accessed by the playing service;
- p_r is a finite set of privacy policies. For any policy $p_r \in P_r$, it is defined as $p_r ::= <op_r, pm>$. It specifies the access privileges that service s can obtain in executing operation op_r, where $op_r \in OP_r$, pm is a privacy policy matrix formed by $|O_r|$ rows and $|T_r|$ columns, for short, policy matrix. The elements of the matrix $pm[i, j]$ $(0 \le i < |T_r|,\ 0 \le j < |O_r|)$ denote the lowest reputation threshold required by service s to obtain the privacy privileges with the data object as j and the type as i, $pm[i, j] \in [0,1]$, where 0 indicates that the privileges can be authorized to any service and 1 indicates that the privilege is not authorized to any service, the policy matrix set of role r is denoted PM; and
- $f_{pm}: op_r \rightarrow pm$ is a mapping function, which obtains the corresponding policy matrix pm of operation op_r, where $op_r \in OP_r$, *and* $pm \in PM$.

Definition 3: Inheritance Relationship of Roles. The inheritance relationship of roles is a partial order relationship in the role set R, $RH \subseteq R \times R$, denoted as $\preceq_R$. For any $(r_1, r_2) \in RH$, we say that r_2 inherits r_1 ($r_1 \preceq_R r_2$), if and only if all of the playing services of r_2 are those of r_1 and all of the authorizations of r_1 are those of r_2.

Definition 4: Service. A service is a role player. It is defined as $s := <id, d, r_c, R_p, M_s, OP_s, O_s, T_s, P_s, f_{rm}, f_{msg}, f_d>$, where:

- id is the identification of the service;
- d is the current reputation degree of the service, where $d \in [0,1]$;
- r_c means a role that the service is currently playing;
- Rp means a finite set of roles that the service has played before;
- M_s is a finite set of messages, for every message $msg \in M_s$, $msg!$ and $msg?$ are used to denote to send and receive message msg, respectively;
- OP_s is a finite set of operations that service interface include, for any operation $op_s \in OP_s$, it is either the sending operation or receiving operation of message msg;
- O_s is a finite set of privacy data objects which are requested to access by the service;
- T_s is a finite set of privacy privileges types which are requested to access by the service;

- p_s is a finite set of privacy privileges which are requested to access by services. For any policy $p_s \in P_s$, it is defined as $p_s ::= <op_s, rm>$. It denotes a set of privacy authorizations that service s requests in executing operation op_s, where $op_s \in OP_s$, rm is a privacy authorization request matrix formed by $|T_s|$ rows and $|O_s|$ columns, for short, request matrix. The elements of the matrix $rm[i, j] \in \{0,1\} (0 \le i < |T_s|, 0 \le j < |O_s|)$, 1 denotes to request the privilege with the data object as j and the type as i and 0 denotes not to request such an privilege, the request matrix set of service s is denoted RM.
- $f_{rm}: op_s \rightarrow rm$ is a mapping function which obtains the corresponding request matrix rm of the operation op_s, where $op_s \in OP_s$, and $rm \in RM$;
- $f_{msg}: op_s \rightarrow msg_s$ is a mapping function which obtains message msg_s the operation op_s has sent or received, where $op_s \in OP_s$, and $msg_s \in M_s$; and
- $f_d: (s, r) \rightarrow d$ is a mapping function which obtains the reputation degree when service s plays role r.

Definition 5: Collaborative Group. A collaborative group describes a dynamic state for a services collaboration. It is composed of a set of roles and services, it is defined as $g ::= < id, R, S, A_{rs} >$, where:

- id is the identification of the group;
- R is a finite set of roles of the group;
- S is a finite set of services of the group; and
- A_{rs} is a finite set of matched pair of role and service. For every $a_{rs} \in A_{rs,}$ it is expressed as $a_{rs} ::= <r, s>$, which denotes assigning role r to service s, where $r \in R$, and $s \in S$.

Since the services are reusable, for role r, the service may have played r or played the inherited role of r at an earlier time. Hence, we say that role r and its inherited role are the historically trustworthy role of the service. The playing experiences of the service are very helpful to increase its reputation degree. Since the service plays roles at different times, its playing experience influences its reputation degree at varying degrees.

Definition 6: Historically Trustworthy Role. For any role $r_h \in R_p$, if there exists $s.r_c \preceq_R r_h$, we say that role r_h is a historically trustworthy role of service s in the current time point. The historically trustworthy role set of s is denoted as R_h, it is calculated by the following equation:

$$R_h = s.R_p \setminus \{\neg s.r_c \preceq_R r_p \mid r_p \in R_p\} \tag{1}$$

Where $r_h \in R_h$, and $R_h \subseteq R_p$.

Definition 7: Accumulated Reputation Degree. The accumulated reputation degree d_a of service s is the accumulated value of the reputation degree of the historically trustworthy roles and the current reputation degree, it is expressed as:

$$d_a = d_c + (1 - d_c) \cdot \frac{1}{|R_h|} \sum_{l=1}^{|R_h|} f_d(s, r_h^l) \cdot \frac{1}{1 + \alpha k} \tag{2}$$

Where:

- d_c is the current reputation degree of service s;
- l is the sequence of the role r_h^l in the historically trustworthy role set of serives s, $1 \le l \le |R_h|$;
- k denotes the moment when service s played role r_h^l. The longer the time elapses, the bigger the k is;
- $f_d(s, r_h^l)$ is used to obtain the reputation degree when service s plays role r_h^l; and
- α is a time decay factor, $\alpha > 0$. The longer the time elapses, the smaller the $\frac{1}{1+\alpha k}$ is.

3 Privacy Authorization Process

Based on the above privacy access control framework, now we can describe the architecture of the privacy authorization enforcement system. This system involves four components: authorization control manager(ACM), authorization decision maker(ADM), service repository(SR) and role repository(RR). When a role requests for the privacy privilege, it firstly sends the request to the ACM, which includes the id of service and the name of operation. After the ACM receives the request, it asks the ADM to make the decision. The ADM firstly finds the SR according to the service id and the operation name and gets the role that the service plays currently and the correspondent privacy request matrix. Then it finds the RR and gets the correspondent privacy policy matrix. And then it computes the reputation degree of the service. Finally it makes the authorization decision according to the request matrix, policy matrix and the reputation degree of service, and sends the authorization result to the ACM. The ACM sends the service about the result that whether the request is accepted or denied. The privacy authorization enforcement system is as follows:

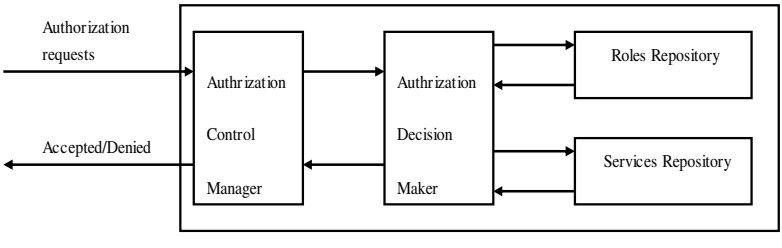


Fig. 2. The architecture of privacy authorization enforcement system

4 Related Work

In recent years, increasing attention has been paid to privacy-aware technologies and mechanisms to protect data privacy in the Web Services. The World Wide Web

Consortium is advocating P3P (Platform for Privacy Preferences) [4] as the standard format for expressing data-collection and data-use practices on the web. The XACML (Extensible Access Control Markup Language) [5] is an XML-based access control language. It provides an application-independent policy language which enables the use of arbitrary attributes in different types of policies, including privacy policies. The problem of those methods is that they use the "all-or-nothing" authorization decision mechanism, which may cause the unexpected privacy leakage.

In our approach, the trust level of every piece of privacy privilege has been set. Only when the reputation degree of the service is higher this level, can it access the privilege. In other words, the access control decision is based on the question of "how much privacy privileges can be allowed for a service with what trust degree", rather than "the privacy privileges allowed for a certain service or not".

5 Conclusions

This paper proposes the RBSPAC framework. First, it applies roles into the specification of the privacy privileges of services, and considers the impact of the historic role playing experience of services on the reputation degree, makes the authorization decision according to the reputation degree of the service. There are many ways to protect data privacy in Web services collaborations. With special consideration of role specifications and role-related policies such as the time properties and conflicts of roles, services collaboration can be made more secure and dynamic. Therefore, a task for future is to extend the RBSPAC framework with regard to policies relevant to the time properties and conflicts of roles in services collaborations.

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Modeling and Simulations on the Intramural Thermoelectric Generator of Lower-Re-fluid

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Abstract. The thermoelectric conversion with lower Renault number (Re) fluid, such as waste heat from industry boiler, and engine's circled cooling water, which can be designed as intramural generator structure. In this research, a thermoelectric project analysis model and the description of an intensified system are presented, its generator with the aligned or staggered platoon structure has strengthened heat-transfer property, and the heat convection coefficient ratio has increased times than plain tube; For the fluid kinetic energy's loss is influenced by the whirlpool, the pressure difference is several hundred Pa level which changes along with geometric parameters of transform components; what's more, heat transfer area increase distinctly under the same generator volume, which has built the foundation for the enhancement output electric power.

Keywords: Intramural, thermoelectric generator, modeling, simulation, Renault number Re.

1 Introduction

Heat conduction is the first process of thermoelectric conversion, which has great influence on the whole process. After determining thermoelectric materials, improving heat flux density and electric field intensity will have decisively influence on evaluating the performance of thermoelectric conversion system. At present, the main problems exist in thermoelectric conversion system are complicated structure and low power density (volumetric specific power) [1] [2]. Most researches on heat transfer and thermodynamics of thermoelectric generator focus on external systems [3]-[5]. For thermoelectric conversion under lower Re number fluid (for example: waste heat from industry boiler or engine's circled cooling water), we can adopt thermoelectric generator with internal thermocouples tubes [6]. This paper presents a project model of thermoelectric conversion and also a mathematical description of intramural thermoelectric generator. The paper also emphasizes on improving the power density of system and good coordination performance through altering the arrangement of transduction elements and heat transfer methods, as well as adding heat transfer coefficients and increasing the heat exchange area in order to reduce the flow resistance and control the pressure differential of fluid in the channel.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 264–270, 2011.
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2 Model of Thermoelectric Conversion System

(1) The model of currently thermoelectric generator is showed in Fig. 1 (a), where 1 is thermocouple's arm, 2 is metal diversion slice, T_1 and T_2 are steady temperatures (K); the output power W_e of a thermocouple can be written as [7]:

$$W_e = \frac{\alpha_{NP}^2 (T_1 - T_2)^2 R_L}{(R_L + R)^2} \tag{1}$$

Where R_L is load resistance (Ω), R is internal resistance (Ω); α_{NP} is Seebeck coefficient of thermoelectric material (μV/K). When this conversion happens on multi-numbers of thermoelectric systems, especially when system works in unsteady-state, it is necessary to consider the influence caused by system on the parameters mentioned above, such that the total resistance of the system is the total sum of each resistance, and the $T_1$and T_2 are influenced by thermo conditions.

Therefore, the general conversion analysis model can be seen in Fig. 1 (b), where P and N are materials; T_h, p_h and c_h are respectively the temperature, pressure and velocity of hot fluid; T_c, p_c and c_c are respectively the temperature, pressure and velocity of cold fluid, and the $T_h > T_c$; T_1 is balance temperature when heat transferring between hot fluid and thermo-element high temperature point, T_2 is balance temperature when heat transferring between cold fluid and thermo-element lower temperature point, while ΔU is output voltage, I-I is heat insulation boundary.

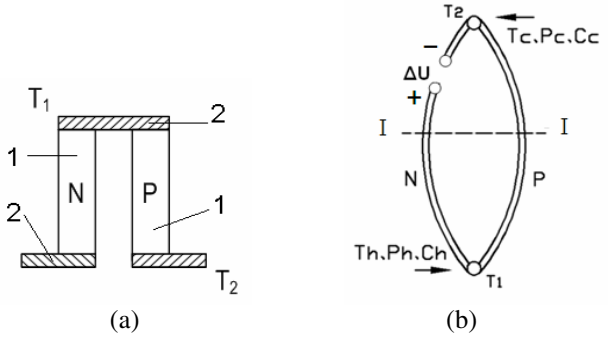


Fig. 1. Model of thermoelectric system

The heater used to conduct heat between high temperature fluid and high temperature thermocouple node is an open thermodynamic system, and the cooler used to conduct heat between cold fluid and low temperature thermocouple node is also an open thermodynamic system. If the heat releasing from the surfaces of two systems can be ignored, and shaft power has no output, then according to the first law of thermodynamics, their energy equations can be respectively written as below:

$$q_c = (u_2 + p_2 v_2 + \frac{1}{2} c_{f2}^2) - (u_1 + p_1 v_1 + \frac{1}{2} c_{f1}^2) \tag{2}$$

$$-q_h = (u_2 + p_2 v_2 + \frac{1}{2} c_{f2}^2) - (u_1 + p_1 v_1 + \frac{1}{2} c_{f1}^2) \tag{3}$$

Where u_1 and u_2 are respectively the thermodynamic energy of the inlet and outlet open system; similarly, pv is flow output, c_f is fluid velocity, q is heat transfer capacity of the thermocouple arm, q_h is negative because of the heater giving off heat, and when the heat is absorbed by the cooler, q_c is positive.

We treat the thermoelectric loop shown in Fig.1 as a whole thermodynamic system. To simplify it, we can suppose that the boundary between heater and cooler is adiabatic, it can only conduct heat and electricity through thermocouple arm and then form a thermodynamic system. Because of the variations in work temperature, the system can realize thermoelectric converting and output electrical power, and: when it is under stable operation, the energy analysis equation can be written as below:

$$W_e = q_{m1}(h_1 - h_2) - q_{m2}(h_2' - h_1') \tag{4}$$

In other words, the thermoelectric power W_e is equal in amount to the different value of the increase in enthalpy h' of warm fluid and the decrease in enthalpy h of cold fluid. In Equation (4), q_{m1} is the mass flow rate of the heater, and q_{m2} is the mass flow rate of the cooler. Since the changes of enthalpy include change of thermodynamic energy which is result from heat transferring between heat fluid and node of thermocouple, Equation (1) contains impact of heat transfer strength of the system on T_1 and T_2.

(2) Therefore, measures of raising output power of thermo generators are: increasing the thermoelectric material Seebeck coefficient; reducing transforms component's internal resistance and enlarging work temperature differences. Because the high temperature is limited by material, reducing a condensation temperature is a more effective method. In order to get more heat under limited temperature variation in multi-thermoelectric couple system, it is needed to strengthen heat transfer, improve heat convection coefficient and heat transfer area, so as to maximize heat flow energy.

3 Enhanced Conversion System and Mathematical Description

3.1 Enhanced Conversion System

According to the analysis above, we present an enhanced intramural thermoelectric conversion system and the principle is presented in Fig. 2, where the heater has channel for warm fluid to go through and it is also the heat sources for thermocouples, thermocouple components have a tube shape as 2 in warm channel which connects cold channel 3, then there forms a thermoelectric loop, and 4 represents heat-insulation layer. The velocity of cooling water in engine or exhaust gas in industry boiler is very low, so it can be considered as lower Re number fluid. In the channel of the heater, those kinds of fluid flow across the tube bundles; while in the cooler, cold fluid (such as cooling water) flow across the tube bundles, and the form of energy conversion is convection heat transfer. L=23 mm is the space between two tubes.

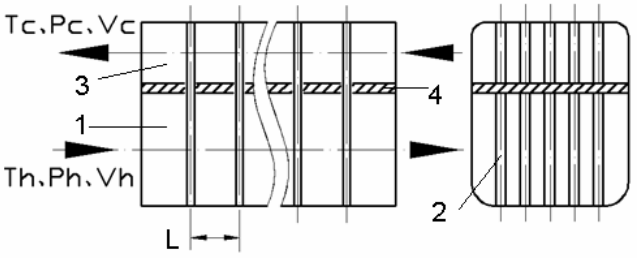


Fig. 2. Enhanced thermoelectric generator

3.2 Conditions for Unique Solution

(1) For describing the characteristics of the laminar flow in the channel, the steady state convection heat transfer differential equations of two-dimensional can be written as below:

Continuity equation:

$$\frac{\partial(\rho u)}{\partial x}+\frac{\partial(\rho v)}{\partial y}=0 \tag{5}$$

Momentum equation:

$$\rho\left(u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}\right)=F_x-\frac{\partial p}{\partial x}+\mu\left(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}\right)$$

$$\rho\left(u\frac{\partial u}{\partial x}+v\frac{\partial v}{\partial y}\right)=F_y-\frac{\partial p}{\partial y}+\mu\left(\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}\right) \tag{6}$$

Energy equation:

$$\rho c_p\left(u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}\right)=a\left(\frac{\partial^2 T}{\partial x^2}+\frac{\partial^2 T}{\partial y^2}\right) \tag{7}$$

In the equations above, u is the speed along x axis direction, v is the speed along y axis direction, p is pressure (Pa), F is volume force (N), μ is viscosity (Pa•s), T is temperature (K), ρ is density (kg/m^3), a is thermal diffusivity (m^2/s), and c_p is heat-absorption capacity J/(kg•K).

(2) The grid division of numerical calculating model is generated by software automatically; its initial parameters are the cooling water speed and the temperature of four-stroke-non-turbocharger gasoline engine. And the airflow initial temperature is set as 650K, inlet boundary condition is velocity inlet, initial velocity of flow is 30m/s, and outlet boundary condition is defined as free exit condition. Pressure, density, mass, force, momentum energy and the optimal relaxation factor value are default. Order of magnitude of calculation residual is 10^{-6}.

(3) The diameter of thermocouple conversion tube is Φ9 mm, the heat flow channel which used for contrast is a plain tube with the same size. Both of them the heat

flow transfers within inner surface of the tube, and conversing heat with air happens outside the tube, the heat transfer coefficient is 15 W/(m^2K); material attributes are as default setting; and the computation establishes 1000 iterations to guarantee restraining stability. The contrast computation adopts the same initial conditions.

4 Numerical Computation and Analysis

Calculation is based on Fluent software, the RNG k-ε model is used to calculate the velocity field, temperature field and pressure field of aligned tube and staggered tube. Figures 3-6 show the cloud pictures of calculation results. Figures 7-8 show the graphs of calculation results.

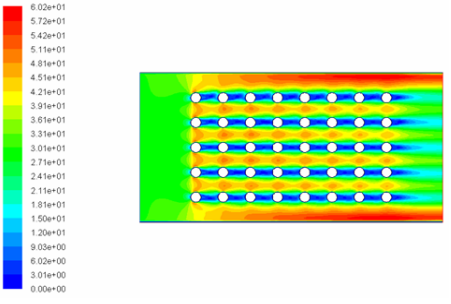


Fig. 3. Cloud picture of velocity in intramural heater

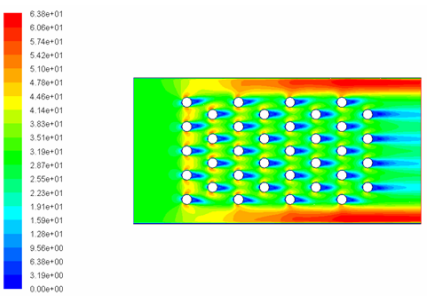


Fig. 4. Cloud picture of velocity in staggered heater

Fig. 3 is a cloud picture of 5×8 layout way of thermocouples tubes and fluid velocity's varying state in the heater. Fig. 4 is the staggered configuration, as well as the fluid velocity varying state in heater flow channel. The cloud charts demonstrate: the interval tubes transfer heat directly with the fluid, simultaneously generate the resistance to the fluid flowing. When fluid flows through the space between two tubes, the fluid speeds up, and produces the whirlpools that affect heat transfer with the next row tube. In a staggered arrangement, the whirlpool produced by the preceding row has little influence to the next row.

Fig. 5 is a fluid temperature change cloud picture in tubes in aligned row structure, which demonstrates that fluid temperature is decreased along with the increasing of axial length, but the value and energy transfer change little which has slight influence on temperature.

Fig. 6 is a fluid pressure change picture in aligned arrangement heater, with the rows of tubes increasing, the pressure is decreased unceasingly. This phenomenon can be explained as the fluid pressure is influenced by the channel volume and flow resistance. Reducing the fluid pressure difference is a very important technical parameter.

Those two most important parameters in evaluating the performance of heat exchanger are pressure difference and convection heat transfer coefficient. Fig. 7 shows the changes of pressure in the heater in which we can see that the pressure

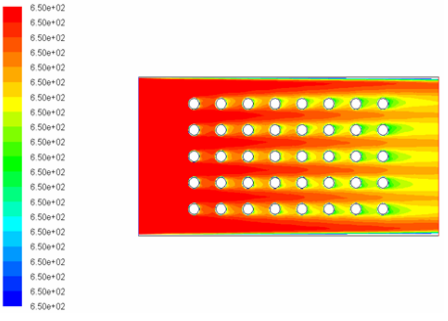


Fig. 5. Cloud picture of temperature in ordered heater

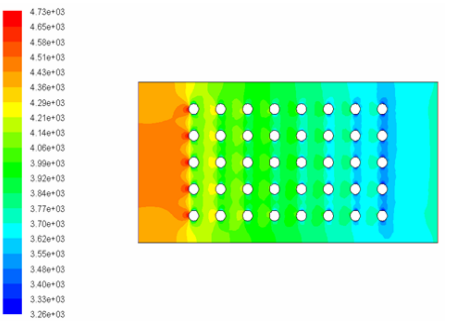


Fig. 6. Cloud picture of pressure in staggered heater

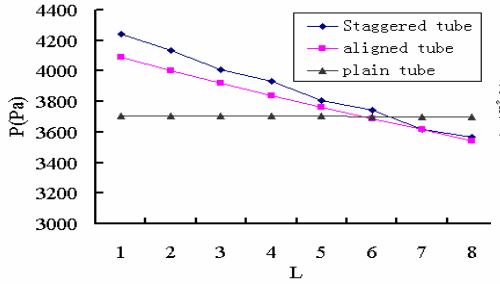


Fig. 7. Changes of pressure in the heater

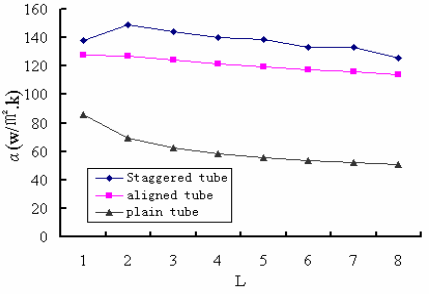


Fig. 8. Changes of convection heat transfer coefficient in the heater

keeps falling with adding of tube row, the pressure difference value is about 600 Pa between the entrance and exit, and the staggered structure has greater influence on this value than the aligned one; but, the value is very small in plain tube.

Fig. 8 shows the changes of convection heat transfer coefficient in the heater. The number of convection heat transfer coefficients of staggered structure is higher than that of other structures, and it is 2.5 times the value of plain tube, but not much more than that of aligned one. It is a notable characteristic on intramural thermoelectric generator. According to Fig. 7 and Fig. 8, the advantage of aligned structure is greater than staggered and plain tube.

5 Conclusions

The intramural thermoelectric generator has aligned and staggered structure. The numerical calculation results show that the performance of heat transfer of staggered structure is better, the convection heat transfer coefficients can be improved times than plain tube channel, but with a high flow resistance; since fluid kinetic energy was influenced by vortex flow, pressure difference is several hundreds of Pa; Moreover, the aligned structure has lower flow resistance and higher convection heat transfer

coefficient, which mainly changes according to design size parameters of the conversion devices; Under same volume condition and aligned structure, the heat transfer area of the intramural thermoelectric generator has been greatly improved. What's more, it has built a good foundation for improving output power through increasing the number of thermocouples.

Acknowledgements. The authors wish to acknowledge the financial support of the Guangdong Science & Technology Plan, the project No. 2009B010900019. This work was supported in part by Dr. Guoquan Xiao.

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The Technology of Extracting Content Information from Web Page Based on DOM Tree

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Abstract. There are huge amounts of information on Web pages, which includes content information and other useless information, such as navigation, advertisement and flash of animation etc. Reducing the toils of Web users, we estabished a thechnique to extract the content information from web page. Fristly, we analyzed the semantic of web documents by V8 engine of Google and parsed the web document into DOM tree. And then, traversed the DOM tree, pruned the DOM tree in the light of the characteristic of Web page's edit language. Finally, we extracted the content information from Web page. Theoretics and experiments showed that the technique could simplify the web page, present the content information to web users and supply clean data for applicable area, such as retrieval, KDD and DM from web.

Keywords: DOM tree; contents infromation; information extraction; pruning; selection.

1 Introduction

With the development and application of Intenet, Google claims that they have found more than 1 trillion independent URL [1], and the number of Web page is growing with billions everyday [2]. According to the statistics, the number of Web user has reached to 2.285 million in China, 2.171 billion in the United States. it is estimated that there will be more than 20 billion global Web users by 2010 and more than 32 billion users by 2015. If the mobile phone become terminal of the network, there will be over 40 million users [3]; And the content information on the Web page will continue to expand, it includes various data styles, such as text, graphics, image, video, sound, animation and so on. So Web has become the most massive database. How to effectively use the information is a huge challenge for researchers, Web data mining quickly become a hot topic.

The task of Web data mining is to mining hyperlinks' structure, Web pages'content and use log. Web content mining is to find information or knowledge from text, images, auditory, video, multimedia and other various types of data in the network. Usually, Web page is stored by HTML document, shown by a block structure, which

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 271–278, 2011.
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is hierachical. Further more, the block belongs to one of the classifications of logic. So, Web page structure analysis has become a hot topic during this years[4-7].

The developer and owner of Web page usually insert lots of non content information into their Web page for commercial purpose or displaying effect, such as advertisement, navigation links, flash of animation and other useless data. This non content information has become a barrier of quick obtaining information for Web users, this obstacle is outstanding to PDA users and mobile phone users because they need to take a long time to operate the scroll bar and skip a lot of irrelevant information. Therefore, we establish a new technology to extract content information from Web page which is based on DOM tree. The technology only provides content information to users by removing useless data from Web page. The following chapters will introduce relevant works, and then is the technology of content information's extraction from Web page, finally is our experimen and conclusion.

2 Related Research

At present, the related works includes structure analysis of Web page and content information's extraction from Web page.

2.1 Analysis of Web Pages' Structure

The layout of Web page is a hierachical block structrue, in which includes various information, and every block holds a topic. Therefore, the Web page structure's analysis has become an interesting topic to many researchers during recent years [6-11]. There are many related works at present, such as:

Microsoft released a technical report entitled "based on visual information page partition algorithm" in 2003, the algorithm divides a page into different blocks which is based on visual features of the Web page[7], because HTML lacks of semantic description, Qi Wang etc estabilished a STU tree mode based on DOM norms[5], Further, retrieval technology on the basis of Web page block have a good results [11]. Song put forward a kind of collectable and storable technology of archives according to the Web page block, which divides a Web page into several independent rectangular areas (blocks), and then extracts and indexes information from the Web page blocks. When archive collection takes place, only the changed blocks are stored. Thus a lot of memory spending is saved.

2.2 Web Page Content Information Extraction

Web page is full of all sorts of information, but only the contents in a page are interesting to a user. The advertisment, navigation and so on are useless information. How to extract contents from a Web page is an interesting and practical topic. It is very important to PAD or mobile phone users. Many related works have been done, such as, Biao Liu etc created a page content retrieval framework on the basis of a new coordinate tree[12], Miao etc did some works for web content retrieval, which is based on page block[13]. Xu Chao etc studied the contents extraction from Web

page[14], Hu etc estabilished a Web page text extraction technology in the light of label density[15].

At present, content extraction from Web page is mainly based on its structure. But the method don't adapt to the fast development of Web technology because of complexity and flexibility of Web page. Therefore, we put forward a new technology to extract the contents from the Web page, we call the method as based on DOM tree contents information extraction technology. Since most Web documents are edited by HTML or XML language, whether advertising, navigation or other information are looks as objects, and contained in some tags. The "table" layout could easily been translated into more flexible and more semantics "div + CSS" layout. So, Web document is ready parsed into DOM tree. We will construct a new technology to extract content according to following steps: firstly, traverse the DOM tree by the recursive way, and then remove all noise data by pruning, at last, extract contents.

3 Content Information Extraction Based on Content DOM Tree

3.1 Basic Definition

Define 1. DOM(document object model) tree: the document object model is called DOM. It is a standards structural specifications promulgated by W3C. In order to facilitate the management and operation, HTML document will be parsed into DOM tree according to the hierarchical relationships of the nodes in the document. Every node in the tree is called an object. A DOM tree not only describes the document structure, but also describes the node object's properties and methods.

Definition 2. Block element :namly an frame of element, which fills with content district of his father element. Block elements could be separated by sparator. The most common HTML block element is "p", "div", "in".

Define 3. The process of transforming HTML document into Dom tree is known as parse. All contents in the HTML document are contained in the tree node. Any opereation to HTML document could be carried on the DOM tree.

Define 4. Set H = {H | H is an HTML document}, we call H as a set of HTML document. Set T = {t | h∈H, t is a tree of "h"}, we call T as, a set of DOM tree. So we difine the process of parsing as parse (H) = T.

Definition 5. According to the structural specifications, each node holds attributes and methods. The type of node cover tag node and text node.

Define 6. The nodes labeled "div" and "in" is called topic content node.

Define 7. When a node is not a topic content node, we add up all children to their father node to constitute cumulative factor. The factor denotes as follow

$$\text{Length(topic)} = \text{错误！未找到引用源。}$$

Define 8. We call the set of topic nodes as Independent document, the others could be called unindependent document,such as static text.

3.2 A System of Web Page Content Retrieval

Our system is divided into five parts: the HTML parser, semantic analyzer and the pruning device, Cumulative device, Screening. The system is dnoted as figure 1.

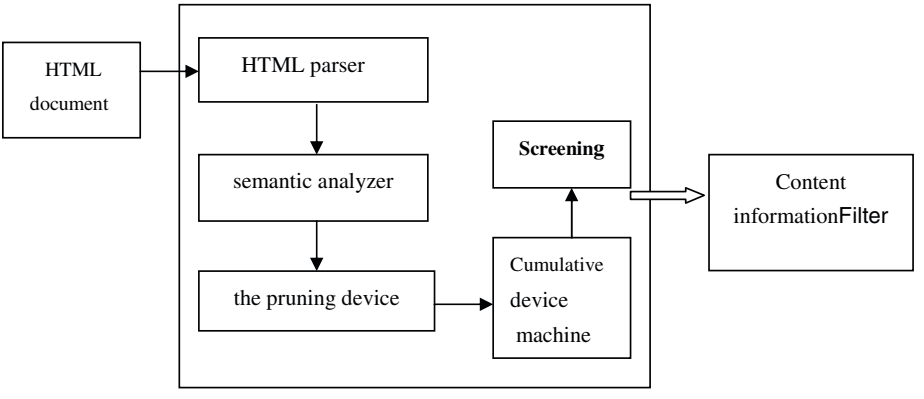


Fig. 1. The system of Web page content retrieval

HTML parser is used to transform HTML document into DOM tree. The function of semantic analysis is to add sematic property to the node in the DOM. The task of pruning device is to prune all non content nodes and its branch. Cumulative device is used to count the length of topic nodes. Cumulative is used to filter all noise nodes.

We use Google company V8 as the semantic analysis and Parser. The other parts of the system are described as follow:

3.3 Pruning Algorithm

Because there are many noise datas in a Web page, firstly ,we traverse DOM tree to prune all sorts of noise nodes. The algorithm is describe as follow.

```
Algorithm 1. The pruning algorithm
Input: DOM tree
Output: the pruned DOM tree
  DeleteDomTree(T){
          If(t.firstChild) return;
      for(var i=0;i<T.childNodes.length;i++){
                var child = T.childNodes[i];
              if(child.tagName == "a") {
                delete(child);
                break;
```

```
                if(child.tagName == "img") {
                  delete(child);
                  break;
                ……
                }
                  DeleteDomTree(child.firstChild);
        }
  }
```

The algorithm uses depth-first strategy to traversal DOM tree. All noise node will be cut out from the DOM tree.

3.4 Cumulative Algorithm

The algorithm counts the length of text contents contained in all qualified nodes

```
  Algorithm 2. Cumulative algorithm
      Input: pruned DOM tree
      Output: A array of text length of topic node
      Count(T){
            If(!T.firstChild) return;
            for(var j = 0 ;j<T.childNodes.length;j++){
                  var child = T.childNodes[i];
                  var length = 0 ;
                  if(child.nodeType == 3){
            length = child.length;
            content = child.nodeValue;
            record(length)
           }
                  if(child.tagName == "table" ||
child.tagName == "div"){
            lengthRecord(record);
            contentRecord(content);
            break;
           }
           Count(child)
        }
    }
```

The algorithm uses depth-first strategy to traversal the pruned DOM tree. Starting from leaf nodes, if a node is not a topic node, it must be add up to its father or its ancestors node. The function of record() is to record the length of Non text nodes. We describe the function as follow $totallength = \sum_{i=1}^{k} length(nchild)$. lengthRecord() denotes the length of text contents in topic node, contentRecord() stores the content of topic nodes.

3.5 Screening Algorithm

The task of screening algorithm is to select the topic node. And then retuns the result.

```
    Algorithm 3. Screening algorithm
Input: All documents wordArray and its length.
    Output: Independent node containing text
Compare(){
    max :=ε ; //ε for the specified length threshold
for(var n = 0 ; n<wordArray.length;n++ )
{
    if(wordArray[n]>max)
{
     output" Subject content is"+wordArray[n];
}
}
}
```

4 Experimental Results

4.1 Sampling Survey

We have test the technique based on our discussion. Table 1 shows the results of our experiment.

4.2 Experimental Analysis

Based on the length of topic content on Web page, we estabilish a extracting cotent information algorithm from Web page. The key issue in our algorithm is whether the layout structure of Web page is "div + CSS" layout or not. According to the statistic analysis, correlation coefficient of the accuracy and "div + CSS" layout is 0.89916. this infers that accuracy and "div + CSS" layout are related.

Table 1. The accuracy is the ratio of being rightly extracted from all Web page Table 2

Table 1. The results of experiment

Web station	classification	amount of page	accuracy	"div+css"
qq.com	sports	3000	95.6%	97.2%
163.com	news	1000	93.2%	96.2%
taobao.com	E-commerce	1000	94.1%	95.3%
sina.com.cn	news	2000	95.5%	97%
sohu.com	entertament	500	98%	98.5%

table 1, the accuracy is the ratio of being rightly extracted from all Web page. "div+css" is the percentage of "Div + CSS": "div + CSS" layout page.

5 Conclusion and Prospect

A new technology to extract content information from Web page is proposed and every algorithms in the technology are detailed, such as Pruning algorithm, Cumulative algorithm, Screening algorithm etc. The technology reduces the complexity of extracting, our contribution lies in the following:

1) A new technology of extracting content information from Web page has been estabilished. This technology promises to reduce human fatigue of selecting content from multifarious pages.
2) The efficiency and accuracy of extracting content information from Web page has been improved. The complexity has been reduced.

Along with the W3C more strengthened, the page tag more standardized and more semanticized, the accuracy will be more and more higher and the Scalability will be more and more larger, the value of application will be more and more considerable. The technology will satisfy the requirements of PDA users and phone users accessing information instantly, but also could provide clean data resources for many other areas, such as retrieval, knowledge discovery and data mining etc.

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Addendum Surface Design Based on the Parametric Method

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Abstract. The paper proposes to establish the section curve types database based on the user-modified characteristic parameters, and presents the method based on thin-plate-under-tension model to generate addendum surface by the section curves and connect-lines, there has the second-order continues between surface-patches, thus ensure the overall good smoothing of the surface. The relevant parametric design modules which based on software KMAS^{TM} are independently developed in Visual C++, and we use an auto panel addendum surface successfully design process as an example to illustrate the application and effectiveness of this proposed method.

Keywords: Material processing; Stamping technology design; Die-face engineering; Parametric design.

1 Introduction

For its complex shape and large size, the forming of the automotive panel is inevitable involved in various technical problems closely related with human's experience in process design, mold design etc. [1-3]. In order to establish good drawing conditions, addendum surface is required to all sides of panel during the pre-treatment period of mold design. The work of this part is the most important component of drawing module works, which affects not only the uniformity of the stress distribution, and the flowing of plastic materials in drawing process, but also have a vital role on the follow-up trimming, flanging and other technologies. Thus the design of addendum surface is of great significance.

Normally, addendum surface can easily create the deformation space of sheet metal forming, considering the design of which, we should pay more attention to the flowing of blank material in drawing forming process, the shape and position of binder surface, parts' forming accuracy and its location requirements and trimming technology requirements et al. However, possibly because of the complexity of sheet metal parts in geometry, to the best of the authors' knowledge, the same work cannot be said of very successful. So far, the design of addendum surface can be divided into two types, as non-parametric design and parametric design. Non-parametric methods are mainly constructing the optimization model of the die face assessing the overall situation to generate surface directly. Liu et al. [4] used a multi-objective genetic

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 279–284, 2011.
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algorithm and a mesh morphing technique to achieve fast modification of the optimal design of die face.

However, the non-parametric methods are not conducive to the application of human-machine interactive commercial software, comparatively, parametric method is more user-friendly generate surface what user needed, thus, this method is more favorable to the mold design which need more artificial intelligence and experience. Wang et al. [5] used technology based section feature to design addendum and binder surface and variation-sweep method to generate surface; Liu et al. [6] adopted feasible parametric method to design addendum surface by technology of bi-direction NURBS skinning. Gong et al. [7] generated addendum surface by using the technique of NURBS. And there still are some contributions of scholars who combinated the parametric method and the optimization algorithm together to achieve the die face design, such as Schenk and Hillmann[8] optimized the geometrical parameters of the die face by evolution algorithms and parametric CAE software AUTOFORM.

Overall, the design of binder surface is not complicated as a block-shaped sheet metal forming, however, addendum surface as a cover around part, its forming is of a very high degree of difficulty. Considering the large amount of difficulties in overall generation of addendum surface, usually the way of generate it is patch-surface-generation method, Most of these studies are based on which. This design ideas easy to implemented, but there is still a major problem that there are easily generate sharp angles between surface-patches which means inadequate smoothness. The problem will greatly affect the subsequent forming processes such as material flowing and the supplementary conditions, forming precision, and even lead to splits or wrinkles [9-10] of the parts et al. serious problems.

Based on the above considerations, this paper tries to use physics-based model from the deformation energy theory of physical, that is, the uses of elastic deformation equation of thin plate in elasticity to construct the addendum surface-patch equation model in parametric design. Therefore, while still using the sub-surfaces method to generate overall addendum surface, but because we considerate overall situation, the algorithm model can generate smoothing surfaces that there is second-order connection between surface-patches. The general organization of the paper is as follows: Section 2 proposes the design of section curves and connect-lines; Section 3 presents the application of physics-based energy method for generate second-order continuous addendum surface base on skeleton lines.

2 Components of Addendum Surface

Located between parts and binder surface, addendum surface contains three components, as well as boundary line, section curves and connect-lines. Parametric design process of addendum surface can be summarized as follows: First, by the shape features of parts and technical requirements of stamping, the section curves are be generated, that is, the v-direction parametric curves of addendum surface, and the second step is to generate the connect-lines base on the section curves, that is, u-direction parametric curves, and the last by section curves and contour lines(boundary line and connect-lines), we can generate the integrative addendum surface base on the patch-surfaces-generation method.

3 Generation of Addendum Surface

According to [10], we use the elastic potential energy equation to construct the surface-patch physics model, this model has been widely used in many fields and the general form of elastic deformation equation is:

$$E = \iint [(\alpha_{11} S_u^2 + 2\alpha_{12} S_u S_v + \alpha_{22} S_v^2 + \beta_{11} S_{uu}^2 + 2\beta_{12} S_{uv}^2 + \beta_{22} S_{vv}^2) - 2Sf(u,v)]dudv \tag{1}$$

where S is parametric surface we needed and where u and v are the parametric variables of S; S_{uv} is mixed partial derivative vector of S, α and β are given material parameters; f is given vector function; S_u, S_v, S_{uu}, S_{vv} are first-order and second-order partial derivatives vector along the u and v direction of surface.

In particular, the parametric surface equation is:

$$S(u,v) = \sum_{i=0}^{m} \sum_{j=0}^{n} d_{i,j} N_{i,k}(u) N_{j,l}(v) \tag{2}$$

where $N_{i,k}(u)$ and $N_{j,l}(v)$ is B-spline basis functions respectively, so we can get partial derivatives vector of S easily as:

$$S_u(u,v) = \sum_{i=0}^{m} \sum_{j=0}^{n} d_{i,j} N'_{i,k}(u) N_{j,l}(v) \tag{3}$$

$$S_{uu}(u,v) = \sum_{i=0}^{m} \sum_{j=0}^{n} d_{i,j} N''_{i,k}(u) N_{j,l}(v) \tag{4}$$

$$S_v(u,v) = \sum_{i=0}^{m} \sum_{j=0}^{n} d_{i,j} N_{i,k}(u) N'_{j,l}(v) \tag{5}$$

$$S_{vv}(u,v) = \sum_{i=0}^{m} \sum_{j=0}^{n} d_{i,j} N_{i,k}(u) N''_{j,l}(v) \tag{6}$$

$$S_{uv}(u,v) = \sum_{i=0}^{m} \sum_{j=0}^{n} d_{i,j} N'_{i,k}(u) N'_{j,l}(v) \tag{7}$$

the equation 3-7 are used to calculate equation 1, and here we do not consider the impact of given vector function f and material parameters α and β, this means that $f = 0$, $\alpha = \beta = 1$ thus we get the result:

$$E = \sum_{i=0}^{m} \sum_{j=0}^{n} (d_{i,j} \sum_{h}^{m} \sum_{t}^{n} (d_{k,t} W_{i,j,h,t})) \tag{8}$$

where $W_{i,j,h,t} = \int_0^1 \int_0^1 T(u,v) dudv$, and

$$T(u,v) = N'_{i,k}(u)N_{j,l}(v)N'_{h,k}(u)N_{t,l}(v) + 2N'_{i,k}(u)N_{j,l}(v)N_{h,k}(u)N'_{t,l}(v)$$
$$+N_{i,k}(u)N'_{j,l}(v)N_{h,k}(u)N'_{t,l}(v) + 2N'_{i,k}(u)N'_{j,l}(v)N'_{h,k}(u)N'_{t,l}(v) \quad .$$
$$+N''_{i,k}(u)N_{j,l}(v)N''_{h,k}(u)N_{t,l}(v) + N_{i,k}(u)N''_{j,l}(v)N_{h,k}(u)N''_{t,l}(v)$$

3.1 Construction of Boundary Conditions

Boundary conditions of medel can be divided into the following two, boundary constraints and trans-boundary derivative vector constraints of surface-patches, it can be presented below:

(1) Boundary constraints

Four of the border curves known as:

$$p_s(u) = \sum_{i=0}^{m} q_{s,i} N_{i,k}(u)\,,\ s = 0,\ 1; \tag{9}$$

$$\text{and} \quad p_s(v) = \sum_{i=0}^{m} q_{s,j} N_{j,l}(v)\,.,\ s = 0,\ 1 \tag{10}$$

Because the same degree of the border curve equations and surface equation, the control vertices of surface boundary is the same as control vertices of border curve corresponding, it means that:

$$\begin{cases} d_{i,0} = q_{0,i}, d_{i,m} = q_{1,i}; i = 0,1,...m \\ d_{0,j} = q_{2,j}, d_{m,j} = q_{3,j}; j = 0,1,...m \end{cases} \tag{11}$$

(2) Trans-boundary derivative vector constraints

As $v = 0$, the conditions for the continuity of the first-order partial derivatives vector of border curve is:

$$S_v(u,0) = p'_v(u) \tag{12}$$

where $p'_v(u)$ is first-order partial derivatives vector along parameter u.

Use equation 5 and 12, we got that:

$$\int (p'_v(u) - \sum_{i=0}^{m}\sum_{j=0}^{n} d_{i,j} N_{i,k}(u) N'_{j,l}(v))^2 du = 0 \tag{13}$$

Finishing equation 13, and order that:

$$H_1 = \Lambda - 2\Gamma + \Upsilon = 0\,,$$

where $\Lambda = \int p'_v(u)^2 du$,

$$\Gamma = \sum_{i=0}^{m}\sum_{j=0}^{n} d_{ij} \int p'_v(u) N_{i,k}(u) N'_{j,l}(0) du\,,$$

$$\Upsilon = \sum_{t=0}^{m}\sum_{w=0}^{n}\sum_{i=0}^{m}\sum_{j=0}^{n} d_{i,j} d_{t,w} \int N_{i,k}(u) N'_{j,l}(0) N_{t,k}(u) N'_{w,l}(0) du\,.$$

Do the same treatment to second-order partial derivatives vector of the border curve, we can get H_2, and continue to do the same to three other border curves we can get H_i, i = 3,…,8.

3.2 Optimization Model of Surface-Patch

After gotten the boundary conditions, the surface that is making equation.1 which is satisfied with boundary conditions acquisiting minimum value is unknown surface-patch, therefore, we can construct the optimization model as:

$$\min E = \sum_{i=0}^{m}\sum_{j=0}^{n}(d_{i,j}\sum_{h}^{m}\sum_{t}^{n}(d_{k,t}W_{i,j,h,t}))$$

$$\text{s.t.}\begin{cases} d_{i,0} = q_{0,i}, d_{i,m} = q_{1,i} \\ i = 0,1,...m \\ d_{0,j} = q_{2,j}, d_{m,j} = q_{3,j} \\ j = 0,1,...m \\ H_0 = ... = H_8 = 0 \end{cases},$$

where $q_{s,i}$ is control vertices along *u* direction, $q_{s,j}$ is control vertices along *v* direction.

For this optimization model, we can use genetic algorithm to find the optimal surface-patch.

Fig. 2 is the example for addendum surface generation based on method above we proposed. The overall surface is high-quality and smoothness, this facilitate the method we used is effective, and meet the commercial software required.

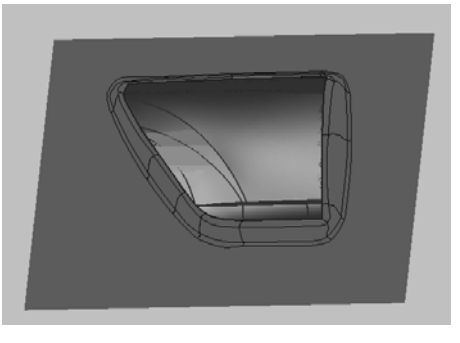


Fig. 1. Section curves and Connect-lines

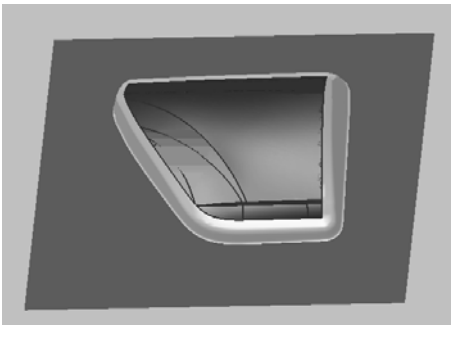


Fig. 2. The example for addendum surface

4 Conclusion

In order to facilitate the tryout or simulation process at the pre-treatment of auto panel drawing die faces design process, we use parametric design method to generate addendum surface. In this paper, we present the method and process of building section curve style database which can be modified by characteristic parameter and users, and

we use surface-patch method to generate addendum surface. To address the smoothing problem between surface-patches, we construct physics model and trans-boundary derivative vector constraints and an optimization procedure used to generate addendum surface based on genetic algorithm, and if the result is not satisfied the user, who can back to amend section curves and regenerate the surface. This generation of addendum surface method has resolved the smoothing problem, but there is a large amount of calculation, thus the configuration of computer by the operation system is higher. Nevertheless, with the growing computer hardware technology, this optimization technology will be more widely used. Even the efficiency in generating surface is not enough high, compared to traditional process of addendum design, in order to ram through the CAE in the cracks, wrinkles and other analysis to repeatedly revise the addendum surface, the time spending on it is still two times or more than the method proposed in this paper. So the method we provided is an effective way to shorten the mode design cycles and improve their design quality, therefore improving the manufacturing of metal stampings and reducing the product development cycle, having a good practical.

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Calculations of Stainless Steel-Aluminum Alloy Clad Forming Limit

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Abstract. Base on the Hosford's higher order yield criteria, the forming limit diagram of clad was developed with M–K theory at the positive strain ratio. The relationship of forming limit with thickness ratio, thickness irregular coefficient and the exponent of yield function were analyzed. The result show that the forming limit of clad material is between those of its component materials, and increases with the rising of stainless steel thickness ratio and the thickness irregular coefficient. So the forming limit can be improved by increase the stainless steel thickness ratio and improve the surface condition of the clad materials.

Keywords: clad, forming limit, strain ratio, M-K theory, thickness ratio.

1 Introduction

In recent years, many types of clad materials have been developed and widely provided for press-forming factories. The formability of the clad are generally different from those of its component sheets, hence it is very important to know the extent to which laminates can be press formed without any failure.

There have been some research works on the press formability of clad materials under various conditions [1-5]. Semiatin investigated the limit strain on stainless steel-clad aluminum sheets base on hill's theory of localized necking in the negative strain-ratio condition and Swift-Hill's theory of diffuse necking in biaxial stretching [6]. Fusahito studied the forming limit of clad material by considering the influence of anisotropy coefficient, and the influence of prestrain to the forming limit is analyzed [7]. Zhang fabricated stainless steel and aluminum clad materials by rolling, and analyzes the mechanical and forming property by method of FEM and experiment [8, 9]. Parsa investigated the redrawing of aluminum stainless-steel clad using FEM simulations and tested the result with experiments [10]. Takuda investigated the deep drawing ability of steel-al clad materials by FEM and experiment methods [11].

In this paper, base on the Hosford's higher order yield criteria, the theoretical FLD of clad material was developed with Hill's instability criterion as well as with Marcinial–Kuczynski (M–K) theory at the negative strain ratio, with revised M–K analysis at the positive strain ratio, and the relationship of forming limit with stain path, thickness ratio and thickness irregular coefficient were analyzed.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 285–290, 2011.
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2 Theoretical Analysis

The FLD of sheet metals represents the relationship between the limits of major and minor principal strains in the plane of the strained sheet. Marciniak and Kuczynskis have developed a theory based on the assumption that necking occurs from local regions of initial imperfection. In this study, the modified M–K theory was applied to calculate the FLD of clad material. As shown in Fig.1,

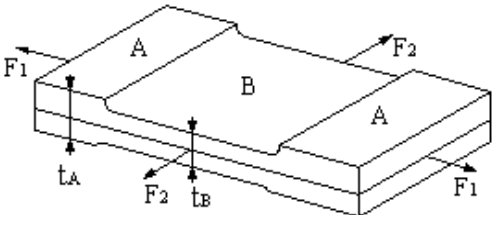


Fig. 1. M-K model of clad materials

As in monolithic material, local neck will form in the direction of zero extension when the force perpendicular to the neck reaches the maximum value. The same can be expressed for a sandwich sheet as,

$$\frac{dF_n}{d\varepsilon_n} = \sum_i A_{ni}\left(\frac{d\sigma_{ni}}{d\varepsilon_n} - \sigma_{ni}\right) = 0 \tag{1}$$

Where A_{ni} is the fractional cross-sectional area of ith layer which is assumed to remain constant during deformation due to iso-strain in the plane of the sheet and the volume constant. Considering Hosford's non-quadratic yield criterion for the aluminum skins, the condition for local necking in the clad material becomes

$$\sum \xi_i \frac{(1-\alpha_i\rho)}{(1-\rho)}\frac{1}{B_i}\left\{\frac{(1+\alpha_i\rho)}{(1+\rho)B_i}\frac{d\overline{\sigma}_i}{d\overline{\varepsilon}} - \overline{\sigma}_i\right\} = 0 \tag{2}$$

Where ξ_i is the fractional thickness of ith layer in the clad materials.

In deriving equation (2) the following relations were used, which relate stress and strain normal to the groove to the flow stress and strain respectively.

$$\sigma_n == (1-\alpha\rho)\left(\frac{1}{1-\rho}\right)\frac{\overline{\sigma}}{B} \tag{3}$$

$$d\varepsilon_n == \frac{B(1+\rho)}{(1+\alpha\rho)}d\overline{\varepsilon} \tag{4}$$

The force balance normal to the groove in clad materials can be written as,

$$t_A\left[\xi_A\sigma_{nAA}+\xi_S\sigma_{nSA}\right]=t_B\left[\xi_B\sigma_{nAB}+\xi_S\sigma_{nSB}\right] \tag{5}$$

Where t_A , t_B are the sheet thickness inside and outside the groove, σ_{nAA} and σ_{nAB} are the stresses inside and outside the groove in the aluminum alloy layer normal to the groove direction. Equation (5) can be written as,

$$\frac{\sigma_{nAA}/\bar{\sigma}_{AA}}{\sigma_{nAB}/\bar{\sigma}_{AB}}=\left(\frac{t_B}{t_A}\right)\left(\frac{\bar{\varepsilon}_B}{\bar{\varepsilon}_A}\right)^n\left[\frac{\xi_A+\xi_S\dfrac{\sigma_{nSB}}{\sigma_{nAB}}}{\xi_A+\xi_S\dfrac{\sigma_{nSA}}{\sigma_{nAA}}}\right] \tag{6}$$

Hosford's yield criteria can be written as,

$$\sigma_{1i}^a+\sigma_{2i}^a+R_i\left(\sigma_{1i}-\sigma_{2i}\right)^a=\left(R_i+1\right)\bar{\sigma}_i^a \tag{7}$$

Uniaxial stress-stain relations equation can be written as,

$$\bar{\sigma}_i=K_i\bar{\varepsilon}_i^{n_A} \tag{8}$$

On substitution of these expressions along with Hosford's yield criteria, related flow rules, uniaxial stress-stain relations equation and iso-strain relations in equation, in the biaxial stretching side, as the direction of zero extension is perpendicular to the direction of maximum load, the following modified M-K equation for clad materials can b e obtained

$$\left[\frac{1+\alpha_{AB}^a+R_A\left(1-\alpha_{AB}\right)^a}{1+\alpha_{AA}^a+R_A\left(1-\alpha_{AA}\right)^a}\right]^{1/a}=f_0e^{\left(\varepsilon_{3B}-\varepsilon_{3A}\right)}\left(\frac{\bar{\varepsilon}_B}{\bar{\varepsilon}_A}\right)^{n_A}\left[\frac{\xi_A+\xi_S\dfrac{B_{AB}}{B_{SB}}\dfrac{\bar{\sigma}_{SB}}{\bar{\sigma}_{AB}}}{\xi_A+\xi_S\dfrac{B_{AA}}{B_{SA}}\dfrac{\bar{\sigma}_{SA}}{\bar{\sigma}_{AA}}}\right] \tag{9}$$

The failure strains are numerically obtained from the above equations by iteratively calculating $d\varepsilon_{1A}$ and $d\varepsilon_{2A}$ for an imposed $d\varepsilon_{1B}$, until the strain increment outside the groove $d\varepsilon_{1A}\le 0.1d\varepsilon_{1B}$. The detailed procedure is presented as the follow:

a). Select ρ_A and calculate α_{AA} , α_{SA} ,
b). Select new strain increment $d\varepsilon_{1B}$ in the groove,
c). Guess the resulting value of $d\varepsilon_{1A}$,
d). Calculate $\bar{\varepsilon}_{AA}$, $d\varepsilon_{2AA}$, $\bar{\varepsilon}_{SA}$, $d\varepsilon_{2SA}$,
e). According with $d\varepsilon_{2AA}=d\varepsilon_{2AB}$, and $d\varepsilon_{2SA}=d\varepsilon_{2SB}$,calculate ρ_B , $\bar{\varepsilon}_B$, α_{AB} , α_{SB} ,
f). According M-K equation to calculate $d\bar{\varepsilon}_A$, $d\varepsilon_{1A}$,
g). Compare the guessed and calculated $d\varepsilon_{1A}$ then adjusted the process repeated until the difference between assumed and calculated values was negligible,
h). Increase $d\varepsilon_{1B}$,until $d\varepsilon_{1A}<0.1d\varepsilon_{1B}$,
i). Write failure strain increment $d\varepsilon_{1A}$, $d\varepsilon_{2A}$ and exit.

The forming limit diagram is calculated with Matlab software in this paper, the main parameters are showed as follow, $d\varepsilon_{1B}$ =0.05, a=8, the mechanical properties of clad component are showed in table 1.

Table 1. Mechanics properties of component

Materials	E /GPa	K /MPa	n	R
1Cr18Ni9Ti	200	1213	0.41	0.94
6061	60	445	0.26	0.72

3 Results and Discussion

The calculated forming limit diagram is showed in Fig.2, it can be seen from the calculated result that the forming limit is increased with the rising of strain ratio ρ_A, and influenced greatly by the failure definition($\varepsilon_{1A}/\varepsilon_{1B}$), when $\varepsilon_{1A}/\varepsilon_{1B}$ is smaller than 0.9, the forming limit is change little with the change of strain ratio.

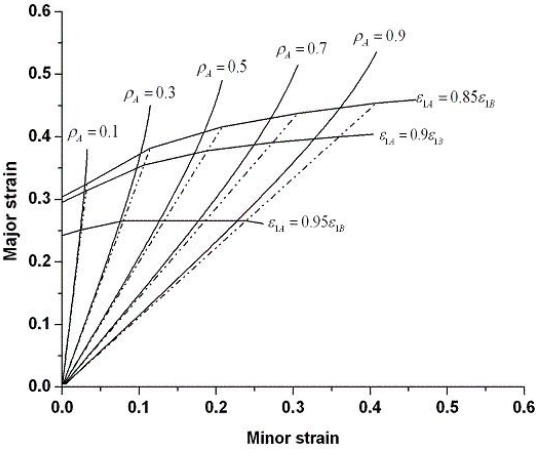


Fig. 2. Calculated forming limit diagram

The forming limit at different thickness ratio of stainless steel is showed in Fig.3, it can be seen from the result that the forming limit of stainless steel （ξ_S =1） is the highest, the forming limit of aluminum alloy （ξ_S=0） is the smallest, and the forming limit of clad material is between those of its component materials, and increases with the rising of stainless steel thickness ratio. So the forming limit can be improved by increase the stainless steel thickness ratio of the clad materials.

The forming limit at different thickness irregular coefficient of clad materials is showed in Fig.4, it can be seen from the result that the forming limit of clad materials

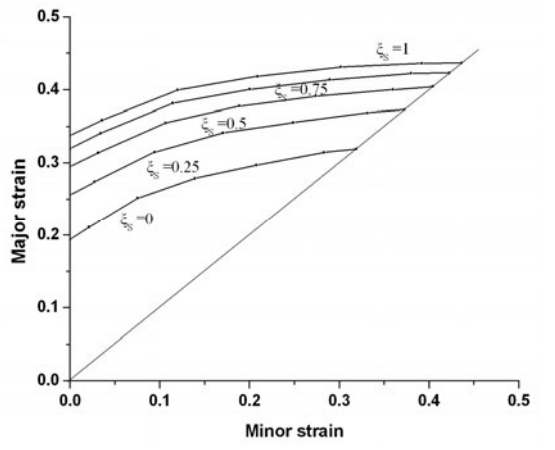


Fig. 3. The forming limit at different thickness ratio of stainless steel

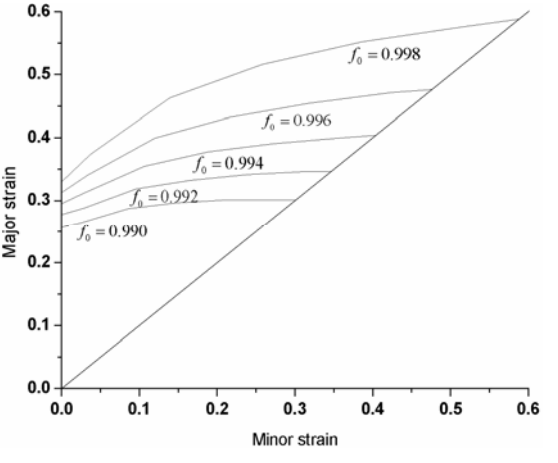


Fig. 4. The forming limit at different thickness irregular coefficient of clad materials

is increased with the rising of thickness irregular coefficient (f_0), so the forming limit can be improved by improve the surface condition of the clad materials.

4 Conclusions

1) Forming limit of clad is increased with the rising of strain ratio. The forming limit of stainless steel-aluminum alloy clad is between those of its component materials, and increases with the rising of stainless steel thickness ratio.

2) The forming limit of clad materials is increased with the rising of thickness irregular coefficient. Forming limit of clad materials can be improved by increase the stainless steel thickness ratio and improve the surface condition of the clad materials.

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Analysis on Causes of Employees' Damaged Rights in Perspective of Property Rights[*,**]

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Abstract. An employment contract is a contract of human capital property rights transaction between employees and employer. Due to its incompleteness, the employees' rights can not be fully defined in the employment contract. Therefore, some rights of employees lie in "Public Domain". Due to the rule of "Power Defining Property" in the prosperity dealing, employers with great power are able to grab at employees' rights in "Public Domain". In this paper, the theoretical foundation on the source of violations to employees' rights, the value of labor contract law and the role of labor union playing in the labor relationship are presented in perspective of property rights.

Keywords: Labor relationship; Employees' rights; Human capital property rights; Incompleteness of contract; Public domain.

1 Introduction

"The employees' rights" usually refers to the legal rights of employees regulated in the Labor law (Chang Kai, 2005). Clause 3 of P.R.C. labour law says that, laborers shall enjoy equal rights of employment and career choice, the rights of obtaining labor remuneration, the holiday rights, the rights of obtaining protection occupational safety and health, the rights of accepting professional skills training, the rights of enjoying social insurance and welfare, the rights of applying for labor dispute procession and other regulated labor rights.

In perspective of property rights economics, employees' rights are virtually human capital property rights enjoyed by employees who work as human capital investors in the enterprise. Property right is a cluster, including ownership, usufruct, assignment right, and disposition and earning right (Harold Demsetz, 1988; Barzel, 1989; Zhang Wuchang 2002). Besides, human capital property rights should have health right, development right which can maintain and add human capital value.

Human capital is "live resources", and energetic resource. Only the carrier of human capital--human is healthy, other human capital elements can work normally.

[*] Supported by Humanities and Social Foundation for the Youth of Ministry of Education of China (10YJC630413).
[**] Supported by Natural Science Foundation of Shandong Province of China (ZR2010GL016).

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 291–299, 2011.
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Only obtaining the education and training, human can continually improve their skills, and increase their resources stock. Consequently, health right and development right are necessary elements of human capital property rights.

This paper consists of four parts. The logic between them is the following. Due to its incompleteness, the employees' rights can not be fully defined in the employment contract. For this reason, some rights of employees lie in "Public domain". Due to the rule of "power defining property" during the process of the property transaction, employers with great power are able to grab at employees' rights in "public domain".

2 Incomplete Employment Contracts

2.1 An Employment Contract Is a Contract of Human Capital Property Rights Transaction

Division and transaction of property rights can increase the using efficiency of assets. This is true of that between the employers and employees. From the angle of employees, firstly, they must reserve human capital ownership, deposition and usufruct, and then they transfer use of human capital property right to the employers, to acquire property usufruct such as wages, insurance and bonuses, etc, through property transactions to employers. From the angle of employers, in order to improve the using efficiency of resources, they transfer practical use of production means to employees and reserve its ownership usufruct and deposition during the process of production.

"Cooperative production process" between employers and employees is highly dependent upon division and specialization of each component of the private property. And "Enterprise is often regarded as a 'black box' formed by output, it's a relevant set of resources from all cooperative owners through the contract. Improvement of its productivity partly attributes to its 'team' productivity" (Alqin,1994).

As a result, division and deal of human capital property rights between employers and employees can increase their respective profit through improving the working efficiency of human capital. In conclusion, the employment contract is virtually a contract about division and transaction of human capital property rights.

2.2 The Definition of Human Capital Property Rights Is Incomplete in the Initial Contract

Under this condition that the transaction cost is not zero, we must consider the cost when we define property rights. Therefore, any definition of rights is relative.

Objective cost of transaction makes it impossible to define totally property rights. For a long time, the technology of measurement can not meet the needs of people. In other words, there is no fewer and acceptable cost to measure objects that need measuring, thus the boundary of interests between people is unclear (Sheng Hong, 2003). It further increases the cost of defining property rights to measure the limitation of technology and each (material) products or every transaction with different attribute. For different attributes, rights of given (material) products, or for different attributes rights of a deal, the level depends on .It can not be fully or completely accurate on account of the enormous cost. Faced with changeable situation, the difficulty of defining the property right depends on the difficulty of obtaining comprehensive information.

Therefore, for any asset, when each cost of this kind rises and the cost of completely protecting and transferring property rises to a high level, the conclusion is that these rights are not complete, because people will find it not worthwhile getting full potential of "their" assets (Barzel, 1997).

This is also true of subjective cost of transaction. Williamson (1985) divided transaction cost into two parts-advanced costs and afterwards cost. Advanced cost refers to the behavior with the relevant of concluding a contract and the cost of work. Afterwards cost refers to tasks' cost about management, communication, supervision and executing contract promise made one by one. No matter which kind of classification standards are followed, there are still transaction cost arising from moral hazard and opportunism. Because of the existence of subjective transaction cost which defines property rights, and the influence of individual optimization .Hence, the cost of completely defining property right is enormously high.

In a labor contract between employees and employers, transaction cost is caused by technical factors, but also subjective factors.

Because the employees and employers are both faced with uncertainty, limited ration, information asymmetry and opportunism tendency, the definition of employees' rights in initial labor contract can only be incomplete. The definition of rights is made during the process of cooperation and game of two parties after signing the initial contract. The initial definition of employees' rights is finished by laws and regulations under a certain condition and the labor contract. These definitions of rights are not only incomplete, but their true realization relies on whether the employees fulfill the contract after entering into enterprises. That is to say, from the moment that employees leave labor market looking equal on the surface and sign employment contracts. Whether the rights are defined or not has nothing to do with their uncertainty about their realization (Barzel, 1997).

Therefore, the relationship between employers and employees is linked together through the employment contract, and this relationship of exchange is the basis of existence of labor relations under the condition of market economy. However, due to the incompleteness of defining rights in the employment and because of the uncertainty in the process of fulfilling contracts, whether the employees' rights the extent of their realization is full of uncertainty too. This is the objective reason of labor conflicts and disputes. But in labor conflicts and disputes, it's caused because of employers' violation to the employees' rights in most cases.

3 Human Capital Property Rights Defined Incompletely in Public Domain

According to Barzel's theory of property rights, human capital property rights defined incompletely will partly lie in "Public Domain". "He stressed, that it take fewer resources to define the ownership of an asset in law than that in reality. Because it's very difficult to define property rights in reality, "Public Domain" still exists in actual economic life despite that all resources are clearly defined as private ownership in law. In other words, the private assets nominally owned by individuals cannot keep its exclusive right because the actual executive costs of private property rights are very high"(Wang Dingding, 1997). And in reality, the rights actually enjoyed are true

rights for obligees. The legal and nominal rights only provide a basis for excising virtual rights but don't equate to virtual rights.

Through the theory of property rights, division of property rights can improve assets' efficiency, but property objects excised by owners with property of different attributes are inseparable. In contrast, the incomplete division makes some attributes of property become into public assets in public domain." In Barzel's opinion, unless property is completely defined, the unavailable valuable property will be always in public domain when the transaction costs are positive (Barzel, 1997). If one product can't be divided into several parts, people exercising property of the same product will easily search for attributes which are not protected appropriately with unsettled value. He once took public domain of a refrigerator warranty service as an example. He said that "warranty service of its manufacturers and customers is an attribute in public domain. Since the "warranty service" has been already included in refrigerator's price, if there's some trouble with customer's refrigerator within the warranty period, manufacturers refuse to repair it or provide low-quality warranty service, it virtually threaten their benefits and grab at their public assets between them and manufacturers.

In the initial contract, human capital property can't be completely defined. Regardless of laws, regulations, labor contracts, collective contract clause and job descriptions, no denying the fact that human's ration is limited, the future is uncertain, people tend to be opportunistic and information is not symmetrical. Therefore, some employees' rights lie in "public domain" between employers and employees. Enterprise is a special agreement of human capital and material resources (Zhou Qiren, 1996). It unites employers and employees to transfer their respective partial property to each other. But these two properties are different, material resources property is like "Checking Products" referred above, which are clearly defined. Human capital property is just like "Experiential Products", which is not clearly defined as well as material resources property. The rest of human capital property remains to be in "Public Domain". This often gives rise to problems of "Public Assets", which leads employers preparing for opportunistic behavior. That employees' rights lie in "Public Domain" can be boiled down to the following.

3.1 "Public Domain" of Use

The use of employees' human capital is divided not only in terms of time, but on direct practical use and indirect legal use. When defining the property in the initial contract, the use of employees' human capital is transferred to employers. Different from its transfer, labor knowledge, skills and experience have to be used by employees but not employers. And employers directly fail to have control over or take advantage of employees' knowledge, skill, experience, etc (Li Yougen, 2004). Therefore, "so-called use transfer about workforce is virtually the external control and use assignees have on their labor ability, such as the use of prescribed ability (working) time and method , standard, results, etc." Therefore, employers have indirect legal use of employees' human capital, while employees have direct practical use.

As a result, not only employers' legal uses but the employees' practical uses are left behind in public domain. When use is divided and partly put in public domain, violations will probably happen. Coase (1937) thought that behaviors usually called

as destructions and violations should happen when rights are divided and use of a owner rights causes damage to other rights.

3.2 "Public Domain" of Usufruct

Human capital usufruct of employees is realized through salary, bonus, insurance, welfare, etc. Public domain of usufruct is a multi-factor multi-level result. In terms of salary, when accurate salary, payment, time and so on are not regulated clearly in the labor contract, problems about public domain of employees' salary arise. What's more, employees firstly provide their human capital and employers pay salary after a period of human capital waste. The middle place of time probably causes that even if wage, payment and time are definitely regulated in the labor contract, employees' salary remains to be in public domain between employers and employees before they are paid. It's not definite whether usufruct is realized and this provides the possibility for employers' opportunistic behavior.

However, public domain of bonus is more complicated. Firstly, bonus can't be regulated in labor contract in advance because of double influence from performance of enterprise and employees. Therefore, bonus value, payment and time can't be regulated in labor contract. This also provides the possibility for employers' opportunistic behavior. Secondly, because performance of employees can't be measured, their bonuses are difficult to define. The reasons are that the production and operation of any enterprise is cooperative, basic characteristics of cooperative production can be boiled down to the following. First, two kinds of factors including human and thing factors are used. Second, the output of it is more than the sum of output of each factor. Third, the contribution each product factor make to cooperative production can't be usually directly observed (Alchian, Demsetz, 1972). That is to say, the output of enterprise can be regarded as a 'collective product' and contribute to cooperative input and output of team members. The "collective product" isn't obviously distinguished as atomic individual, because in a team total output isn't equal to the sum of partial output from each particular cooperative input but is inseparable non-ownership value produced by a team (Alqin, 1994). Therefore, it's impossible to identify or define the output of each of those resources in the final output value for those items cooperatively produced by respective resources,. And it's difficult to define the bonus usufruct of employees. Meanwhile, the special input out output tends to be shared and shared property is also difficult to define the proportion of that of employees and employers. Therefore, it's more likely to be left behind in public domain for the bonus usufruct.

3.3 "Public Domain" of Personal Life and Health

Although the law have specific regulations on employees' life and health, such as rest and leave, labor safety health right, but there is a long distance between legal rights and reality. For instance, public domain about life and health of employees between employers and employees is a barrier to practical rights.

"Contract about life and health" illegally signed between employers and employees threaten employees' life and health seriously. What's "Contract about life and health"? On one hand, the statements in the contract clause about labor safety and

health of employees are ambiguous, for example, "employees injured from labor are treated by normal regulations", and on the other hand, there are some clauses in the contract that employers aren't responsible for employees' injury and death. For instance, there are some labor contracts regulating that "employees injured or killed from labor are only paid some money.

This contract puts employees' life and health in "public sphere", which causes a serious consequence. Firstly, it provides an excuse for employers to dodge responsibilities in accidents. As regulated in the above contract that "employees injured from labor are treated by normal regulations", normal regulations aren't clearly defined. Once it happens, employers will deal with it at random or ignore this or only give employees' family some money (ChangKai, 2004). Secondly, it strengthen employers' adverse choice behavior, which further reduce the investment of safety production equipments and management to decrease the product cost and this poses a more serious threat to employee's health safety.

4 Rules of "Power Define Property Rights" in the Transaction of Human Capital Property Rights

In the non-public society, there are all sorts of formal and informal definitions of property and transaction phenomenon here and there. It is the right mastered by the owner of property rights that affects the definition of property rights and transaction result.

4.1 Rule of "Power Defining Property Rights" in General Property Transaction

Because any definition of right will leaves "Public Domain", the resources left in public domain. If they still have economic value, it will lead to the so-called "rent-capturing" (Barzel, 1989). Each participating in the contract has different opinions on resources of the same "Public Domain" because they each has different cost of rent-capturing (for example, geographic advantages, technical advantages, psychological advantages, etc). Those behavior subjects, who have higher evaluation about renting cost than the cost of asking for rent, will spare no efforts to ask for rent (Wang Ding ding, 1995).

The theory of "power defining property rights" suggests that we can still analyze unequal facts between transaction parties, even in an analytical framework of contracts. It means that, the equality which the contract requires is only legal equality of identity and opportunity rather than equality of strength and results. Following this thought, the process of signing the contracts can be described as that: People with unequal strengths undertaking equal transaction, will get an unequal result (Yang Ruilong, 2000).

4.2 Power Status of Employers in Human Capital Property Rights Transaction

The transaction of human resources property right between employers and employees acts through employment relationship. Simon (1957) pointed out that: the nature of employment relationship is the power-use and power-to-obey relationship which is

established through such an economic behavior of paying wages between two independent people and the relationship between decision-maker and decision-accepter.

People with great power are easier to grab at wealth in "Public Domain". In employment relationship, employers are at power status apparently. The combination of capitalist and political power is the system source of existing employer-power. The employer's power status determines that the equal transaction between employers and employees in the labor market implies essentially inequality and this is the political source of violation to employees' rights.

The equality on the surface between employers and his employees in labor market is based on inequality in fact. For every certain employee, the exchange conditions provided by employers are established, which are decided by employers with central status in economic relations. Compared with the scattered employees, employers' negotiation lies in a powerful position. In terms of regulating labor remuneration, working time and labor intensity, labor environment and conditions, employers have a first-mover advantage. When the resources is short in early industrialization and the labor is in surplus, the threats of withdrawing resources in process of producing from employers are more serious than withdrawing labor from employees. As a result, employers have a unilateral control in fact. While "power can affect these results of negations" (Raghuram, 2003). Usually, employees have no alternative but to accept employers' conditions in order to obtain jobs.

4.3 Employers' Partly Exploitation of Human Capital Property Rights in "Public Domain"

In supplying labor market, employees have no choice at all. If the employees are equal to employers at facing uncertainty, the employers can still control employees with their powerful background, which forces employees to have to accept their various harsh conditions and work by their will.

Consequently, even if employers and employees are equal in labor market and in law, phenomenon about "power defining property right" is still inevitably, because as long as the contract signed by both parties gives their respective asymmetric rights, the one who have right-advantage can take measures to expand its right. This right-recycle-accumulation phenomenon is common in powerful system of enterprises. The result is that, although the right of employers and employees are respectively left in 'public domain", the extent employees' human resources rights are damaged are more serious than that of employers.

As a consequence, as long as contracts do not give complete definitions of rights, as long as there is "Public domain", signing contract does not guarantee that it accords with justice and generate fair result.

5 Conclusions and Enlightenments on the Chinese Labor Relation Adjustment

On the basis of theoretical analysis above, we can draw a conclusion that the employment contract is a human capital property rights transaction contract between employers and the employees. Because of the incomplete of the employment contract,

the human capital property rights of the employees can not be completely defined in labor contract and the collective contract; Due to the incomplete definition of the rights, some rights of employees are in "Public Domain" between employer and employee. In the non-public society, because of the rule of "power defining property" in the definition and transaction of property, it makes the employers with great power are able to grab part of the employees' property rights of "Public Domain".

Research conclusions above provide some enlightenment to Chinese labor relation adjustment: To reduce the degree of the employees' damaged rights, it must reduce the scope of employees' rights "Public Domain", and carry out effective constraints to abuse of the employers' power. Specific revelations are as follows:

1. National labor unions, industrial trade unions, local trade unions at all levels, should participate in establishing of the relevant labor laws and regulations, to define the employees' rights for more detailed and specific from the source, in order to achieve the purpose of that using laws and regulations to narrow the whole employees' rights of "Public Domain".
2. National, regional, industry related labor administrative departments, should formulate and publish authoritative "labor contract" and "collective contract" templates by setting necessary funds, and strongly carrying forward the implement of the labor contract and the collective contract system. Then through the contract means to narrow the employees' rights' scope of in "Public domain", and reduce the possibility of employers' opportunism.
3. Industries, industrial, local or enterprise labor union, should represent the employees, through consultations and negotiations with employer organizations or employers, to sigh the detailed specific and can be performed as collective contract, in order to narrow part of the employees' collective rights of "Public domain".
4. When signing labor contract with employer, individual employee should pay attention to improve integrity and clarity in the labor contract to the employees' rights definition, to narrow the individual employees' rights in "Public Domain".
5. To enhance enterprise union's power. When rights issue appears defined in the labor contract and the collective contract or initial contracts during the implement of the contract, labor union can have consultations and negotiations with employers timely and effectively, and can participate in defining employees' rights at any time.
6. To give fully play to labor mediation, arbitration and judge institutions function, reduce the cost for the employees' labor dispute and solve the fuzzy problems appeared in labor rights definition effectively and quickly during the implement of the labor contract and the collective contract, to ensure employees' rights of public domain to get a fair and impartial definition.

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FEM Realization of Laser Curve Bending Process

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Abstract. Laser bending of sheets is a flexible metal forming process. In this paper, the process of laser curve bending including transient temperature fields, displacement fields, stress fields and strain fields was investigated. The results show that: (1) radiation of the laser beam yields to a rapid temperature increase at the irradiated surface, which leads to high temperature gradients between the upper surface and the lower surface; (2) the difference of displacements of the demarcated three points is noticeable due to the rigidity restriction of the unheated zone. So, the final sheet edge is warped and dissymmetric due to laser curve scanning; (3) compressive stresses occur in the heated zone because the materials around the heated zone are cold, and slight tensile stresses occur in the neighboring areas. There exists a large strain difference between the upper surface and the lower surface in the three directions in the heated zone, which leads to the 3D bending deformations.

Keywords: Sheet metal, Titanium, Laser bending, Finite element simulation.

1 Introduction

Laser bending is a new type of flexible manufacturing process for sheet metals. The mechanism is the forming caused by thermal stress resulted from irradiation of laser beam scanning. With this process, a variety of shapes can be formed, and even brittle materials may be deformed [1-3]. Due to its flexibility of the process even an alignment of smallest parts, with sizes in the range of a few millimeters, can be realized with accuracy in the submicron range. In addition, laser bending can be used for compound process with forming, cutting and welding easily [4-5].For the complex shaped parts, it is more convenient and efficient to apply curved irradiation paths instead of linear paths. Many researches have been conducted on the finite element simulation of laser bending [6-10].

The forming mechanism of the complex sheet geometry has been analyzed using various simulative softwares based on finite element method [12]. In this study, a three-dimensional coupled thermal-mechanical model for finite element simulation was used, the heat flux model based on scanning path was built with the development of the finite element code ANSYS, temperature fields, displacement fields, stress fields and strain fields during the laser curve bending process were investigated.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 300–305, 2011.
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2 Finite Element Model of Heat Flux

Fig.1 shows a schematic diagram of the laser curve bending process of sheet metals.

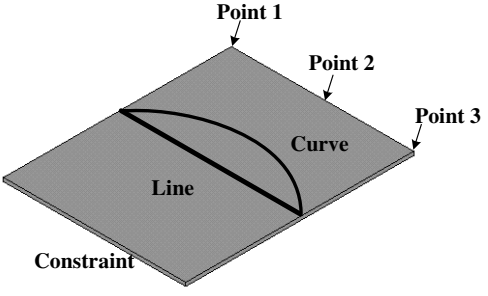


Fig. 1. Schematic of laser bending process

In the coordinates, the general mathematical model of the three dimensional transient temperature can be written as:

$$\rho c \frac{\partial T}{\partial t} = \frac{\partial}{\partial x}(\lambda \frac{\partial T}{\partial x}) + \frac{\partial}{\partial y}(\lambda \frac{\partial T}{\partial y}) + \frac{\partial}{\partial z}(\lambda \frac{\partial T}{\partial z}) + Q \tag{1}$$

Where T is the temperature (℃), which is a function of coordinate and time t(s), ρ is the material density (kg/mm^3), c is the heat capacity (J/kg℃), λ is the thermal conductivity (W/(mm℃)), Q is the source of heat being expressed as heat generation per unit volume (J/mm^3).

If T_0 is the temperature of the environment, the initial condition is:

$$T|_{t=0} = T_0 \tag{2}$$

During the simulation, the thermal load can be given in the form of the heat flux density that obeys a normal distribution as follows:

$$I = \frac{2AP}{\pi R^2} \exp(-\frac{2r^2}{R^2}) \tag{3}$$

Where I is the thermal flux density of the laser beam, A is the absorption coefficient on the sheet metal surface, P is the laser beam output power, R is the radius of the laser beam irradiated to the surface of the sheet metal, and r is the distance from the laser beam center.

In the focused laser spot, the beam power P is input as an external heat flux vector:

$$k \frac{\partial T}{\partial z} = -I \tag{4}$$

The other boundary condition is as follows:

$$K \frac{\partial T}{\partial n} = h(T - T_0) + k_r (T - T_0) \tag{5}$$

Where n expresses the direction of the surface, h is the natural convection exchange coefficient, and $k_r = \varepsilon\sigma(T^2 + T_0^2)(T + T_0)$, where ϵ is the surface emissivity and σ is the Boltzmann constant.

Based on the thermal elastic-plastic FEM, a three-dimensional coupled thermal-mechanical model for numerical simulation was used. And the heat flux model based on scanning path was built with the development of the software ANSYS [13].

3 Simulation Results and Discussion

The laser bending process of Ti-6Al-4V alloy sheet was studied. The length of the sheet was 50mm, the width (along the scanning direction) was 40mm and the thickness was 0.8mm. The material physical property parameters were taken from literature [11]. The processing parameters were 1000W for laser power, 66.67mm/s for scanning velocity and 5.2mm for laser spot diameter.

3.1 Transient Temperature Fields and Displacement Fields

Fig.2 shows the temperature distribution on the upper surface. Note that there is a pre-heated zone in front of the laser spot and a "tail" behind the laser spot because of the heat transfer. As can be seen in Fig.3, radiation of the laser beam yields to a rapid temperature increase at the irradiated surface, which leads to high temperature gradients between the upper surface and the lower surface.

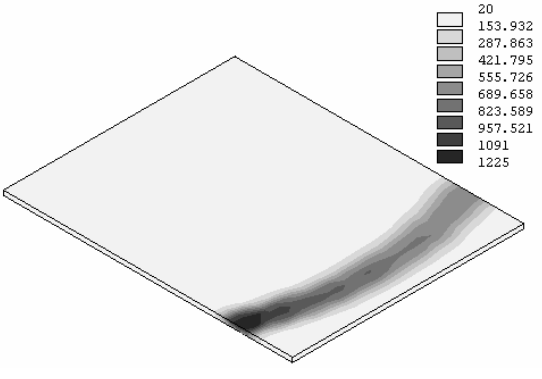


Fig. 2. The temperature distribution at t=0.5s

Fig. 4 shows the variation of displacement of free end in the z-direction. It can be seen that a noticeable counter-bending occurs due to thermal expansion in the heated zone when the laser beam has just scanned the edge of the sheet. The difference of displacements of the demarcated three points is noticeable due to the rigidity restriction of the unheated zone. The final sheet edge is warped and dissymmetric due to laser curve scanning, as shown in Fig.5.

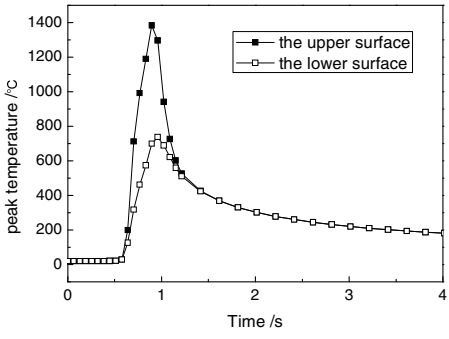


Fig. 3. The temperature peak of the upper and lower surface along with time

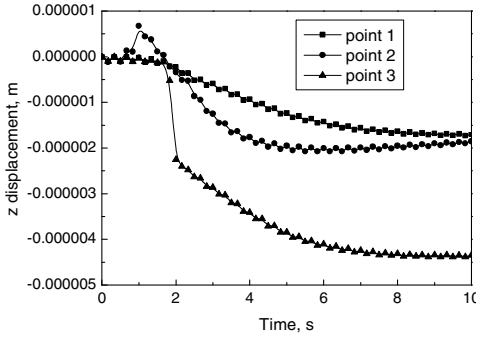


Fig. 4. Variation of displacement of free end

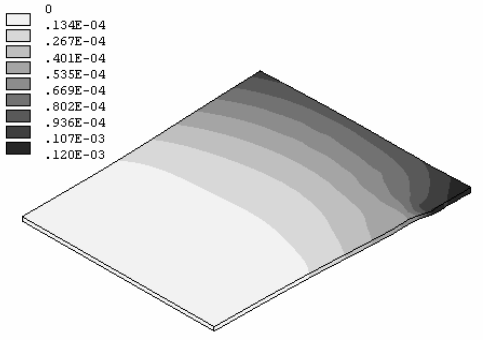


Fig. 5. The displacement distribution at t=20s

3.2 Stress and Strain Fields

The simulated temperature distributions referred above, the yield stress and plastic strain distributions displayed in Fig.6 and 7. It can be seen that compressive stresses occur in the heated zone because the materials around the heated zone are cold, and

slight tensile stresses occur in the neighboring areas. The upper surface keeps compressive strain during the process of heating. And there exists a large strain difference between the upper surface and the lower surface in the three directions in the heated zone, which leads to the 3D bending deformations.

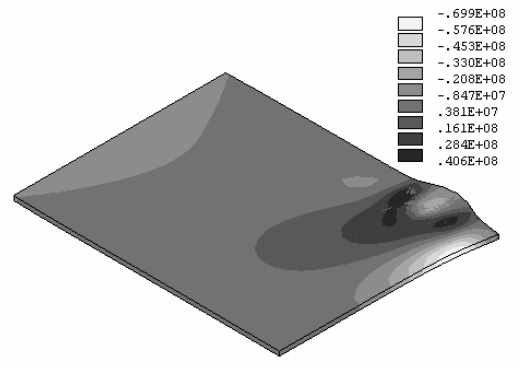


Fig. 6. The stress distribution at t=0.05s: x direction

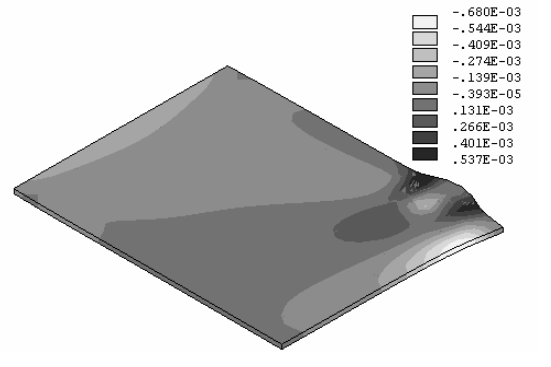


Fig. 7. The strain distribution at t=0.05s: x direction

4 Conclusions

(1) Finite element simulation of transient temperature fields, displacement fields, stress fields and strain fields produced by laser beam scanning on the forming sheet metals were carried out. The simulated results are in good agreement with experimental results.
(2) The difference of displacements of the demarcated three points is noticeable due to the rigidity restriction of the unheated zone. So, small deformation occurs in the process of laser curve bending of sheets compared to laser line bending.
(3) During the laser curve bending process, compressive stresses occur in the heated zone because the materials around the heated zone are cold, and slight tensile stresses

occur in the neighboring areas. There exists a large strain difference between the upper surface and the lower surface in the three directions in the heated zone, which leads to the 3D bending deformations.

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Implementation of Electronic Workflow Systems in Higher Education Institutions: Issues and Challenges

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Abstract. To different extents, electronic workflow systems have been widely used in higher education institutions for administering the daily and routine operations. Whilst workflow automation is advocated for streamlining business processes, there are technical limitations as well as management constraints, especially on process review and re-engineering. During the process review, a big challenge is to make sure that the system would not only meet the business requirements but also improve the process flow. It is important for one to retain the legacy stature while coping with the changes in workflow, but taking into consideration of the needs to accommodate managerial constraints. This paper investigates the issues and challenges in implementing electronic workflow systems in higher education institutions. Different approaches to the process review, workflow design and re-design are discussed.

Keywords: electronic workflow, workflow design, workflow system, process review, process re-engineering.

1 Introduction

For decades, paperless office and workflow automation have been the key objectives of office automation in many organizations. In recent years, with the advent of new network and communication technologies, the ideas of automating administrative workflows have evolved in order to achieve these objectives. Electronic workflow systems were then introduced for such workflow automation [1], [2], [3]. Todays, workflow systems have been widely implemented in many organizations, including higher education institutions.

In many universities and higher education institutions, in order to meet the ever-increasing administrative workload as well as the ever-rising public expectation of quality and expeditious services, it is necessary to explore new and latest technologies to replace the practices of paper-based, mail-based and e-mail-based workflows for high productivity and effectiveness. For these reasons, many institutions are adopting electronic workflow systems to automate their routine administrative workflows, such as on leave administration, procurement, venue booking, and services request and management [4], [5].

Typically, in implementing an electronic workflow system, a number of issues have to be considered. These issues can be non-technical, such as on the need of

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 306–311, 2011.
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imposing control and monitoring measures for effective administration. Given many limitations to accommodate various managerial constraints, it is a great challenge for one to review and re-engineer the business processes and automate the workflows [6], [7], [8]. Despite these difficulties, the implementation of electronic workflow systems would inevitably enhance the operational efficiency and effectiveness. It is envisaged that as more administrative processes are automated using electronic workflow systems, the core values can be promoted at the business level by streamlining and re-engineering the operational procedure.

This paper investigates the implementation of electronic workflow systems for higher education institutions, with a special focus on the issues and challenges in implementing these workflow systems. The rest of this paper is structured as follows. Section 2 is an overview of electronic workflow systems. Section 3 describes the implementation of electronic workflow systems in higher education institutions, where the issues and challenges in the implementation are discussed. Section 4 briefly concludes this paper.

2 Electronic Workflow Systems

Workflow basically refers an entire or part of a business process which involves tasks, procedural steps, people, and resource required. It consists of the intelligent routing and tracking of information to control and coordinate execution of tasks based on some pre-defined organizational polices. In brief, it mirrors the management and operation system as a depiction of connected operation steps, normally declared as the work of a person or a group of persons through some mechanisms [9], [10]. As the "work" flows through the organization, data are collected data from various sources in order to determine the subsequent routing. A flow usually describes the transfer from one step to another in accordance with a set of procedural rules.

As the core component of a workflow system, a workflow engine records all the procedures, steps and rules for a business process. It is responsible for managing and providing run-time execution of a pre-defined business processes, which controls and determines whether the process is ready to move to the next step. For workflow management, it utilizes workflow technology to provide procedural automation of a business process by managing the work activities and resources, and enabling users to submit requests and execute plans [11], [12], [13].

To face the increasing administrative workloads without the proportional increase in resources, workflow automation allows a company to create a workflow model and components, such as online forms, to manage and enforce consistent handling of tasks and usage of resources. It enables the creation of efficient, effective and manageable business process which can result in significant time savings and prevent delays. When used in combination with the routine and manual business processes, many paper-based administrative procedures can be eliminated such as information input, archiving and retrieval [14], [15].

Many business processes follow the "90/10 rule". 90% of the time is "lag time" – the time waiting in the in-boxes, in transit, in queues of the performers or consumed in tracking status, while only 10% of the total process time is consumed by the "task time" – the time performers actually spent on the tasks [3]. In order to optimize costs

and increase efficiency in the whole process, workflow automation would shorten the lag time. It enables organizations to speed up their business processes by minimizing the task transfer time, proactively monitoring and escalating late tasks, and providing the right information to the right users at the right time. Business rules and logics are implemented and enforced in order to avoid manual errors. The benefits of workflow automation are summarized below:

1. Better management and control : to improve the management of business processes through standardized methods, and enhance the control through reliable security system.
2. Improved efficiency : to review and re-engineer the business processes, by eliminating unnecessary steps and procedures.
3. Improved quality service : to maintain consistency in the business processes, for greater predictability in response to requests and better follow-ups.
4. Promoted process improvement : to improve the business processes, by streamlining and simplifying the processes.

There are challenges in implementing electronic workflow systems. First, we need to know the organizational culture. If the organization is considered as "quiescence", it would be relatively insensitive to the cost of changing a process. Organizations of the type "coherence" would make benefit by splitting the cost of a process across many departments. However, if the organization works on a typical autocratic basis through a centralized command and control, then it would be less sensitive to changes and more appropriate to the centralized control [16]. Besides, it is necessary to decide the processes for automation, and organize training for users.

It would be useful to develop a knowledge repository for managing, automating, and improving processes. This helps clarify and lessen some of the tension arisen from new changes. The repository may contain internal and external best practices, as well as some process templates, and process patterns for re-use.

3 Electronic Workflows for Higher Education Institutions

A university is a place where academics meet with administrators and policy makers. While academics put a lot of emphasis in promoting knowledge transfer and academic freedom, administrators and policy makers stress on information security, rules and regulations. Conflicts usually stem from these two contradicting lines of thought, especially are new procedures are introduced. In order to satisfy the needs of both parties, we have to build an integrated environment, embracing the academic needs and administrative requirements, while supported by a technical system enforcing the business rules, policies and other technical requirements [4], [5].

For implementing electronic workflows with policy enforcement, the management support is primal for a policy to be successfully enforced. Good communication is indispensable to prepare people for the forthcoming changes.

It is an undeniable fact that people are usually reluctant to change. This resistance to change can be a result of fear, uncertainties, ignorance of benefits, etc. There should be motivations to drive the change. For a higher education institution, a practical way to motivate people can be made via mentality change. People should be motivated to share information and a workflow system is considered as a vehicle of sharing.

Most institutions do not have a strategic view of emerging technologies. This is partly due to the rapid changes in the society and technology. With commoditization of technologies, it is time for educators to review and seek opportunities to implement systems that are more adaptive to the latest needs. The implementation of electronic workflow system is usually regarded as a part of the business process reengineering. Workflow allows separation of process rules from the applications and improvements in business processes. When choosing a process to automate, the following issues should be considered:

1. whether a process involves a large user community;
2. whether a large number of instances are to be tracked;
3. whether the process would last a long time
4. whether any mistakes would be crucial

In implementing an electronic workflow system, the technical infrastructure should be considered before choosing the technology to be used. Good connectivity is crucial as the efficiency of the electronic workflow system is attributable to it. The decision framework starts from assessing the needs or responding to a change. After visioning and studying the organization readiness, the next step is the enactment. It involves the capacity building, resource allocation, enforcement of policies and procedures, and the process review and re-engineering. Workflows are then designed [6].

It is a good practice that a business case should be established before implementing an electronic workflow system. The cost-benefit analysis of an electronic workflow system can be evaluated from the following aspects:

1. direct cost savings, such as the time saved in paper shuffling and staff training, and the possible reduction of the number of support staff.
2. Indirect cost savings, such as better control and management of processes and improvement in the productivity and quality of processes.
3. Intangible benefits which cannot be quantified, such as improved services, user satisfaction, data privacy and security enforcement.

The general functional requirements for implementing electronic workflow systems should include:

1. online acknowledgments to relevant parties with the status of application within the defined process;
2. pro-active reporting of the status change of the application to all relevant approvers as well as the initiator;
3. pro-active reporting to each approver for a given step in the process that the application is now available for approval;
4. available of mandatory information, and blocked from progressing until all mandatory information is available;
5. form creation and editing as well as approval be accessible by relevant parties;
6. communications from the workflow system;
7. communications be for the purpose of informing the recipient the location of the application either for approval or denial and obtaining status;
8. supporting electronic documents such as word processing documents, spreadsheets and presentations;

9. an application identifier be assigned throughout the process lifecycle for status tracking;
10. relevant parties be informed of the application passing deadlines without status change plus follow-up reminders at designated time periods.

In planning an electronic workflow system, it may be a good starting point to consider the automation of simple processes and mirror the workflow to the existing procedures. Through process automation and re-engineering, some of the existing activities may no longer be required, such as the manual logging and filing. Usually, at the early stage, full scale re-engineering may not be required as benefits can be achieved simply by process improvement.

4 Conclusion

Like many organizations, higher education institutions have the needs to automate workflow processes to achieve administrative efficiency. This automation usually comes with process review and re-engineering, where changes are inevitably required. It is a fact that, for an organization or institution, the existing processes are held in place by the organizational culture and people's habits. Re-engineering processes is not only simply a matter of drawing new flows and introducing new technologies, but also a matter of reorganizing practices and people's interests. It is speculated that complex processes involving many parties would be difficult for changes, unless the parties find significant gains in productivity and efficiency after automating the workflow with technologies.

With the advance of the network and communication technologies, workflow automation becomes mature and is widely used in many organizations. It is also well proven that, through the appropriate use of electronic workflow systems, processes can be systemically re-engineered for higher productivity and efficiency. Moreover, the re-engineered or re-designed processes can help meet the new changes and needs for better user satisfaction. Although it can be seen that workflow system is an effective way to improve the quality and quantity of work, the importance of the preparation stage cannot be overlooked. Process review and re-engineering usually triggers the needs of electronic workflow systems. Once the right process is chosen and defined, the next challenge is how to fit the electronic workflow system into the environment which includes the organizational culture, user requirement, expectation, control issues and management concerns.

In this paper, various issues and challenges in implementing electronic workflow systems in organizations, especially higher education institutions, are presented and discussed. This helps to provide some reference for higher education institutions in planning, designing and implementing electronic workflow systems.

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Design of Flat Screen Printing Machine Controller Network Based on ZigBee Technology

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Abstract. ZigBee is a wireless dual communication technology with the characteristics of low-cost, low power consumption and low rate, which is launched in the recent year. Monitoring network of flat screen printing machine based on ZigBee is design, which of the hardware of network node and the interface are made, The monitor system includes acquisition node and receiving equipment. In actual use, the acquisition node was designated deployment, through specific deployment device. The data that collected by acquisition node can be transported through ZigBee networks, receiving equipments get it, then transmission and storage. The node working principle, hardware and software development of acquisition node has been carried in this paper. moreover, the function of every part device of network is introduced in detail.

Keywords: ZigBee, wireless network, flat screen printing machine, CC2430.

1 Introduction

At present, new flat screen printing machine using field bus technology and microprocessor terminal control technology is sold in international and domestic markets, two flat screen printing machines can be networked, which can implement some new function ,such as direct remote control, maintenance, monitoring, parameter changes and trouble clearing. Production measures and production tracking can be printed. production information monitoring and simple automation of management functions can be implemented.

In fact, flat screen printing machine based on field bus technology has a series of restrictions, data acquisition equipment can not be installation easily, poor scalability of extension, cumbersome wiring is unsightly. Moreover, because of the metal wire connection, cabling costs of the project rise with the area and other requirements of the monitoring, lines susceptible to aging affected by environment after a period of time, and easily be damaged by rodent bite. In order to carry out real-time monitoring and production management of flat screen printing machine, this paper presents a ZigBee-based wireless controller and communication system, using ZigBee technology to collecting information on the flat screen printing machine condition by wireless transmission. The system has some advantage for easy to use, network to expand and

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 312–317, 2011.
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power to consume, so it meet with the needs of flat screen printing machine monitoring system, and meet with the needs of modern dyeing and printing production information management requirements.

2 ZigBee Technology Overview

ZigBee is an IEEE 802.15.4 standard for data communications with business and consumer devices [1]. It is designed around low-power consumption allowing batteries to essentially last forever. The ZigBee standard provides network, security, and application support services operating on top of the IEEE 802.15.4 Medium Access Control (MAC) and Physical Layer (PHY) wireless standard. It employs a suite of technologies to enable scalable, self-organizing, self-healing networks that can manage various data traffic patterns. ZigBee is a low-cost, low-power, wireless mesh networking standard.

ZigBee makes possible completely networked homes where all devices are able to communicate and be controlled by a single unit. Current list of application profiles either published or in the works are: home automation, ZigBee smart Energy, telecommunication applications, personal home. The relationship between IEEE 802.15.4 and ZigBee is similar to that between IEEE 802.11 and the Wi-Fi Alliance. For non-commercial purposes, the ZigBee specification is available free to the general public.

These features are enabled by the following characteristics, 2.4GHz and 868/915 MHz dual PHY modes; Low power consumption, with battery life ranging from months to years; Maximum data rates allowed for each of these frequency bands are fixed as 250 kbps @2.4 GHz, 40 kbps @ 915 MHz, and 20 kbps @868 MHz; High throughput and low latency for low duty cycle applications; Channel access using Carrier Sense Multiple Access with Collision Avoidance (CSMA-CA); Addressing space of up to 64 bit IEEE address devices, 65,535 networks; 50m typical range, Fully reliable “hand-shaked” data transfer protocol; Different topologies as illustrated below: star, peer-to-peer, mesh.

3 Wireless Monitoring System

Flat screen printing machine controller network system includes three parts, acquisition nodes , receiving equipment and control center . When we need know the condition of the flat screen printing machine, the acquisition nodes ,which are placed each parts of the print unit, collected key parameters of the print information in time, packaged and transparent transmission; the receiving device of flat screen printing machine through a wireless link receive print unit information and other condition information, and further analysis and processing. System block diagram is shown in Fig.1.

Software design process of Acquisition node. In sensor networks of flat screen printing machine monitoring system, data acquisition node is the slave node, i.e. sensor node. The flat screen printing machine is the master node, act as the network coordinator. The RFD and the FFD is used for the slave node and the master node respectively. The master node is supplied power or reset, is initialized and establishes a new

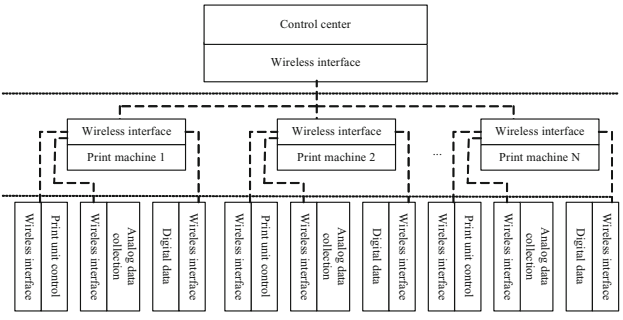


Fig. 1. System application instruction

network, gives the network ID number, channel number and other network information, and then establishes a connection with the host computer. and then the master enter the carrier sense status, if a slave node request to join the network, the master node give the new node the network number and ID number.

4 The Design of Information Acquisition Node

Wireless acquisition node includes two parts, data collection and wireless transmission. The former primarily collect the original physical signal, then makes pre-processing, such as filtering, amplification, AD conversion, then convert the analog signals into digital signals; While the latter major completed data format package and modulation, then the data was sent to flat screen printing machine by a wireless link.

4.1 The Hardware Design of Acquisition Node

The acquisition node hardware includes three modules: the signal pre-processing module, ZigBee communications and processing module and power supply modules. The signal pre-processing module complete the original signal filtering, amplification and analog-digital conversion, then convert the analog signals into digital signals; The ZigBee communication and processing module complete the data signal processing and information exchange, which includes the signal encoding, ZigBee frame format, packaging and signal modulation, then the signal was transmitted by wireless means; Energy supply module supply the power of various functional blocks. System principle is shown in Figure2.

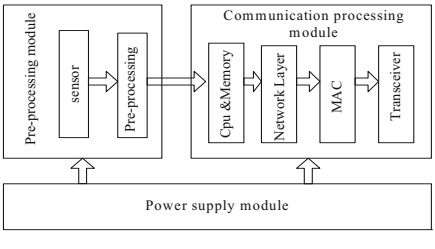


Fig. 2. The acquisition node hardware diagram

Sensors. Sensor is a detection device that can be measured sensed information. And it can convert this information into electrical signal according to certain laws, then transmitter by through wire. In the flat screen printing machine monitoring system, displacement sensors, temperature sensors and pressure sensors are used. They mainly measure the information of the flat screen printing machine.

Pre-processing Module. The output electrical signal from the sensor is very weak, in order to transmit and process, this signal must be done filter and low noise amplifier. Here multi-level filtering and amplification circuit has been adopted, the filter extracted bandpass signal from the original input signal, eliminate band noise. Through two Filtering and amplification, the weak amplitude signal hidden in the noise has become the appropriate amplitude stationary signal. Next step complete A/D conversion, data storage and other signal processing. This process constitutes a signal filtering amplification system, schematic diagram is showed in Fig.3.

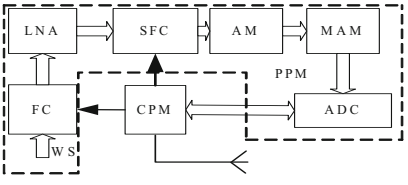


Fig. 3. Signal pre-process module(inside the dashed border)

In flat screen printing machine monitoring system, the measure device deals with the weak signal of near to zero frequency, such as displacement, temperature and pressure of printing machine condition. Therefore, in the choice filter parts, the filter has a low center frequency, wide frequency range and a steep transition zone. And the same time, the lots of measured physical quantity from the machine , which signal spectrum are differ, must be adopt the same filter circuit with low cost.

ZigBee communications and processing module. The CC2430 [2] as a communication processing chips is used for this module. The CC2430 is a SoC solution specifically tailored for IEEE 802.15.4 and ZigBee applications. It enables ZigBee nodes to be built with very low total bill-ofmaterial costs. The CC2430 combines the excellent performance of the leading CC2420 RF transceiver with an industry-standard enhanced 8051 MCU, 32/64/128 KB flash memory, 8 KB RAM and many other powerful features, combined with the industry leading ZigBee protocol stack, the CC2430 provides the market's most competitive ZigBee solution. The CC2430 is highly suited for systems where ultra low power consumption is required. This is ensured by various operating modes. Short transition times between operating modes further ensure low power consumption.

Power supply module. The main power circuit convert the 5V into 3.3V through the TPS9533 chip for actually application. There are two methods for power supply, one is the 5V DC power supply, another dry battery power supply.

4.2 The Software Design of Acquisition Node

Z-Stack. Z-Stack [3] is TI's ZigBee compliant protocol stack for a growing portfolio of IEEE 802.15.4 products and platforms. Z-Stack is compliant with both the ZigBee®2007 (ZigBee and ZigBee PRO) and ZigBee®2006 specification, supporting both ZigBee and ZigBee PRO feature sets on the MSP430+CC2420 and CC2430 System-on-Chip. Z-Stack supports the smart energy and home automation profiles.

The ZigBee specification is a standard that defines a stack protocol enabling the interoperability of wireless devices in a low-cost, low-power consumption and low-data-rate network. MAC and PHY layers define the RF and communications components of neighboring devices. ZigBee stack layers, on the other hand, include a network layer, an application layer and a security service provider (SSP).

Software Development Platform. Software development platform of data acquisition node use IAR's Embedded Workbench, which is an excellent ZigBee software integrated development environment, integration of embedded C/C++ optimizing compiler, assembler, debugger and other tools. Compiled using the development platform optimized, compact and efficient code can be generated.

Software design process of Acquisition node. In sensor networks of flat screen printing machine monitoring system, data acquisition node is the slave node, i.e. sensor node. The flat screen printing machine is the master node, act as the network coordinator. The RFD and the FFD is used for the slave node and the master node respectively. The master node, when it is supplied power or reset, is initialized and establishes a new network, gives the network ID number, channel number and other network information, and then establishes a connection with the host computer. and then the master enter the carrier sense status, if a slave node request to join the network, the master node give the new node the network number and ID number.

When data acquisition power-on or reset, it begins to initialize and then sends a request to the master node to join the network, if it is successful, this node go into sleep mode. If the sensor node received instruction of data collected, it generates an interrupt and activates the node. The slave node received instruction from the master node and stopped collecting data and go into sleep mode until the next data collection.

5 Conclusion

A wireless network for flat screen printing machine information acquisition node based on ZigBee technology is presented and working principle of the node and data acquisition node hardware and software design is given a detailed description. System work shows that this device can work well. The node can in time collect flat screen printing machine by wireless means, it is reliable for data to transfer and to receive, and data is automatically stored. It is a good foundation to establish expert decision-making system of the flat screen printing machine, meanwhile it provides a scientific basis for flat screen printing machine production status.

Acknowledgment

This work was partial supported by Scientific Research Program Funded by Textile Industry Association (NO. 2009142).

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Study on Collaborative SCM of Construction Enterprises Based on Information-Sharing

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Abstract. Economic globalization and the integration process has led to competition among construction enterprises become increasingly fierce, which are adjusting their development strategies and efforts to seek for the knowledge economy and network environment to promote enterprise survival and development, enhancing the competitiveness of enterprises in the new business management models and ideas. This paper first discussed the concept of the supply chain collaboration of the construction enterprise and constituted a information management platform of the general contracting project. At last, the paper puts forward tactics which aims at helping construction enterprises realize supply chain collaboration and enhance the competitiveness of enterprises.

Keywords: information-sharing, supply chain collaboration, construction enterprises.

1 Introduction

The construction industry becoming one of the pillar industries of China, but the problems of the low centralization, rough technology, overheating competition, and poor economic benefit are still serious. So the construction industry are adjusting their development strategies and efforting to seek for the knowledge economy and network environment to promote enterprise survival and development, enhancing the competitiveness of enterprises in the new business management models and ideas.

2 Supply Chain Collaboration of Construction Enterprises

2.1 Connotation of the Supply Chain Collaboration

Supply chain collaboration refers to two or more enterprises through company agreement or joint organization form to realize a strategic goal. Supply chain collaboration external reason is obvious, which is in order to deal with the increasing competition and environmental dynamics. Their inner motivation includes: seek the intermediary effect, achieve value chain advantage, constitute competitive advantage group and keep the core competitiveness of culture.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 318–323, 2011.
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Supply chain collaboration of construction enterprises taking an engineering project as a carrier, based on the share of the information of the project, is a managerial mode of cooperative integration of all the participating parties (main contractor, owner, suppliers) to achieve the best and win-win result (as shown Figure 1). This managerial mode stresses both the internal integration management of the various departments within the core enterprise on the supply chain (general contractor) and the integration management of the participating parties outside the core enterprise, which is to heighten the enterprise's efficiency and quickly respond to the market change through the information share, which is enhance the core competence of construction enterprises.

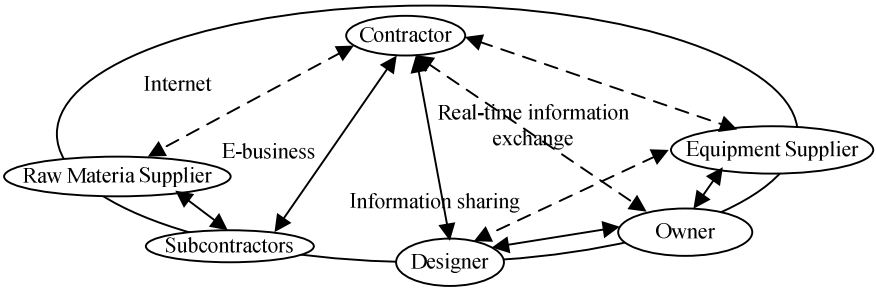


Fig. 1. Model of SCC in the construction enterprises

2.2 Establishing the Supply Chain Cooperative Fellowship for a General Contractor

Supply chain management requires the integration, synchronization, and quick response of information. Therefore, the support of information technology and information exchange platform to the general contracting project management is absolutely necessarily. In order to realize the quick exchange of the project information flow of the general contracting project and heighten the information share and interaction, a information management platform of the general contracting project should be constituted on the basis of basic mode of the general contracting supply chain system. This platform consists of three sub-platforms: the cooperative fellow selection and evaluation platform, project management platform, and procurement and inventory management platform (as shown in Figure 2).

(1) The cooperative fellow selection and evaluation platform can make the selection and evaluation of the cooperative fellow more scientific. Its main functions are: disposing the information of the various subcontractors, designers, and /or suppliers with the strategy supporting system and these evaluation results will be taken as the basis for electing the best strategic cooperative fellow; further evaluating the various subcontractors, designers, and suppliers on the supply chain and these further evaluated results will be the basis for the next selection and further evaluation.

(2) The project management platform can change the information lag and twist on the basis of the network's in-time communication and exchange and document disposal platform. The main functions are on-line electronic document transmission,

quickening the document transmission, shortening the disposal time of various engineering procedures; submission and checking of the subcontractor's progress and quality, the in-time online updating of the information of the fund usage; online organization and coordination and disposing the uncertain events during the project execution, such as design variation, project disputes, various burst-out events, and etc.

(3) Procurement and inventory management platform can realize the centralized procurement and in-time goods supply. The main functions are the subcontractor publicizing the material inventory information, general contractor accounting the procurement data and working out the centralized procurement plan; the supplier browsing the procurement plan on-line and disposing the online orders with the contractor; the third logistic company working out the goods distribution plan according to the procurement plan.

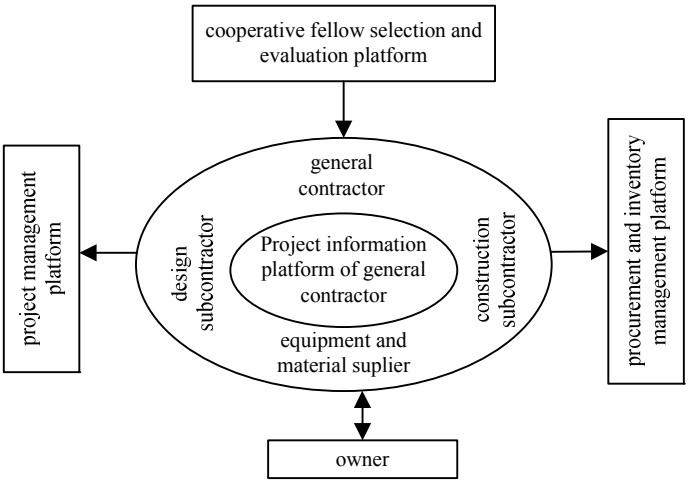


Fig. 2. Information platform for the general contracting project

3 Tactics of supply Chain Collaboration of Construction Enterprises

The characteristics of the construction industry determines that enterprise engaged in the production, to satisfy the requirement of the owner enterprises needs material suppliers, equipment suppliers, subcontractors, construction units, advisory units, design units effective cooperation. Construction enterprise itself is a complex system; in order to survival and development need constantly draw from the resources in the external environment.

3.1 Build the Trust and Performance Tract with Materials and Equipment Suppliers to Realize Collaboration

The construction companies need to re-evaluate the evaluation system of suppliers and a pertinent evaluation index system should be established in accordance with the

various types of material and equipment to develop, select, and examine the suppliers, and gradually the self supplier information database should be set up to support the necessity of the selection and comparison of suppliers during the actual procurement business. During the business process, the equipment and goods department should continually collect a reputation data of suppliers, including the responsiveness to the procurement requirement, delivery accuracy, product service quality, delay payment, technical support, and etc. of the suppliers. In this way "survival of fittest" and examination and evaluation of suppliers can be constantly continued, and the supplier system can also be gradually optimized. Choose the suppliers steps is in figure 3.

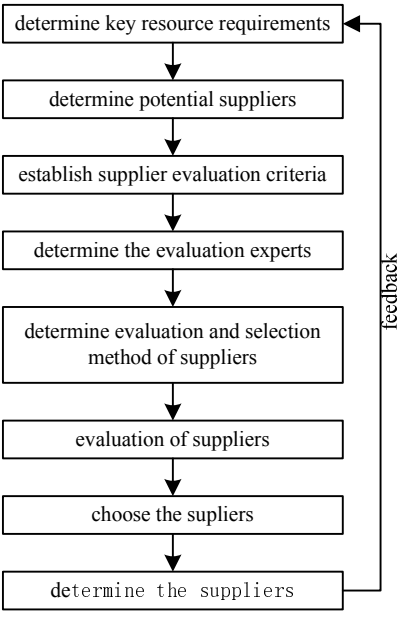


Fig. 3. Choose the suppliers steps

The connection and cooperation between the node enterprises on the general contractor's supply chain is strengthened through the established cooperative relation between the general contractor, subcontractor, designer, equipment and material supplier, and etc. to heighten the degree of the information share. The general contractor, as an information center, is responsible for the collection and gather of information, and the other parties provide in time the information from themselves and relative information, they also can get the corresponding information from the information center to meet their own needs, thus enabling the each ache on the supply chain to clearly know the goods flow, fund flow, information flow and working flow for better harmony and communication and reducing the overall operation cost of the supply chain, reducing the delay time of each ache on the supply chain, and eliminating the zoom-out effect of an information twist.

3.2 Technology Collaboration Based on Internet and E-business

Internet Technology and E-business to improve information-sharing level. Adoption of Internet technology and E-business applications can be an effective link suppliers, contractors, subcontractors, the strengthening of relations between information sharing, the supplier can access demand information through the web site, in accordance with the project plans to provide products, suppliers can also provide information to the contractor in time is formed the new requirements. In the supply chain members between different levels of direct communication can be achieved suppliers and contractor's interconnection.

Internet Technology and E-business build the logistics network system. Third-party logistics system is effective methods and strategies of logistics supply chain integration, through the coordination of the transport system between enterprises, the enterprise's logistics business are outsourcing to a specialized department to undertake. Through outsourcing to a third-party logistics contractor, construction companies can put time and energy on their core business and improve efficiency. Third-party logistics system provides an integrated transport model, which achieves the Just in Time; zero inventories to make the inventory management of construction enterprises have become more economical. Second is a design logistics network. Optimization of logistics is not considered a node, but from an overall point of view, especially from the global supply chain management point of view. The main problems are select and indentify supplier for the upstream supply chain, determine the distributors and agents for the downstream. The global logistics network design of the main decision-making problems and the supply chain for the supplier selection and identified on downstream supply chain for is determined, so the global logistics network design make two markets constraints are taken into account. The construction enterprises is mainly consider of transportation costs, the advantages of technical cooperation, delivery reliability and collaborative management costs for the upstream suppliers, regardless of the downstream owners.

Internet technology and E-business can reduce costs and improve efficiency. Through electronic transactions and reduces the transaction process, greatly reducing the cycle from order to delivery to achieve a low-cost and improve efficiency. The main functions are on-line electronic document transmission, submission and checking of the subcontractor's progress and quality, online organization and coordination and disposing the uncertain events.

3.3 Customer Collaboration Based on CRM

To win customers concern is get through fast, flexible and agility, set the continuous and uninterrupted connection information between the between firm and customer. CRM can create value for enterprises, reduce cost and satisfy customer demand, which can various activities orderly links up according to the customer demand to provide products for customer.

(1) Time effect. Application of technology can greatly reduce enterprise to provide service or product time for clients to realize value-added.

(2) Customize services. Enterprise can fully understand the demand of customer by obtaining relevant information, recording and analysis the customer situation, which realize the customize services.

(3) Improve customer service and support quality. Through technology enterprise can improve efficiency for the customer service, which is access to satisfy and support of customer.

(4) Reduce costs. In customer service and support, the enterprise staff can save time of those mechanical problems and attention on more complex problems, which can reduce cost and provide better service for customers.

4 Conclusion

To realize the collaboration, request building enterprise and strategic partners sharing the knowledge innovation achievements based on technology and Internet network. Each node enterprises sets up "win-win" consciousness in order to achieve the same target. On the basis of trust, commitment and elastic agreement between the participating parties is cooperation. Meanwhile, the requirement for collaborative node enterprise on supply chain is re-integration based on the free exchange of information and sharing knowledge innovation achievements, mutual trust and collaborative decision-making, seamless connection of production process to achieve “win-win” goals.

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The Research on the Loan-to-Value of Inventory Pledge Loan Based Upon the Unified Credit Mode

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Abstract. This paper focus on loan limit indicator of seasonal inventory financing in supply chain financial innovation based on the logistics features of unified credit mode. According to the "corporate and debt" method in trade credit, this paper analyzes the cash flow properties of borrowing firm and the profit level of logistics enterprise, then it assumes downside-risk-averse logistics enterprise instead of risk-neutral logistics enterprise and takes the method of VaR to figure out the maximum loan-to-value ratio of inventory which is in accord with the risk tolerance level of logistics enterprise in seasonal inventory impawn financing.

Keywords: unified credit, inventory financing, loan-to-value ratios, VaR.

1 Introduction

Current financial supply chain inventory pledge financing business models are 3 kinds: delegated supervision model, unified credit mode and logistics banking mode. In the entrusted supervision mode, in order to avoid logistics enterprises of the moral risk, the bank must adopt corresponding incentive and restraint mechanisms, and must produce relevant costs, so based on comparison of costs and benefits, part of the bank in business to implement the unity of credit extension business model. For example, China Materials Storage and Transportation Company has cooperated with such as Industrial and Commercial Bank of China, China Construction Bank, and more than a dozen other financial institutions, reached on the scale of nearly 5.0 billion credit line. Shenzhen Eternal Asia Supply Chain Services enterprise uses a lot of bank credit facilities provide logistics and supply chain financial services for enterprises on the supply chain. In addition, the logistics banking model developed from unified credit model have also been great development recently. Unified credit patterns in the business process and relevant operation steps shown below:

Step 1: Bank allocates the line of credit to the logistics enterprises.

Step 2: The inventory of the borrowing firms will be kept by logistics enterprise.

Step 3: The logistics enterprises establish the inventory of closed-end account for sales collection after signing a contract with the borrowing firms, after that they issue the loans to the borrowing firms.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 324–329, 2011.
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Step 4: The borrowing firms access to the goods and inject stock sales collection into the closed-end account according to the contract.

Step 5: The logistics enterprises control quantity and value of the pledge according to the contract.

Step 6: The borrowing firms repay all the loans and the logistics enterprises issue all pledge inventory.

According to the above operation steps, the logistics enterprises must sign a pledge loan contract with the borrowing firms, in which the loan-to-value ratio is a major indicator in loan risk control. Theoretically, for the collateral whose price is stable and unified, Boot, Thakor and Udell, Gabriel, Salas and Saurina, Pang SuLin and Li RongZhou analyze the loan-to-value ratio of secured loans and the function that similar index avoid the role of moral hazard, but these scholars who are supposed to collateral price stability don't consider enterprise operating decision-making and security features to the impact of cash price, like seasonal inventory, its cash value often changes between normal selling price with reduced price, so for short life cycle or seasonal inventory and the stock supplier commitment to buy back, Buzacott and Zhang analyzed borrowing firm ordering decision-making and the interest rate of logistics enterprise, zhang YuanYuan(2006) who was based on the analysis of Buzacott and Zhang, established the enterprise inventory decision-making model and bank loan value than decision-making model in the case that the bank cooperate with the logistics enterprise, furthermore Li YiXue(2007) analyzed the logistics operation decision-making model of borrowing firm and loan-to-value ratio decision model of logistics enterprise under unified credit mode and logistics banking mode, aiming at the characteristics of inventory financing, they consider the changes of collateral value and the decision-making which creates the changes of stock inventory value. In addition, with the new Basel capital accord, the bank and the logistics enterprises must consider downside-risk of loans, so that scholars apply the measurement methods of VaR downside-risk in the supply chain operation decision-makings, for example Tapiero (2005) used VaR method to measure and manage risk exposure of inventory management, Gan etc (2005) studied the supply chain coordination problems of risk-neutral suppliers and downside-risk-averse retailer through the method similar to VaR, they just applied the measures of downside-risk control in supply chain operation decision-making.

Based on the downside-risk analysis, this paper conducts a modeling analysis aiming at unified credit mode and its corresponding cost benefit structure, and then analyzes the loan-to-value ratio decision-making behavior of logistics enterprise according to the “corporate and debt” method in trade credit and the method of VaR.

2 Basic Assumes

It assumes that SME risk-neutral and the logistics enterprises downside-risk-averse on supply chain and the pledge of borrowing firm is a seasonal stock or life cycle shorter and supplier commit to counter-purchase. The purchase price of inventory unit is B, the normal sales price is c, for no sales out of stock ,the price supplier repurchase is c', the unit storage charges is s, and $c' \succ s$. The needs distribution of borrowing

firm is $F(x)=p(\varepsilon \prec x)$, and the density function is $f(x)=F'(x)$. Due to the logistics enterprises are familiar with the industry and business of the borrowing firms, they can understand the real information before loan, so that the demand distribution state has become consensus between the logistics enterprise and the borrowing firms.

If initial inventory pledge of the borrowing firms is q_0, the loans from the logistics enterprises is $\omega c q_0$, and ω is loan-to-value ratio of the pledge loan, borrowing firm will order stock q with the loan. The subject default rate of borrowing firm is Q, if all inventory sale cash flow were unable to pay off the mortgage loan, the subject of firm still provides funds to guarantee the loan repay from other business at the rate of $(1-Q)$. The logistics enterprise set r as the loan interest rate, r' is the interest rate of the loan logistics enterprise get from bank, and $r' \prec r$. In addition, the unit number inventory cost is m and s' is the storage cost of unit number inventory.

Based on the hypothesis above, if the subject of the borrowing firms don't breach, no matter whether there is enough cash flow in closed-end account for debt service, the logistics enterprises are not suffer from loan risks. But once the default of the subject of the borrowing firms has happened, their final cash flow expression is as follows:

$$X(\varepsilon)=B\min\{\varepsilon,q_0+q\}+c'\max\{0,q_0+q-\varepsilon\}-cq(1+r)-s(q_0+q) \tag{1}$$

Through analyzing the borrowing firms final cash flow expression can get lemma 1:

LEMMA 1: when the subject of the borrowing firms breach, if $q \le q_1$, the repayment probability of the borrowing firms is 1; if $q \succ q_1$, the repayment probability of the borrowing firms is $1-F(\varepsilon_x)$, among them,

$$q_1=\frac{c'-s}{c(1+r)-c'+s}q_0,\ \varepsilon_x=\frac{(c(1+r)-c'+s)q+(s-c')q_0}{B-c'}.$$

Proof: it assumes that the subject of the borrowing firms breach, when $\varepsilon=0$, the final cash flow of borrowing firms is $X(\varepsilon)=c'(q_0+q)-cq(1+r)-s(q_0+q)$, make $X(\varepsilon)\ge 0$, get $q \le \frac{c'-s}{c(1+r)-c'+s}q_0=q_1$, at this time the borrowing firms must repay the loan which is without any business risk. If $q \succ q_1$, when $\varepsilon \ge q_0+q$, the final cash flow of borrowing firms is $X(\varepsilon)=B(q_0+q)-cq(1+r)-s(q_0+q)$, but it must consider that $B \succ c(1+r)+s$, if $B \prec c(1+r)+s$, the borrowing firms can't lend money because the income of inventory sales less than cost, so the cash flow is positive. When $\varepsilon \prec q_0+q$, the final cash flow of borrowing firms is:

$X(\varepsilon)=B\varepsilon+c'(q_0+q-\varepsilon)-cq(1+r)-s(q_0+q)$, make $X(\varepsilon)\ge 0$, we get $\varepsilon \ge \frac{(c(1+r)-c'+s)q+(s-c')q_0}{B-c'}=\varepsilon_x$, so when $q \succ q_1$, the repayment probability of the borrowing firms is $1-F(\varepsilon_x)$.

3 The Financial Risk Measurement of Supply Chain

According to the methods which calculate financial risk VaR on supply chain in Philippe Jorion's book Value at Risk, this paper think that the loss caused by risk can be explained by two independent random variables N and Z which represent the loss occurred frequency and severity.

It assume that loss frequency follows geometric distribution, the probability density function is $f(n) = p(1-p)^{n-1}$ .When the loss frequency is n and p as the probability of one risk event happening once, $0 \prec p \prec 1$, Expected loss frequency $E(N) = 1/p$, variance $D(N) = (1-p)p^2$. Because the data distribution of loss severity disobeys normal distribution, we have the hypothesis that the loss severity Z obeys index distribution, and the probability density function is $g(z) = \lambda e^{-\lambda z}$, parameter $\lambda \succ 0$ as eigenvalue. $E(Z) = D(Z) = 1/\lambda$.

We can work out the distribution of all losses during the period of pledge.

$$W_n = \sum_{i=1}^{n} Z_i \tag{2}$$

Supposing N is independent with Z , the total probability when the sum of observation less than w as follows:

$$P(W \le w) = \sum_{n=1}^{\infty} P(W_n \le w \mid n) f(n) \tag{3}$$

Then we have the gamma distribution with the sum of random index variables that are independent and identically distributed:

$$P(W_n \le w \mid n) = \int_0^w \frac{1}{(n-1)!} \lambda^n u^{n-1} e^{-\lambda u} du \tag{4}$$

After clearing up, $P(W \le w) = 1 - e^{-\lambda p w}$, and we have the distribution of loss itself with the parameter $\lambda p : h(w) = (\lambda p) e^{-(\lambda p)w}$, $E(W) = 1/\lambda P$.

Finally, in certain confidence level C_0 ,

$$VaR = 1/C_0 \lambda p \tag{5}$$

4 The Loan-to-Value Ratio Decision of Downside-Risk-Averse Logistics Enterprise

This paper assumes the logistics enterprises downside-risk-averse, it supposing $L = lcq = VaR = 1/C_0 \lambda p$, in which L means the biggest loss the logistics enterprises are willing to take and l means the loan losses ratio bank determines. We should get $P(loss \succ lcq) \le \beta$ on the basis of the logistics enterprises downside-risk restrictions in

which $loss = cq(r-r') + (s-s')(q_0+q) - m(q_0+q) - \prod(\varepsilon)$, $\prod(\varepsilon)$ is the profits when stock sales of logistics enterprise is ε, and β represents the risk tolerance level of logistics enterprise, $\beta \succ 0$.

LEMMA 2: (1) if $q \le q_1$, $P(loss \succ lcq) = 0$;

(2) $q \succ q_1$, and $c(1+r-l)+s-c' \succ 0$, there is a critical point $q_2 = \dfrac{c'-s}{c(1+r-l)-c'+s} q_0 \succ q_1$, then when $q_1 \prec q \le q_2$, $P(loss \succ lcq) = 0$;

When $q \succ q_2$, $P(loss \succ lcq) = QF(\dfrac{(c(1+r-l)+s-c')q-(c'-s)q_0}{B-c'})$.

Proof: (1) if $q \le q_1$, the loss of logistics enterprise is 0 because borrowing firm must repay the loan, so $P(loss \succ lcq) = 0$.

(2) If $q \succ q_1$, when borrowing firm repay the loan, the profit of logistics enterprise is:

$$cq(r-r') + (s-s')(q_0+q) - m(q_0+q) \tag{6}$$

Otherwise the profit of logistics enterprise is:

$$\prod(\varepsilon) = B\min\{\varepsilon, q_0+q\} + c'\max\{0, q_0+q-\varepsilon\} - cq(1+r') - s'(q_0+q) - m(q_0+q) \tag{7}$$

So the loss of logistics enterprise is:

$$loss = cq(r-r') + (s-s')(q_0+q) - m(q_0+q) - \prod(\varepsilon) \tag{8}$$

When $\varepsilon = 0$, $loss = cq(1+r) - c'(q_0+q) + s(q_0+q)$, if $c(1+r-l)+s-c' \succ 0$, there is a critical value of borrowing firm's re-ordering stock with the loan to meet .

Then we get $q_2 = \dfrac{c'-s}{c(1+r-l)-c'+s} q_0$, due to $l \succ 0$, $q_2 \succ q_1$, so When $q_1 \prec q \le q_2$, $P(loss \succ lcq) = 0$, if $c(1+r-l)+s-c' \le 0$, $P(loss \succ lcq) = 0$ all the time that means even without any market demand, logistics enterprises still can undertake their losses, which indicate the loan loss degree logistics enterprise determine is too high.

When $\varepsilon \succ q_0+q$, $loss = cq(1+r) - B(q_0+q) + s(q_0+q)$, due to $B > c(1+r)+s$, $P(loss \succ lcq) = 0$.

When $0 \prec \varepsilon \prec q_0+q$, $loss = cq(1+r) + s(q_0+q) - B\varepsilon - c'(q_0+q-\varepsilon)$, then

$$\begin{aligned} p(loss \succ lcq) &= QP(cq(1+r) + s(q_0+q) - B\varepsilon - c'(q_0+q-\varepsilon) \succ lcq)q) - B\varepsilon - c'(q_0+q-\varepsilon) \succ lcq) \\ &= QP(\varepsilon \prec \frac{cq(1+r-l) + s(q_0+q) - c'(q_0+q)}{B-c'}) = QF(\frac{(c(1+r-l)+(s-c')q-(c'-s)q_0}{B-c'}) \end{aligned} \tag{9}$$

Theorem 1 based on Unity credit mode and the control degree of downside-risk, the highest loan-to-value ratio logistics enterprise give borrowing firm is:

$$\omega_{\max} = \frac{F^{-1}(\beta/Q)(B-c') + (c'-s)q_0}{(c(1+r-l)+s-c')q_0}, \tag{10}$$

β represents the risk tolerance level of logistics enterprise, $\beta \succ 0$.

Proof: if $q \le q_1$, $P(loss \succ lcq) = 0 \prec \beta$; if $q_1 \prec q \le q_2$, $P(loss \succ lcq) = 0 \prec \beta$; if $q \succ q_2$, according to lemma 2, there is $P(loss \succ lcq) = QF(\frac{(c(1+r-l)+s-c')q-(c'-s)q_0}{B-c'}) \le \beta$, from $q = \omega q_0$, we get $\omega \le \frac{F^{-1}(\beta/Q)(B-c')+(c'-s)q_0}{(c(1+r-l)+s-c')q_0}$, because of $P(loss \succ lcq)$ monotonic increasing, the highest loan-to-value ratio logistics enterprise give borrowing firm is $\omega_{\max} = \frac{F^{-1}(\beta/Q)(B-c')+(c'-s)q_0}{(c(1+r-l)+s-c')q_0}$.

5 Conclusion

According to the "corporate and debt" method in trade credit, this paper analyzes cash structure of borrowing firm under the mode of unified credit, then it takes method of VaR to make the financial risk of supply chain becoming a specific value so as to help downside-risk-averse logistics enterprise make the right decision about loan-to-value ratio. The study shows that the risk of loan is in accordance with the setting tolerance level if logistics enterprise can control its downside risk.

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QoS Multicast Routing Optimization Algorithm Based on Hybrid Algorithm

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Abstract. The multicast routing problem with multiple QoS constraints is NP complete problem. The solution of the problem usually adopts the method of optimizing. In this paper a network model suitable for investigating the routing problem was described based on QoS constrains such as delay, delay jitter, bandwidth and packet loss metrics. A multicast routing algorithm with multiple QoS constraints was presented based on GA and TS hybrid strategy. This algorithm took advantage of GA and TS (Tabu Search), and overcame the shortcomings of GA in solving the multicast routing problem with multiple QoS constraints-poor climbing ability and immature convergence. Simulation results show that higher search efficiency and faster convergence is achieved in the hybrid algorithm and the algorithm is an effective approach to multicast routing decision with multiple QoS constraints.

Keywords: QoS; multicast routing; genetic algorithm; tabu search (TS).

1 Introduction

Multicast routing has continued to be a very important research issue in the areas of networks and distributed systems. QoS multicast routing is a key technology of information transmission by network multimedia. With the development of network technology with high performance such as AON (All Optical Network) , the study of design theory and methodology based on QoS multicast routing protocol has been an important subject in network study [1~3]. QoS multicast routing relies on state parameters specifying resource availability at network nodes or links, and uses them to find paths with enough free resources. The problem of QoS multicast routing with multiple constrains is the NP-complete problem [4,5].

GA (Genetic Algorithm) has been extensively used to solve any NP problem. Many scholars such as document [2,3,5,7] has put forward different methods based on GA to solve the problem of QoS multicast. These methods make full use of GA's characters just like parallel search and seeking the best from population. Different encoding plans and fitness function are used to improve the efficiency of algorithm [4]. But the partial comparability of chromosome in the colony produced by the genetic operator and crossover operator brings on poor climbing ability and immature convergence of GA and search will stagnate at the partial optimal preference.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 330–336, 2011.
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TS (Tabu Search) algorithm is a kind of algorithm to do overall domain search. It makes use of partial domain search mechanism and corresponding tabu rules to avoid circuit search. Breaking the tabu level to releases some excellent states that are tabooed it assures the diverse and effective search and overcomes the shortcoming of premature to realize overall optimization. But TS depends on initial solution deeply.

In this paper we will concentrate on determining multicast routes from a source to a set of destinations with strict end-to-end delay requirements and minimum bandwidth available. The goal of this paper is to develop an algorithm to find out QoS-based multicast routes by simultaneously optimizing end-to-end delay, bandwidth provisioning for guaranteed QoS and proper bandwidth utilization without combining them into a single scalar optimization function.

2 Network Model

A network is usually represented as a weighted digraph $G = (N, E)$, where N denotes the set of nodes and E denotes the set of communication links connecting the nodes. $|N|$ and $|E|$ denote the number of nodes and links in the network respectively, Without loss of generality, only digraphs are considered in which there exists at most one link between a pair of ordered nodes[1-4,6-8]. We consider the multicast routing problem with bandwidth and delay constraints from one source node to multi-destination nodes. Let $M=\{n_0, u_1, u_2, \ldots, u_m\} \subseteq N$ be a set of form source to destination nodes of the multicast tree. Where n_0 is source node, $U=\{u_1, u_2, \ldots, u_m\}$ be a set of destination nodes. Multicast tree $T= (N_T, E_T)$, where $N_T \subseteq N$, $E_T \subseteq E$, there exists the path $P_T(n_0, d)$ from source node n_0 to each destination node $d \in U$ in T

Definition 1. The cost of multicast tree T is:

$$C(T)= \sum_{e \in E_T} C(e) \tag{1}$$

Definition 2. The bandwidth of multicast tree T is the minimum value of link bandwidth in the path from source node n_0 to each destination node $d \in U$. i.e.

$$B(T) = \min(B(e), e \in E_T) \tag{2}$$

Definition 3. The delay of multicast tree T is the maximum value of delay in the path from source node n_0 to each destination node $d \in U$. i.e.

$$D(T) = \max \left(\sum_{e \in P_T(n_0, d)} D(e),\ d \in U\right) \tag{3}$$

Definition 4. Assume the minimum bandwidth constraint of multicast tree is B, the maximum delay constrainis D, given a multicast demand R, then, the problem of bandwidth-delay constrained multicast routing is to find a multicast tree T, satisfying: (1) Bandwidth constraint: $B(T) \geqslant B$. (2) Delay constraint: $D(T) \leqslant D$. Suppose $S(R)$ is the set, $S(R)$ satisfies the conditions above, then, the multicast tree T which we find is:

$$C(T) = \min (C(T_s), T_s \in S(R)) \tag{4}$$

3 Multicast Routing Algorithm Based on Hybrid Evolution Strategy

QoS based multicast route discovery. This function takes the source node v_s and a specific number of multicast destination nodes, say, v_{d1}, v_{d2},…, v_{dn} as input. It calls the function *path finding*() to find all possible multicast paths from v_s to each of v_{d1}, v_{d2},…, v_{dn}, using the basic depth first search (dfs) algorithm. This gives birth to the initial set of multicast trees. The primary objective of our algorithm is to find the multicast trees, from this set, which will satisfy the multiple constrained QoS parameters.

Encoding is the key to find GA solution. In this algorithm chromosome adopts tree-shaped structure encoding and a subtree, which overlays source node and destination node set, is used to indicate an individual. So this is convenient to use corresponding data structure to describe chromosome and do without transition of encoding space and solution space.

Before the production of initial population network $G=(V,E)$ will be pretreated: First of all, the leaf nodes that are non-destination nodes with 1 degree will be removed. Then links that fails to suffice the bandwidth constraint will be eliminated. At this time, if multicast source node and destination node are not in the same connected graph, which means that the network cannot suffice bandwidth constraint, then the constraint should be relaxed and the processing should be done again. Finally a connected graph *G'* containing source node and destination node set is selected to be the network processed by the algorithm. After pretreatment bandwidth constraint conditions are eliminated and search space of the algorithm is reduced.

Production of initial population adopts random DFS(Depth-First Search). First of all, we start from source node and randomly select a corresponding node, then we connect these two nodes, and then select another correlative node (Attention: Avoid the appearance of loop. If loop comes into being, then select again.) until find all destination nodes.

The individual with good performance has high fitness level, and the individual with bad performance has low fitness level. Let links be service queues where packets to be transmitted get serviced. For most cases this service can be assumed to follow Poisson distribution. The service time should follow an exponential distribution. Let the delay for link l be denoted by the variable d_l, which is a random variable following exponential distribution with parameter equal to λ. So the delay over a path consisting of k links would be the sum of k independent random variables all having the same exponential distribution and so would follow an Erlang-K distribution. From the definition of Erlang-K distribution we get that the probability that the delay (d_p) over a path P of length k is less than t is given by the following equation:

$$Pr(d_p < t) = \frac{\lambda^k t^{k-1} e^{-\lambda t}}{(k-1)!}. \tag{5}$$

From the classical probability theory we can say that the probability that the delay (d) of the selected multicast tree (T) will meet the specific delay constraint can be obtained by taking the product of delay over individual paths in that multicast tree:

$$Pr(d_T < t) = \prod_{p \in T} Pr(d_p < t). \tag{6}$$

To find an optimal path, our objective is to maximize this probability of satisfying delay requirements. The measure of the bandwidth guarantee can be obtained by assuming a similar model for the network links. If the service rate or the transmission rate, which is basically a measure of link bandwidth, is assumed to follow a poisson distribution, the probability that a link $l \in E$ can provide a bandwidth of B is given by

$$Pr_l(B) = \frac{\lambda^B e^{-\lambda}}{B!}. \tag{7}$$

We can now say that the probability with which the bandwidth guarantee of B is satisfied for an entire multicast tree (T) is given by:

$$Pr_T(B) = \prod_{l \in T} Pr_l(B). \tag{8}$$

The total residual bandwidth in the network after allocating bandwidth for a multicast $T(s, M)$, is given by $\Sigma_{l \in E}(c_l - b_l)$, where c_l is the capacity of a link $l \in E$ and b_l is the bandwidth allocated for all the paths in the multicast $T(s, M)$, along the link l. Obviously, b_l is 0 if $l \notin p$ where $p \in T$. The fraction of total bandwidth available as residual bandwidth is given as

$$R(T) = \frac{\sum_{l \in M}(c_l - b_l)}{\sum_{l \in M} c_l} \tag{9}$$

The fitness sharing function of QMRGA can be defined as follows:

$$f'(x_i) = \frac{f(x_i)}{m_i} \tag{10}$$

To incorporate this idea of fitness sharing we compute the value of niche count for every individual string present in the population, as:

$$m_i = \sum_{j=1}^{popsize} SH[d_{s1}, d_{s2}] \tag{11}$$

where $d_{s1,s2}$ is the distance between individuals $s1$ and $s2$ and $SH[d_{s1,s2}]$ is sharing function. For simplicity, triangular sharing function has been used:

$$SH[d_{s1,s2}] = \begin{cases} 1 - \dfrac{d_{s1,s2}}{\sigma_{hare}} & d \le \sigma_{share} \\ 0 & d > \sigma_{share} \end{cases} \tag{12}$$

here is the niche radius, and it is a good estimate of minimal separation expected between the goal of solutions. The phenotypic distance between two strings is nothing but the Eucledian distance between their different fitness values:

$$d_{s1,s2} = \sqrt{(\sigma_{delay_{s1,s2}})^2 + (\sigma_{bw_{s1,s2}})^2 + (\sigma_{bit_{s1,s2}})^2} \tag{13}$$

where $\sigma_{delay_{s1,s2}} = Pr(d_{s1}<t) - Pr(d_{s2}<t)$, $\sigma_{bw_{s1,s2}} = Pr_{s1}(B) - Pr_{s2}(B)$, $\sigma_{bit_{s1,s2}} = R(s1) - R(s2)$.

Similarly, we compute the niche radius σ_{share}

$$\sigma_{share} = \frac{\sqrt{(\sigma_{delay_{\max}})^2 + (\sigma_{bw_{\max}})^2 + (\sigma_{bit_{\max}})^2}}{4} \tag{14}$$

where $\sigma_{delay_{\max}} = Pr_{\max}(d<t) - Pr_{\max}(d<t)$, $\sigma_{bw_{\max}} = Pr_{\max}(B) - Pr_{\max}(B)$, $\sigma_{bit_{\max}} = R_{\max} - R_{\min}$.

4 Simulations Results

The algorithm put forward in this paper is a kind of GA with hybrid strategy. First of all, it makes use of TSR and TSM produced by TS, and its processing is in fact the performing of TS Algorithm. They suffice the requirements of theorem 7.1[8] and can get the optimal solution. Meanwhile the algorithm put forward in this paper suffices three conditions of astringency put forward by theorem 2.7[9], so this algorithm can get the optimal solution.

Fig.1 describes the movement curve of cost, delay, delay jitter with the operation of the algorithm when QoS constraint value D_{max}=20, J_{max}=30, B_{min}=40. Fig.2 describes the movement curve of cost, delay, delay jitter with the operation of the algorithm when QoS constraint value D_{max}=25, J_{max}=35, B_{min}=40. From Fig.1 and Fig.2 we can find out that this algorithm can get the optimal solution.

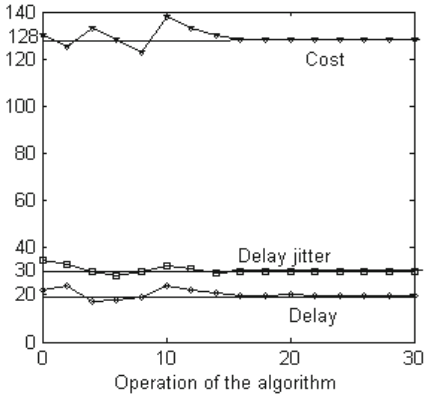


Fig. 1. Movement curve of cost, delay, delay jitter with the operation of the algorithm

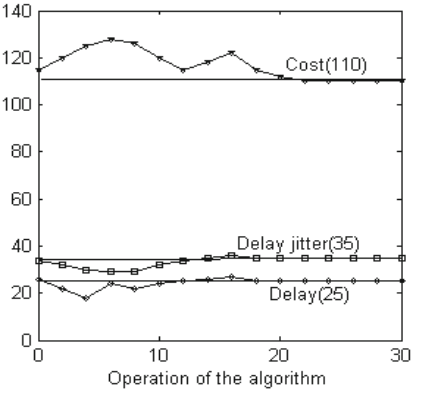


Fig. 2. Movement curve of cost, delay, delay jitter with the operation of the algorithm

The initial status of link route in the network: the delay of link route is randomly distributed among [5ms, 30ms], the bandwidth among [60Mbps, 100Mbps], the price of the link route is randomly distributed among [5, 30]. Simulation experiments are performed over a network of 100 nodes, the source node and destination node of the multicast is randomly chosen, the multicast destination node is less than the 20% of

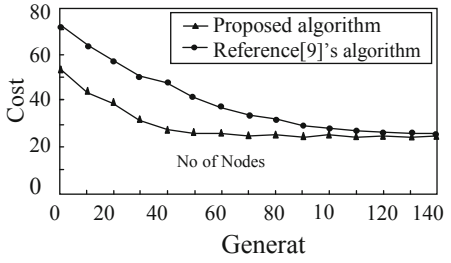


Fig. 3. The effect of the cost with genetic generation

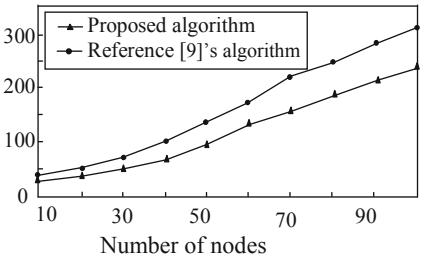


Fig. 4. Performance of the algorithm with Increasing

total nodes, delay constraint D is 60, Bandwidth constraint B=80. The multicast QoS routing protocol, designed by us tries to maximize the probabilities of meeting end-to-end delay, bandwidth requirement and bandwidth utilization within a few generations by building the Pareto optimal fronts.

Fig. 3 denotes the convergence comparison of cost with operation algebra of multicast tree generated by the two algorithms, this algorithm can speedily generate the optimal solution, furthermore, its advantage is more obvious when network scale is bigger, and bandwidth constraint is amplified. Repeat the simulation with increasing number of network nodes and observe the efficiency of our algorithm. As the network becomes highly condensed, our algorithm exhibits a more linear and stable pattern than existing scalar optimization algorithm. This approximate linearity of the curve in Fig. 4 corroborates the scalability of the algorithm.

5 Conclusions

This paper puts forward a least-cost multicast routing algorithm based on QoS constrains such as delay, delay jitter, bandwidth and packet loss metrics. This algorithm takes advantage of GA's characteristic —parallel search and seeking the best from population. And it overcomes the shortcomings of GA—poor climbing ability and easily converge in partial solution. In this paper detailed moves of this algorithm realization are enumerated and this algorithm is validated by simulation test.

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Centrality Measures in Telecommunication Network

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Abstract. Centrality is an important notion in network analysis and is used to measure the degree to which network structure contributes to the importance of a node in a network. In this paper, node centrality measures of telecommunication network are calculated in four different approaches. And it is found out that the four centrality measures are significant correlated with edge counts. We also discuss the usability of centrality measures in node ranking, and suggest that centrality measures can be useful indicators for network analysis.

Keywords: structure; telecommunication network; commplex network; centrality measures.

1 Introduction

The structure of many complex networks, from biological and social network to the Internet including the telecommunication network, can be represented as a graph. Ability to analyze networks in order to identify important nodes and discover hidden structure has led to important scientific and technological breakthroughs. As a single profound example, PageRank algorithm, which ranks Web documents by analyzing the structure of hyperlinks between them, has revolutionized both Internet search and commerce. Network analysis algorithms are also used to discover communities of like-minded individuals[17], identify influential people and blogs, rank scientists and find important scientific papers.

Centrality determines node's importance in a network. This measure is dependent on the network structure. The simplest centrality measure, degree centrality, measures the number of edges that connect a node to other nodes in a network.

Over the years many more complex centrality measures have been proposed and studied, including Katz status score, α-centrality, betweenness centrality, and several variants based on random walk, the most famous of which is PageRank. The path-based centrality metrics measure the extent to which a node can influence, or control how much information flows to, other nodes in a network.

In this paper, we apply four classic centrality measures (degree centrality, closeness centrality, betweenness centrality and information centrality) to the telecommunication network.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 337–343, 2011.
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2 Centrality Measures

Centrality has been a fundamental concept in network analysis since its introduction in structural sociology. For this telecommunication network we take four centrality indices into account.

2.1 Degree Centrality

Degree centrality equals to the number of ties that a vertex has with other vertices. The equation of it is as following where $d(n_i)$ is the degree of n_i:

$$C_D(n_i) = d(n_i) \ . \tag{1}$$

Generally, vertices with higher degree or more connections are more central to the structure and tend to have a greater capacity to influence others.

2.2 Closeness Centrality

Closeness centrality measures to which extent a node i is near to all the other nodes along the shortest paths, and is defined as [15]:

$$C_C(n_i) = \frac{N-1}{\sum_{j \in G, j \neq i} d_{ij}} \ . \tag{2}$$

where d_{ij} is the shortest path length between i and j, defined, in a valued graph, as the smallest sum of the edges length l throughout all the possible paths in the graph between i and j.

2.3 Betweenness Centrality

Betweenness centrality is based on the idea that a node is central if it lies between many other nodes, in the sense that it is traversed by many of the shortest paths connecting couples of nodes. The betweenness centrality of node i is [15]:

$$C_B(n_i) = \frac{1}{(N-1)(N-2)} \sum_{j,k \in G, j \neq k \neq i} n_{jki}(i) / n_{jk} \ . \tag{3}$$

where n_{jk} is the number of shortest paths between j and k, and $n_{jki}(i)$ is the number of shortest paths between j and k that contain node i.

2.4 Information Centrality

Information centrality relates the node centrality to the ability of the network to respond to the deactivation of the node [16]. The information centrality of node i is defined as the relative drop in the network efficiency $E(G)$ caused by the removal from G of the edges incident in i:

$$C_I(n_i) = \frac{\Delta E(G)}{E(G)} = \frac{E(G) - E(G')}{E(G)} \quad . \tag{4}$$

where the efficiency of a graph G is defined as:

$$E(G) = \frac{1}{N(N-1)} \sum_{i,j \in G, i \neq j} d_{ij}^{Eucl} \Big/ d_{ij} \quad . \tag{5}$$

and where G' is the graph with N nodes and $K - k_i$ edges obtained by removing from the original graph G the k_i edges incident in node i. An advantage of using the efficiency to measure the performance of a graph is that $E(G)$ is finite even for disconnected graphs.

3 Resultes and Analysis

3.1 An Overview

After constructing the model of telecommunication network which is shown in Fig.1 we figure out the mean-shortest path length, clustering coefficient and degree–degree correlation listed in Table1.

Table 1. Summary statistics for the telecommunication network

	Value
Number of Nodes	42
Mean Shortest Path Lenghth	2.2492
Clustering Coefficent	0.5630
Degree–degree correlation	0.0339

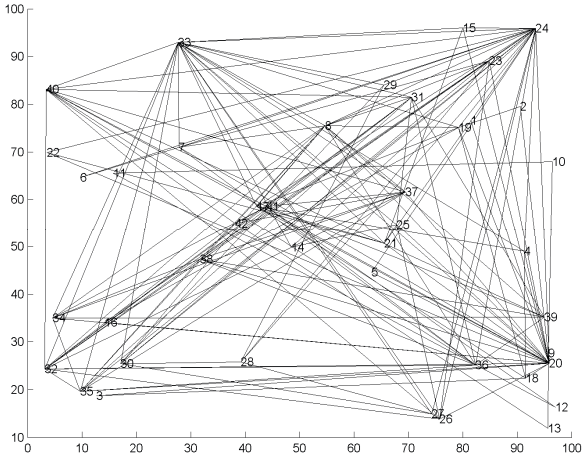


Fig. 1. Structure of the telecommunication

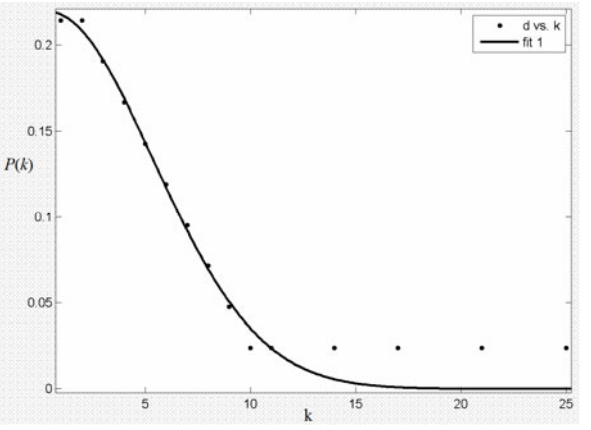


Fig. 2. Degree distribution

There are 42 nodes in this telecommunication network, in which the mean-shortest path length is 2.2492 and the clustering coefficient is 0.5630. The distribution of degree $P(k)$ of this network is shown in the Fig.2.

3.2 Applying Centrality Measures to Nodes

In this study, we calculate four centrality measures for nodes in the telecommunication network which are shown in Fig. 3 through Fig.6.

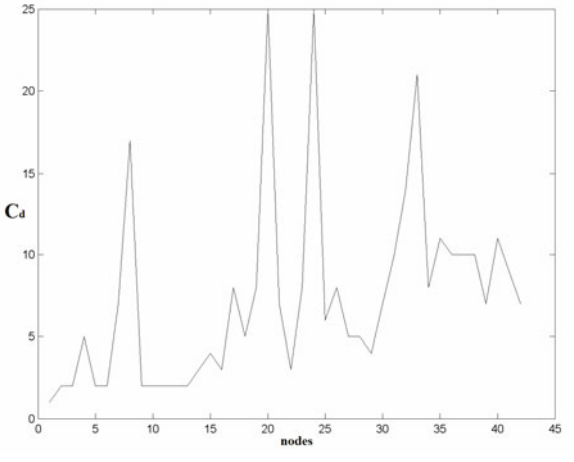


Fig. 3. Degree centrality

Table 2 show the top 5 nodes based on degree centrality, closeness centrality, betweenness centrality, and information centrality calculated with the telecommunication network.

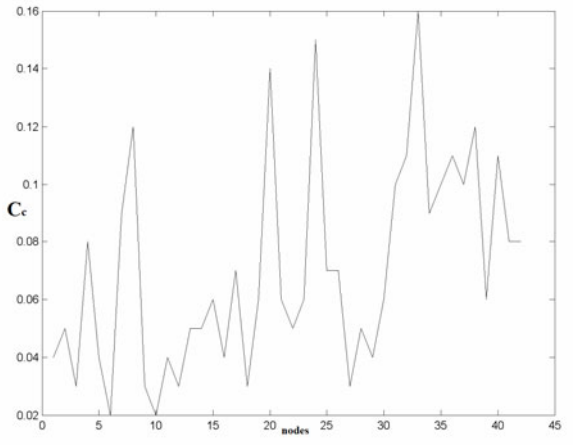


Fig. 4. Closeness centrality

Table 2. Top 5 nodes

Rank	Node No. (C_D)	Node No. (C_C)	Node No. (C_B)	Node No. (C_I)
1	20	33	20	35
2	24	24	24	38
3	33	20	33	32
4	8	8	41	24
5	32	37	42	8

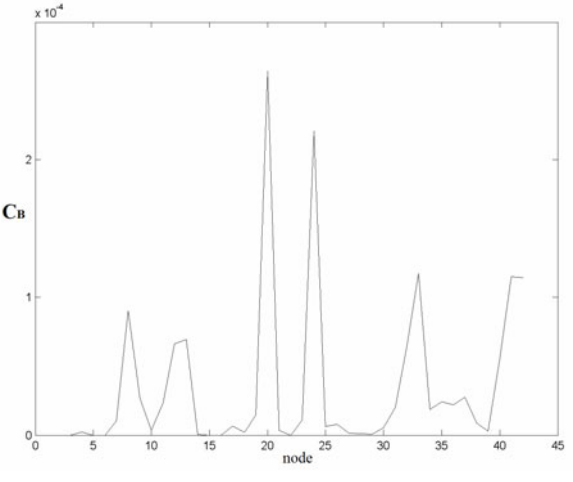


Fig. 5. Betweenness centrality

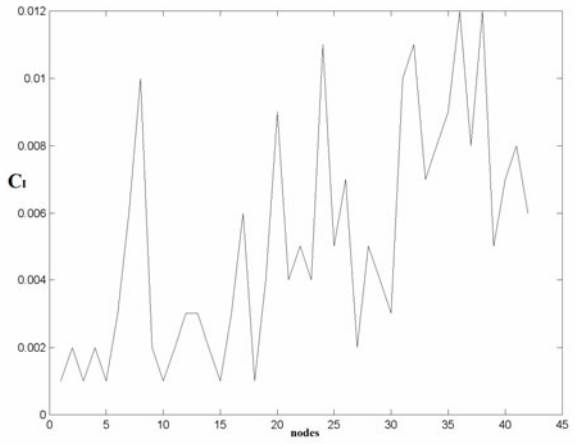


Fig. 6. Information centrality

A few nodes are highly ranked through all four classic centrality measures. Examples are node 24(2-2-2-4: 2nd in degree centrality, 2nd in closeness centrality, 2nd in betweenness centrality and 4th in information centrality). And a few other nodes are highly ranked through 3 centrality measures.

4 Discussion and Conclusion

The centrality measures are effective in revealing the position of node in the telecommunication network. The different ranks of nodes reflect the position of nodes. We find that some nodes are highly ranked in the four centrality measures, indicating that these nodes are more important than others.

In future studies, it will be necessary to improve the algorithm of centrality measures, and focus on the centrality measures of evolving networks.

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How to Make Students Feel Happy in the Course of Aerobics

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Abstract. With its own charm, aerobics is accepted by more and more university students, and becomes one of the most popular sports for girls in colleges. So the Aerobics Teachers must change the single mode of teaching. Aerobics Teachers should start from the actual situations, adopt the method of "group teach", and teach students to appreciate themselves and help each other in a team. And teachers also should make students feel happy of success and sports when they compete in teams.

Keywords: group teach, cooperation, happy Physical Education.

Introduction

Aerobics is a combination of gymnastics, dance, music appreciation, fitness and entertainment and is loved by young people. It is a very popular sport. The teaching of aerobics should adapt to quality education and make full development of a student's body and mind to keep up with the times. Teachers cannot use a set of old aerobics to complete the entire semester. Students should play a "principal" position and the teacher play the "leading" role, so that students get the maximum degree of initiative and creativity of the play. We should meet students' need, and make them practice aerobics by themselves. If teachers can arouse students' learning interest effectively, the students will get happiness and satisfaction when they improve their skills. With many years of teaching experience, and I want to discuss with other teachers.

1 Lead the Students to Appreciate Themselves in Aerobics Course

The pursuit of beauty is human's nature, and also the source for success. So teachers should seize the psychological characteristics of students, and set up their correct view of beauty. Teacher should teach students to show themselves, and express their feelings, and ideas in the details of every movement. This sport has a soul, so it is the most beautiful sport.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 344–347, 2011.
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1.1 Correct the Bad Habit, and Encourage Students in Every Small Progress

For new learners, some movements are hard. So the teacher should teach some easy movements at first, and correct their fault. At the same time, teachers should teach them the concept of beauty, and let the students know that correct movement can not only excises the body, but also can improve body's shape and be more beautiful and strong. When students finish the movements, teachers should confirm their scores and praise their advantages, which will make students be confident and positive. In this way, teacher can exploit students' potentiality and improve their wishes and ability of perform.[1]

1.2 Pay More Attention to Combination of Movement and Awareness in Teaching

After correctly performing the basic movement of aerobics, the students should strengthen their postures. When doing exercise, students must focus their attentions on it, move their hands and eyes at the same time, smile and notice every movement in the mirror. They should imagine that she is a beautiful dancer whose arm is powerful, actions and emotions are rich, and wear a right expression. Teachers should make students feel the charm of aerobics, and encourage students to watch sports with more expressiveness to expand their horizons, and develop their ability of thinking and appreciation. Then the students can be more outgoing and have a dignified air, and make students can perform more in progress.

2 Various Preparation

2.1 Choose the Popular Music Which Fit Today's University Students

According to the movement's feature, teachers choose some music which fit this rhythm. Teachers should teach students how to listen to the music and appreciate it. Students put their movements, emotion and the music together. The music can arouse students' interest and help them have a strong feel for music. One single song will be boring and cannot arouse students' creativity. Music can deepen the conation of the movement, and make students' feel the real charm of aerobics.

2.2 Teachers Should Lead Different Styles of Aerobics

Aerobics is a sport which keeps pace with the times. Teachers must break the tedious single teaching style, such as Latin aerobics, wrestling aerobics, fitness dance, jazz dance, etc which are preferred by university's students. Teachers can put basic steps in the syllabus as exercises in preparation. And combine the preparation with class teaching very well.[2]In addition, teachers can put interesting plays in preparation periodically and the students can be happy from the sport.

3 Use "Group Teach" to Raise Teaching's Quality, and Active Class Atmosphere

In aerobics teaching, we can use the "group teaching" to break the old model whose main object is individual competition. Students in this group can learn techniques and

skills, teach each other, and cooperate with each other. The group's interest is more important than individuals'. Different groups often compete with each other[3] Our goal is to bring up students' spirit of cooperation and tenacious struggle, as well as favorable will.

3.1 Divide Students into Different Groups According to their Ability

According to uniform standards, teachers divide students into groups by 5-8 people, and choose a leader by the members in the group. Teacher must constantly explain the task for team leader and the importance of cooperation of team members. Team leader should arrange different student to lead others do exercises and change the students from passive acceptance into active learning, greatly improve their learning power. Teachers should make full use of the role of leader, and put students as main body. Teachers should arouse students' interest in study and their spirit of cooperation, and pick up other student's wrong movement and learn from others' strong points. In this way, students will be real leader and feel happy when they can perform these movements and methods. Some students like aerobics but afraid of not performing well, and some ones are not confident in aerobics. They can find study goals and impetus in their small group, where they encourage and help each other and make progress together. Then students' activities are arouses and the class atmosphere is more active.

3.2 Teacher Organize Competition Between Groups Regularly

According to class' content, teacher can make some basic principle, and organize students to change their team's shape, and compete with other groups. Members in the first group will get A, and if they get A for 3 times, their final score of performance in class is A. this method can establish and motivate students' awareness of competition and sense of collective honor. To gain honor for their team, students can overcome difficult in the course of study, and commit themselves to the competition. And train their unremitting strong will-power to elevate their ability of dealing with difficult. In addition, when making up movements, every student can cooperate with each other. Teachers can also organize students to make a flower ball or little rod for aerobics, which can open up students' thinking and enhance their friendship. This can raise their ability of cooperation and lay a basis for cooperating with people when they step into society.

4 Problems Which Have to Be Noticed in "Group Teaching"

From beginning to the end of dividing group, teachers must guide students patiently. Before dividing groups, teachers must set goals for students, and choose backbone team in class who can lead other students. But teachers cannot let students form groups by themselves. When groups do exercises, teachers have to make an inception tour of each group and pick up mistakes timely. In a group, we can use the method of "one student helps another" and make full use of students' principle status. After every competition, teachers must conclude timely and put forward both strong and weak points of each group. This method can improve "group teaching", and establish

a basis for next phase' study. A good teaching method can make aerobic class better, and the students can enjoy from sports. The teacher can pose with elegant postures which arouse students' enthusiasm. Then students will enjoy sports without tirelessly.

Every aerobic teacher must think actively, dare to create new teaching method, and really give principle role to students. Teachers must bring up talents who can adapt in society and meet 21st century's need. Teachers should improve their teaching method and exploit every teaching method's potentiality and accumulate more teaching experience in every aerobic class.

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Design of Solar Street Lamp Control System Based on MPPT

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Abstract. This paper proposes a new solar street lamp control system which is composed of photovoltaic cell, controller, battery and load. In this system controller as the key part applies the microchip to achieve many functions. According to the nonlinear output characteristics of solar cell and the influence of environment, it uses the perturbation and observation (P&O) method to realize the maximum power point tracking (MPPT) and promotes the efficiency. In order to prolong the battery life the pulse width modulation (PWM) charge mode is selected to control the battery capacity and provent the battery from the state of over-charge and over-discharge. Meanwhile the function of temperature compensation, charge and discharge protection are set to improve the running safety and stability.

Keywords: solar street lamp controller; battery; perturbation and observation method; MPPT; PWM.

1 Introduction

Today with the shortage of petrochemical energy getting worse day by day, solar energy which is a kind of non-pollution, renewable, inexhaustible energy, has been exploited and employed in many fields [1]. The solar street lamp is one of the important aspects. Now the green and environmental protection solar street lamp will be a new utilizing highlight with its some advantages, for example, the solar lamp street can be installed everywhere and don't need to connect with public power network and it is convenient and flexible.

At present in photovoltaic power station the solar energy is collected by solar cell and stored in battery to supply to users. The battery is often lead-acid battery and its life will shorten greatly if it is in deep discharge (the state of capacity is below 20%) when using. Vice versa, the life will be longer greatly even up to more than one time if the battery is always in floating charge and shallow discharge (the state of capacity is over 50%). So we should consider how to prolong the battery life during charge and discharge. What's more, when solar cell charges up battery, the solar cell output characteristic is non-linear, its working point can't be always at the maximum power point. Meanwhile the solar cell has high cost and low efficiency, which is its development bottleneck problem, then we need use controller to solve above questions, i.e. how to make solar cell work at its maximum power point.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 348–353, 2011.
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2 Key Technology Analysis

2.1 The Solar Characteristic Analysis

The P-U characteristic curve of solar cell is non-linear [2], as shown in Fig.1, where Fig.1 (a) is the P-U curve in different illumination and in the same temperature while Fig.1 (b) is in the same illumination and in different temperature. Through observation we draw a conclusion that the solar cell output maximum power point is different when the outside conditions change. So in the photovoltaic system MPPT technology must be applied.

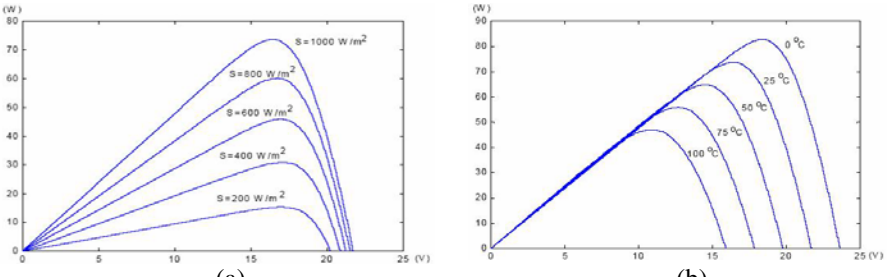


Fig. 1. The P-U characteristic curve of solar cell

2.2 The Maximum Power Point Tracking Technology

The solar maximum power point tracking is an electrical system which makes the photovoltaic cell output the most energy by regulating the state of electrical modules [3]. If the load and solar cell link directly, the output power will decrease and can't get the maximum power when the illumination or temperature varies. In order to transport the power into battery furthest, a controller is set to realize the maximum power. That is to say, an impedance converter is set, which makes the input impedance of load and the output impedance of cell be in a best matching state, thus the maximum power is got. The realization of MPPT is a self-optimizing process, i.e. control terminal voltage or other physical variables to make photovoltaic panel output maximum power intelligently in different illumination and temperature conditions.

Now according to judgment principle and realization approaches, the solar cell's MPPT algorithm about has six classes [4][5]: Constant Voltage Tracking and its improved algorithm; Constant Current and its improved algorithm; Perturbation and Observation (P & O); Incremental Conductance; Fuzzy Logical Control; Neural Network Control, etc. Considering the method complexity, tracking efficiency and hardware requirement, (1) and (2) are suitable in sample and low power application, but they have low tracking efficiency when the work environment varies; (3) and (4) have been applied widely because of their high tracking efficiency and easy realization; while (5) and (6) have incomparable superiority on study of non-linear and uncertainty factors in theory. But (5) and (6) are often affected by some factors in practical implementation, and the algorithm is very complex so it is limited in some degree. In this paper the P & O is selected to achieve the solar MPPT.

2.3 Battery Charge and Discharge Control

In this system the battery is as energy storage unit, because the generated electrical energy by solar cell is influenced greatly by weather conditions, it has high requirement for battery charge and discharge. So a three-stage method is selected to charge battery [6]. The step of three-stage charge method is as follows: (1) Charge battery using the maximum current supplied by solar cell when the terminal voltage is lower than the open-circuit voltage, until the battery terminal voltage reaches the rated open-circuit voltage; (2) Charge battery by the rated open-circuit voltage until charge current decreases to the rated floating charge current; (3) Charge battery by the rated floating charge voltage after the second charge state.

3 Structure of Control System

This solar street lamp control system is comprised of photovoltaic panel, controller, battery, power driver of PWM, output protection and power driver, load etc. It can mainly finish such functions that MPPT, battery charge, load power supply, battery protection and so on. Where, the solar cell is the input of lighting system and supplies the whole system light and electricity. On daytime the solar cell converts receiving luminous energy to electrical energy and charges battery by charging circuit; at night the solar cell stops working and the output terminal is at open-circuit state. The battery as an energy storage converts the electrical energy from solar cell to chemical energy to store on daytime and at night it converts them to electrical energy and output to lighting load. The lighting load usually selects energy saving lamps which has long life and high efficiency to promote system efficiency and stability. The system structure is shown in Fig.2.

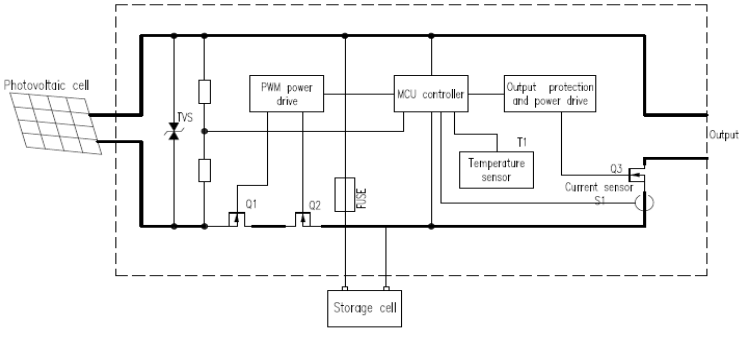


Fig. 2. Structure of solar street lamp control system

The microprocessor control unit（MCU）is the key part of system and selects AT89S52 as main controller. The chip is an 8-bit microprocessor with low cost, low power loss, high performance and 8K bytes memory. The chip has strong functions and can supply flexible and effective methods for many embedded application systems. The controller structure is shown in Fig .3.

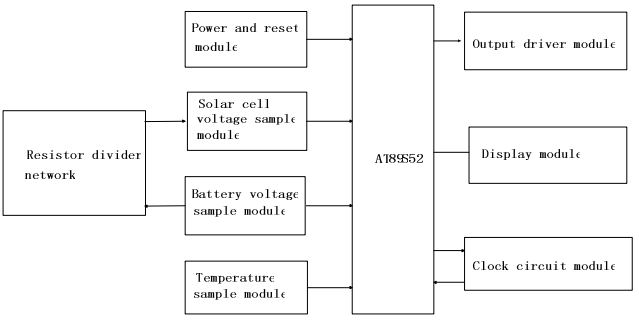


Fig. 3. Structure of street lamp controller

Where, the resistor divider network is to supply a certain sample voltage though resistance dividing voltage. The power module is to supply voltage of +5Vand +l0V (or +12V) for system. The solar cell voltage sample module is to accomplish sampling solar cell voltage. The battery voltage sample module is to accomplish sampling battery voltage. The output driver module is to supply voltage and protection technology to power MOSFET driver. The display module is to display function and its output state. The temperature sample module is to sample temperature and implement temperature compensation automatically. The clock circuit module is to make lamp controller adjust load's working time automatically.

3.1 Battery Charge Mode

According to charge mode the controller applies PWM. Between cell and load a power converter is set to match voltage. The relationship of output voltage u_o and input voltage u_i is as follows in equation (1).

$$U_o / I_o = \alpha^2 U_i / I_i = D * U_i / I_i \tag{1}$$

Where, D is duty cycle. When working duty cycle adjustment can adjust the impedance of output load to make the solar cell voltage at working point and control photovoltaic output at maximum power point. Thus it can improve the output efficiency and make a good use of solar cell.

3.2 Temperature Compensation

The system sets temperature compensation link because the electrochemical activity of lead-acid battery increases with temperature getting higher and decreases with temperature getting lower. So when the environment's temperature gets higher the charge voltage should decrease to avoid over charge; when the temperature gets lower the charge voltage should increase to avoid insufficient charge. The charger with temperature compensation can prolong battery life greatly.

3.3 Hardware Selection and Implementation

The intelligent controller based on microchip is special designed for solar direct-current power system. Press the switch and all the operation and settings can be

finished. The controller completes intelligent management of battery's charge and discharge according to actual situations and has such functions that over-load protection , battery auto off when over-charge and over-discharge, preventing reverse charge, controlling load on or off and so on. In this design chip LM331 is selected as V/F converter to realize A/D conversion and sample the battery terminal voltage to determine the SOC. LM331 converts the battery voltage signal into square wave signal with a certain frequency which is corresponding to voltage signal, and the battery voltage can be got by detecting frequency signal. The controller samples battery terminal voltage and charge current, solar cell output voltage and current, and controls corresponding circuit to regulate the duty cycle of PWM. The chip output a PWM square wave of 24kHZ which makes photo coupler TLP250 drive switching tube to reach MPPT control.

4 Software Analysis

The software mainly contains the following modules: initialization module, processing sub-module on daytime, processing sub-module at night, battery voltage detection module and timing module etc. They finish initialization, voltage and current sampling, power computation and comparison, and regulate PWM value to adjust duty cycle to control MPPT [7].

According to above contents the P & O method is applied in this design. The P & O is defined that measuring the solar cell's output voltage and current at a certain moment to get their output power, and compare this power to the former one. According to the two power values (or more sample values), determine the next adjustment direction of preference voltage in given load end. From power comparison, suppose that the two sample values are respectively P1, P2, where $\triangle P=P2-P1$, when $\triangle P>0$, that means the adjustment direction is correct and continue to adjust by original direction; when $\triangle P<0$, that means the adjustment direction is inverse to the expected, and need to adjust in inverse direction. Though repeated perturbation, observation and comparison, it can reach the maximum power point of photovoltaic cell and achieve MPPT. In realization of MPPT algorithm, because the photovoltaic system is soft and usually the change is not drastic, the fixed step optimization is often used, thus it is convenient to implement.

5 Conclusions

The novel solar street lamp control system proposed in this paper adopts high performance microchip as main controller, selects the adaptive P & O method to realize the MPPT, and improve the efficiency effectively; The battery adopts PWM charge circuit and three-stage charge style to optimize and control SOC intelligently. The system has the function of solar cell's MPPT, voltage detection and fault diagnosis, real-time detection of battery voltage and current, many kinds of safety protection function such as over-charge and over-discharge, short circuit, over-load etc. It also has temperature compensation and applies high precise digital clock chip to control load on or off by computing automatically sunrise and sundown time

according to longitude and latitude of this region. Presently the system has been put into use, and improved the solar cell's efficacy. It also cuts down the cost greatly and improves system's safety and stability. The solar conversion system will be more studied and applied in new energy field which would make great contribution in solving energy questions in future.

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Knowledge Operation Capability Evaluation Model and Strategic Orientation of Supply Chain: Exploratory Research Based on View of Ecology

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Abstract. The competitiveness of Supply Chain (SC) correlates intim*a*tely with its knowledge operation (KO). In order to realize better assessment value, this paper constructed an evaluation framework on knowledge operation of SC and a detailed index system. According to theory of ecology, expounded the evaluation orientation and future research direction from view of comprehensiveness and adaptability. Additionally, a case about Toyota recall-gate was analyzed. Through research, it provides two dimensions of results evaluating orientation which may help enterprise make right decision upon SC.

Keywords: Knowledge Operation; Supply Chain; View of Ecology.

1 Introduction

The combination of SC and knowledge management will cause big motivation on performance and competitiveness of SC[1]. For SC, the most important factor is not knowledge innovation but knowledge sharing and compatibility. Plenty of researches have been done on influencing factor of knowledge sharing and transferring before. But for knowledge evaluation the problem lies in lack of united assessment angle. Tseng[2] uses a novel hybrid multi-criteria decision-making model to evaluate firm environmental knowledge management; Andrade[3] establishes a knowledge based system for knowledge management capability assessment. But insufficient part of researches so far is lack of support of reasonable evaluation framework. Without framework support, relative research can only emphasize in local factor which may make sequential suggestion unilateral.

Inspired by environmental ecology, this paper constructs an evaluation model on SC knowledge operation. Former researches have touched basically most of the factors relating to knowledge operation. Based on those researches, this paper provides an evaluation index system and provides several analytical frameworks, includes: method choosing, assessment angle and strategy orientation analysis. In addition, it's pointed out that future research should go further combined with actual case. The value of this paper lies in that it provides relatively scientific index system and makes it integrated with conceptual model perfectly so that leading many evolution possibilities for future research.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 354–360, 2011.
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2 Construction of Model and Index System

Research before mainly focus on trunk procedure, which consists of obtainment, sharing & transferring, absorption &commercialization .Capability of KO could be divided into three sub-process capabilities based on such procedure. But the three capabilities overlapped in some way. So, the best way is to take each capability for analysis. Generally, it consists of capability foundation, object and environment.

Capability foundation (CF): pre-requisite for capability performance. The premise for KO is knowledge storage, and in order to performance well, the company has to provide an excellent platform for knowledge obtainment and integration. So, CF could be composed by organizational foundation and technical foundation.

Capability object (CO): object to be functioned. The complexity of object and match of capability subject are two key factors influencing the ultimate performance of KO. The object of KO is knowledge within the scope of SC in this paper.

Capability environment (CE): External environment may affect main body straightly or recognition to objective in an indirect way. For example, the link relationship of SC could exert a strong influence on cooperation preference and the culture diversity may affect the understanding level of knowledge sharing.

2.1 Conceptual Model

This structure is quite in line with concept of ecology, just like a grown up process of plant. Knowledge growing process includes three stages: knowledge generation and achievement (KG&KA), knowledge sharing and transferring (KS&KT), knowledge absorption and commercialization (KA&KC). Environment is made up of relationship compatibility, cultural compatibility and structural compatibility; Technical platform and organizational support constitute the culture medium. (As shown in fig. 1)

Platform: technical platform is kind of tools or methods which promote knowledge operation more efficient, usually its point is support from network and information

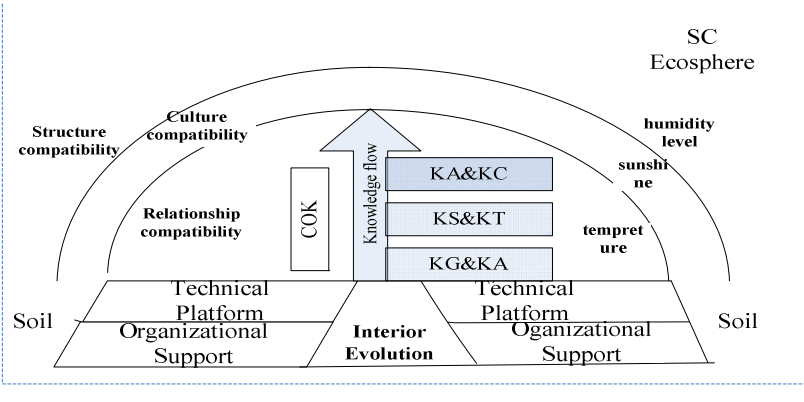


Fig. 1. Conceptual model based on theory of ecology

system. Many enterprises have set up construct knowledge management information system these years, namely establishment of technical platform. Organizational support is kind of inner guarantee lead by organizational mode and atmosphere.

Environment: relationship compatibility means how well links of SC cooperate between each other; cultural compatibility also shows more importance, especially for multinational firms. Therefore, this is also an important environment factor. The structure includes mainly organizational structure, product structure and geological structure, etc.

Knowledge characteristics: namely trait and complexity of knowledge production and transmission. The difficulty of KO will arise with deepen of knowledge complexity which often relates to industry characteristics and the purpose of KO.

2.2 Constructing of Evaluation Index System

Process of KG&KA. According to definition by Microsoft, there are three layers for business knowledge: business data, information and knowledge. The upper layer's knowledge evolves from low layer in a figure of spiral. So, the obtainment of SC knowledge bases on industry and emprise knowledge. If companies cooperate well, SC knowledge will produce more with innovative dynamics. Additionally, organizational learning in SC is an important shortcut to make SC knowledge transform from tacit to explicit. The capability of KG&KA can boil down to three points: knowledge stock, external knowledge tunnel and interior knowledge origin.

Process of KS&KT. Knowledge sharing(KS) functions as important foundation for SC links to build up steady relationship and to promote cooperation level[4].There are lots of examples about making economic value through KS, such as GE, Ford and British petroleum ltd. The process of KT is: senders transfer knowledge to recipient through medium and every part influences the quality of KO. Due to voluntary not compulsory act the KS is, this kind act shows like game playing. The factor in game includes confidential attitude, benefit distribution, opportunism, restrain and incentive mechanism. For other aspects, Foster[5]testified that KS varied inversely with information technology gap amid links; Wagner[6]indicated the tacit knowledge would affect the satisfaction of KSMorgan[7]summed up four factors affecting KS. In short, game playing, cooperation and difficulty of KT constitute the capability of KS&KT.

Process of KA&KC. Lane regarded the absorption process as relationship like teacher and student (T&S), and he also believed there were three keys determining the quality of KA: the concrete knowledge type from T; resemblance of salary system and organizational structure; familiarity with organization definition from S to T. Also, KA&KC can be divided into three processes[8]: exploratory learning, transforming learning and developing learning. It can be easily found the former two processes relate to knowledge type and personal learning ability, and the latter one has intimate relation with KM and innovation ability. Besides, Tomas[9] compared enterprise strategy with knowledge strategy, and explained that matching between them was directly bound up with performance of KO. Evaluation index system shows as table 1.

Table 1. Evaluation Index System of KO of Supply Chains

index	1st-level	2nd-level	3rd-level
Koc Of Sc (U)	**Organization Support appraisal$(U)_1$**	Strategy intensity U_{11}	Strengthen knowledge strategy Match between knowledge Strategy and business strategy
		Quality of knowledge workerU_{12}	Strategy and business strategy Rate of knowledge worker
		Assessment on learning U_{13}	Style of organization Atmosphere of learn& innovation cognitive competence
		Incentive mechanismU_{14}	Effectiveness of incentive Perfection of traning system
	Technical platform appraisal(U_2)	Information &networkU_{21}	Informatization level Communication platform
		MIS ConstructureU_{22}	functionality reliability operability
	Compatibility of SC(U_3)	Compatibility of relationshipU_{23}	Trust level Commitment level Communication level
		Compatibility of cultureU_{24}	Culture resemblance Culture repellence
		Compatibility U_{25}	Compatibility of organization Cognitive to other's structure
	Characteristic Of Knowledge (U_4)	Knowledge decrepancyU_{31} Knowledge customizationU_{32} Knowledge embeddednessU_{33} Knowledge complementarity U_{34} Implicit degree of knoledgeU_{35}	

3 Evaluation Method and Strategy Orientation

Does KO capability of SC positively correlate to its competitiveness? Researchers could do some empirical research on such problem Based on above index. Evaluation questionnaire can be designed in the light of above analysis and index. As this paper is just an exploratory research, empirical research will be done in next paper.

Qualitative indexes' identification: Taking typical bilateral structure for example, if core enterprise is manufacturer, manufacturer is mainly responsible for assessment with supplier who provides opinions of coordination. One of this method's advantages is it can get the cognitive biases between them which may helps when partners want to tackle those biases.

Set U= {U_1, U_2, U_3, U_4}, and the results could be easily divided into three degrees. Combined with scoring of $U_{1\text{-}4}$, SC shows four KO types: Toddler (low scoring of all indexes), Strong type (middle in U but well in), mature type (all indexes score well) and decline type (middle in U but bad in U_3, U_4).

3.1 Adaptive Evaluation

Aspects expected to be improved may be too many to take care of all sides, and it's hard to calculate precisely the cost for improving and subsequent benefit. The central theme of evaluation based on ecology lies in its ecological suitability, different knowledge traits require variable environment and so do different developing stages of SC. The following is analysis based upon typical developing stages.(Taking Supplier-Manufacture bilateral structure for example)

Stage model one: state description: Under non-longtime cooperation expectation, M build up contract relationship with S, suppose material or components totally fit in standard from M, order is ligament of their mutual communication. The environment is unset, namely state of U_3 is null, and the capability of $U_1U_2U_4$ is φ_1, φ_2, φ_4.

Resolution Consideration: Premise one: $\varphi_1+\varphi_2/2 > f(\varphi_4)$ (suppose value of k is as same as assessing degree). In this period impetus of knowledge renewal and innovation is greater than resistance, and external performance of M is product scale expansion and upgrading of technique. Meanwhile, the requirement of supplier speed and quality from M keeps improving. If S could handle the requirement from M, M will choose to build up long term cooperation. And then, S must have the similar knowledge upgrading capability just as M, otherwise, the satisfaction from M will incline. And the results will probably be end of cooperation. But in another case, namely $\varphi_1+\varphi_2/2 >> f(\varphi_4)$, M will tend to build up long term relationship with S whether S is excellent or not through the program of knowledge sharing and transferring. Premise two: $\varphi_1+\varphi_2/2 < f(\varphi_4)$. Impetus of knowledge renewal and innovation is weaker than resistance. The external performance of M is product aging and share of market will be lost. In this period, the order S received become less and unsatisfied with M which results in appearance of substitute. Meanwhile, M hopes to set up long tern relation with S for tiding over its difficulties. Owning to the non- long term expectation premise, S is not obliged to pay the bill for M, SC will collapse.

Strategy orientation: knowledge upgrading ability of core enterprise decides the possibility of SC stability. Thereby, first thing for enterprise is to raise organizational support and to establish technical platform so as to nurture innovative capability.

Stage model two: state description: S and M reach agreement of long term cooperation. Suppose they could choose two different strategies on knowledge cooperation: be Positive or negative. Suppose results of game playing act like table 2.

Table 2. Gaming matches of strategy

M/S strategy	POSITIVE	NEGATIVE
POSITIVE	A_1,A_2	B_1,B_2
NEGATIVE	C_1,C_2	D_1,D_2

Two consideration: First, regulate benefit distribution system, make $C_1 > A1$, $B_2 > A_2$ untenable. In a SC which centers in M, since M has powerful strength and quick knowledge upgrading, most of S will choose negative strategy waiting for knowledge sharing and transferring from M. Meanwhile, the strategy of M is to regulate benefit

distribution mechanism, supplying knowledge assistance with treaty which can reduce S's expectation under negative strategy so that they may have to be positive again. Second, facilitate repeated game, and ends up with mutual positive strategy. Effective negotiation is required for optimizing repeated game.

Strategy orientation: In this stage, compatibility of SC should be strengthened. They should improve correlation intensity through frequent interactivities so as to make mutual cooperation last for a long time.

Stage model three: state description: After SC reach to stage of stability, core M execute cost leadership strategy and the knowledge function is to shorten the production cycle. In this case there are two remarkable changes: first, the number of S keeps enlarging for matching market expansion strategy and meanwhile lots of temporary workers join in which can destroy the balance of SC; second, cooperation between S and M shows more unilateralism. Based on market strategy, M need to change design idea and raw material thus leading weaker compatibility, namely during this stage, φ_3 keeps decreasing but$\varphi_1\varphi_2\varphi_4$ keep steady rising. If there is something wrong with integration of knowledge and product, namely deviation appears on KA&KC, and it could cause big risk. Suppose the risk parameter M could stand is r ($0<r<1$), standard compatibility of SC is W, W= g (φ_1, φ_2, φ_4). After cost priority strategy adopted, cost declined c, direct yield from that is E, and risk cost of compatibility is $\xi=t\ (W-\varphi_3)^2$, the compensation cost of accident is h (ξ). When E> h (ξ), M will neglect the risk brought by cost priority strategy, and when E<h (ξ), M should control expansion speed of SC and give way to inner stability first.

Strategy orientation: Requirement for compatibility of SC chimes in with its maturity, corporate strategy can exert an important influence on knowledge sharing and transferring, priority to expansion or quality need to be decided.

3.2 Case Analysis: Toyota-Recall Gate

The accelerator pedal problem came from CTS, but CTS refuted that their production based totally on Toyota's design paper and the same pedal for GE, Ford have no problem found. For Toyota, the quality of organizational support, technical platform and compatibility of SC could be supposed to be excellent, and the stage of Toyota SC is pretty mature. Also, Toyota can be positioned typical stage three. During the past 10 years, the number of overseas production has enlarged to 17, but many temporary plants have joined. So lots of changes have happened on Toyota.

Analysis based on compatibility: Knowledge in SC vertically connects with each other. The stronger knowledge upgrades, the more for compatibility of SC. With Toyota's global expansion strategy, the sales kept rising and the structure of SC kept changing which lead to compatibility declining: 1) correlation intensity and reliance between Toyota and suppliers became unbalanced 2) supplier control became weak: under lean production, dependent coefficient from each other is very high. But in overseas market, Toyota had given up its lean production which leaded to declining of mutual reliance. CTS only were in charge of production on the basis of design paper and never paid any attention to knowledge integration or relative communication.

Analysis based on knowledge trait: A car is made up of 20-30 thousand parts, but different parts usually come from different suppliers. Due to complexity of integration,

it's hard to make it perfect which explains recall system reasonable. The mistake Toyota made is put development strategy ahead of product quality with sacrifice of quality control unit. It's thought to be no problem using pedal from CTS without sufficient test on its applicability. Cognitive fault is the direct reason for Toyota issue, but the primary reason for that is potential risk brought by global expansion strategy.

4 Summary and Outlook

The main conclusion of this paper is knowledge operation in SC accords with ecology characteristic. As exploratory research, the key work of this paper is to discover some potential new research problem which may provide a brand new view of SC research. Through comprehensive evaluation system, enterprises may find their operation problem in a new angle. In this paper, analysis and model are both carried on by summary of actual case which can provide real business environment.

As an exploratory research, the primary shortage of this paper is lack of quantitative research and empirical research, but it provides a framework of following research: ① An empirical research: Does performance of knowledge operation of SC positively correlates with its competitiveness? The research objective could focus on several SC in different industries. ② Classification of SC based on view of knowledge operation. It provides a classification method in this paper, but it hasn't been testified in practice, so actual case must be combined. ③ The best environment for SC development need to be studied. Just like flowers need different environment to blossom, developing conditions for different SC varies. So the point of next research is to find which part needs to be firstly improved for SC's healthy growth.

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Quantitative Analysis on the Inter-provincial Distribution of Major Public Goods' Expenditure in China—Based on the Data for 2007

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Abstract. This paper uses the principle of Gini Coefficient which measures the equity of income distribution, based on the sample of the financial expenditure of typical public goods and the data of population size which belong to each province and municipality in 2007 to construct the mathematical model. It investigates the regional distribution structure of national public goods' financial expenditure and calculates the corresponding "Gini coefficient" values through the quantitative research method, regression analysis. The calculated results show that it is reasonable on the distribution of the population that China's finance invests in major public products and services vital to the people's livelihood, and the investment does not exceed the bottom line of inequity. At last, the paper analyzes the reasons for the conclusions.

Keywords: typical public goods,financial expenditure, gini coefficient.

1 Introduction

It is the important conditions for building an equal and harmonious society and the important measures of improving people's livelihood, especially the situation of vulnerable groups, which the equalization of urban and rural areas of basic public goods and services is promoted, and public equal access to public resources is promoted.

Financial expenditures reflect the scope and objectives of government activities, and it is the main tool for government to regulate the economy and promote social justice. The quantity and structure of government's financial investment in public products and services which relate to people's vital interests not only decide the reasonable degree of fiscal expenditure structure, but also are the important gauge to measure the government fulfilling its responsibilities to achieve the social justice. Based on various provinces and municipalities' financial expenditure of typical public goods and services in China, the paper tries to investigate the distribution of expenditure of inter-provincial public goods. Through the quantitative analysis methods and related data, the paper will make a conclusion that whether the distribution is equal and reasonable.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 361–367, 2011.
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Generally speaking, a region's investment in public goods is directly correlated to its fiscal capacity. In other words, the stronger its fiscal capacity is, the more ample financial funds which can be used to the expenditure of public goods. Because the fiscal capacity is decided by the economic development, then view from the absolute size, the developed areas' financial investment in public goods should be far more than the less developed areas'. For a variety of historical and practical reasons, China is an uneven development country. There are significant differences among the East, Central and Western per capita GDP, which leads to the great difference of fiscal capacity in areal distribution. And this has been proved by related research.。 For example, In his paper called "financial capacity difference among different areas and institutional innovation of transfer payment ", Rongcang Liu indicates that in 1999, the coefficient of relative variability about regional per capita GDP in China is 77.05%, among which Shanghai's per capita GDP is 11.14 times more than Guizhou's; But in the same year, the variability coefficient of per capita financial income in each area is 130.57%, the financial income in maximum area is 14.23 times more than that in minimum area.[1] From looking up the Statistics Yearbook and calculating, He finds that there are also great differences among various areas' financial capacity in recent years. Take the year 2007 for example, the financial income in more developed eastern area contribute more than 60% of our country's income. But both the central and western areas contribute less than 20%. That is to say, The East' income is 3 times more than the Central and Western's.

Now in the condition that these areas have quite different financial capacity, whether these areas' financial investment in public goods will show the similar difference? And how much is the difference? Whether the difference has exceeded the rational limits, and become a main barrier to affect the development of regional balance? The questions all above will be answered in this paper.

2 Model Constructing

We know that Gini Coefficient is an indicator used to measure the difference of income distribution, whose principle is to show the degree of concentration or dispersion of income distribution through comparing percentage of total population with that of total income. Expressed in mathematical language, Gini Coefficient means that based on sample date first, describing the Lorentz curve, which reflects the corresponding relationship between percentage of total population and that of total income; then determining the size of the area which is surrounded by the curve and the straight line (the incline angle is 45°and absolutely and mean line); finally comparing the above size with the size of a triangle which is surrounded by two adjacent legs of the triangle (the absolutely and uneven line), and gaining a material value of Gini Coefficient. The smaller the Gini Coefficient value, the more equal the income distribution, vice visa.

Because we study the same question about the balance of fund distribution, We may investigate the balance degree of typical public goods investment of various provinces

[1] Rongcang Liu, Guohua Jiao. Financial capacity difference among different areas and institutional innovation of transfer payment[J], Finance, Trade and Economics, 2002(6).

and municipalities through the Gini Coefficient and "Lorentz Curve" which is determined by percentage of total population and that of total income. Then the key is how to determine the "Lorentz Curve" which reflects condition of financial expenditure distribution. By looking up the statistical yearbook, we can easily get various provinces and municipalities' percentage of total income and that of total population about their typical public goods expenditure. After that, by summary statistics, several sample points will be gained. Then we can fit these sample points and draw the similar "Lorentz Curve", which contributes to the study on distribution balance. The sample points fitting can use the method of regression analysis. Considering the quality of fitted curve, the form of regression model can be set as:

$$\ln Y_i = \beta_0 + \beta_1 \ln X_i + \varepsilon_i \tag{1}$$

Among this form, Y_i means various provinces and municipalities' percentage of total public goods expenditure, X_i means percentage of total population, ε_i means the random error. And the corresponding regression equation is:

$$\ln \hat{Y}_i = \hat{\beta}_0 + \hat{\beta}_1 \ln X_i \tag{2}$$

If we use natural base e to do the transformation of same base, then the equation is:

$$\hat{Y}_i = e^{\hat{\beta}_0} \bullet X_i^{\hat{\beta}_1} \tag{3}$$

It is appropriate theoretically to use the above mathematic model to describe Lorenz curve. The following work is to find sample points and calculate the regression coefficient $\hat{\beta}_0$ and $\hat{\beta}_1$ with least square method.

3 Data Explanation

The data in this paper comes from the 2008 China Statistical Yearbook, among which the data about various provinces and municipalities' financial expenditure of public goods is arranged based on the eighth table of Chapter 7 called "Finance" in the Yearbook. The following are the methods of data arrangement.

1. Various provinces and municipalities' (hereinafter referred to as province) total percentage of typical public goods' financial expenditure. First, count various provinces' total financial expenditure of typical public goods; then add up the all provinces' total expenditure and get the whole nation's total value (hereinafter referred to as total value) of typical public goods' expenditure, and proportion every province's total expenditure to the total value and get every province's percentage. Finally, arrange every province's percentage from small to large order, and get the total percentage of typical public goods' financial expenditure according to total sum of every province's order.

2. Various provinces' percentage of total population. Based on every province's order of percentage of typical public goods' financial expenditure, arrange the

population of every province, and get the whole nation's population according to total sum of every province's population. Then count every province's percentage of total population, and get corresponding percentage of total population through the total sum of this percentage according to the above order.

4 Regression Analysis and Its Results

Import the total percentage of public goods expenditure （yi） and total percentage of population （xi） shown in figure 1 into the metrology software, Eviews, and then make regression analysis for variable ln yi and ln xi （ln yi as explained variable and x_i as explaining variable). That means, input x_i in the command window of Eviews, and press enter key then we can get results of regression analysis shown as figure 1. According to table 2, double logarithmic regression equation of total percentage of public goods expenditure and total percentage of population can be written as follows.

$$\ln \hat{Y}_i = -0.080961 + 0.909893 \ln X_i \tag{4}$$

SE （β_i） : 0.016534 0.00903

t : -4.896619 100.7624

$R^2 = 0.998017$ $\overline{R}^2 = 0.99787$ DW=1.404359

F=6794.942

It should be noted that the results showed in figure 1 by heteroscedasticity and serial correlation test and calculation. The first regression analysis results have the characteristics of heteroscedasticity and serial correlation (respectively use the White test and Durbin - Watson d test). To eliminate their impacts on the results of regression analysis, weighted least square method (the weight is reciprocal of absolute for the residuals) and AR (1) method are used. Revised regression analysis results eliminate the heteroscedasticity and serial correlation, and have good degree of fitting. After adjustment, the coefficient of determination is up to 0.99787, the fault probabilities of t test and F test are close to 0.

If we use natural base e to do the transformation of same base for equation 4 to get the form of equation 3, then get the fitted Lorenz curve of various provinces' typical public goods expenditure.

$$\hat{Y}_i = e^{-0.080961} \bullet X_i^{0.909893} \tag{5}$$

Then we get Gini coefficient of various provinces' typical public goods expenditure with the following equation.

Fig. 1 shows some results of data arrangement. For the accuracy of value, the data in Table 1 keep 10 places of decimal.

Item / Province	Total value of public goods' expenditure (ten thousand Yuan)	Percentage of public goods' expenditure	Total percentage (Y_i)	Population (ten thousand people)	Percentage of population	Total percentage (X_i)
Tibet	10170313	0.57852339%	0.57852339%	1633	0.21859774%	0.21859774%
Hainan	4660178	0.62085476%	1.19937815%	1115	0.65040525%	0.86900299%
Ningxia	9483496	0.65488325%	1.85426140%	6943	0.46952332%	1.33852631%
Qinghai	6806303	0.74814853%	2.60240993%	3393	0.42488012%	1.76340643%
Gansu	7038412	1.90055757%	4.50296751%	2405	2.01433201%	3.77773844%
Tianjin	11786884	1.93939858%	6.44236609%	4298	0.85822705%	4.63596549%
Guizhou	5600930	2.02679220%	8.46915829%	2730	2.89565037%	7.53161585%
Xinjiang	7763643	2.14831710%	10.61747539%	3824	1.61254320%	9.14415905%
Chongqing	12311257	2.22876494%	12.84624033%	1858	2.16750437%	11.31166342%
Fujian	15887801	2.24198564%	15.08822597%	7625	2.75633279%	14.06799621%
Jilin	11104088	2.33090575%	17.41913172%	5060	2.10130928%	16.16930549%
Jiangxi	7907882	2.47155422%	19.89068594%	6118	3.36209484%	19.53140033%
Guangxi	5387264	2.49387892%	22.38456486%	3581	3.66997899%	23.20137932%
Shaanxi	5938894	2.77484376%	25.15940862%	4368	2.88487442%	26.08625374%
Shanxi	14285411	2.83253867%	27.99194729%	9367	2.61162724%	28.69788099%
Inner Mongolia	11918249	2.92913409%	30.92108138%	9360	1.85115341%	30.54903440%
Yunnan	8168451	3.03929230%	33.96037368%	5699	3.47447256%	34.02350695%
Heilongjiang	8543891	3.23094917%	37.19132285%	6355	2.94337241%	36.96687936%
Anhui	17870480	3.29097625%	40.48229910%	9449	4.70908797%	41.67596733%
Hubei	5992538	3.39941570%	43.88171481%	4768	4.38657933%	46.06254666%
Hunan	1491851	3.55566034%	47.43737514%	845	4.89150933%	50.95405599%
Hebei	5355496	3.94669017%	51.38406531%	2816	5.34409902%	56.29815500%
Beijing	11484675	4.23251872%	55.61658403%	8127	1.25693701%	57.55509202%
Zhejiang	4870176	4.62112231%	60.23770633%	3762	3.89473441%	61.44982643%
Sichuan	7303111	4.77950894%	65.01721527%	4514	6.25543608%	67.70526251%
Liaoning	1390133	4.90527746%	69.92249273%	284	3.30821512%	71.01347763%
Henan	6667668	4.95994685%	74.88243958%	3748	7.20448895%	78.21796658%
Shanghai	4566847	5.12350266%	80.00594224%	2617	1.43012185%	79.64808842%
Shandong	1797725	5.94507459%	85.95101683%	552	7.20987692%	86.85796535%
Jiangsu	1573618	6.61193172%	92.56294855%	610	5.86904148%	92.72700683%
Guangdong	5162188	7.43705145%	100.00000000%	2095	7.27299317%	100.00000000%

Fig. 1. Various provinces' total percentage of typical public goods' financial expenditure and percentage of total population in 2007

Dependent variable: LOG(Y)				
Method: least squares				
Date: 08/12/09 Time: 10:04				
Sample (adjusted): 2 31				
Included observations: 30 after adjustments				
Convergence achieved after 4 iterations				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.080961	0.016534	-4.896619	0
LOG(X)	0.909893	0.00903	100.7624	0
AR(1)	0.040727	0.107387	0.379257	0.7075
R-squared	0.998017	Mean dependent var		-1.43583
Adjusted R-squared	0.99787	S.D. dependent var		1.196261
S.E. of regression	0.055206	Akaike info criterion		-2.86085
Sum squared resid	0.082288	Schwarz criterion		-2.72073
Log likelihood	45.91277	F-statistic		6794.942
Durbin-Watson stat	1.404359	Prob(F-statistic)		0
Inverted AR Roots	0.04			

Fig. 2. Results of regression analysis about double logarithmic of total percentage of public goods expenditure and total percentage of population

$$\eta = \frac{\int_0^1 (X_i - e^{-0.080961} \bullet X_i^{0.909893}) d X_i}{\frac{1}{2} \times 1 \times 1} = 0.034260392912155982122840877995259$$

$$\approx 0.03426$$

5 Conclusion

Based on the principle similar to the "Gini coefficient", through regression analysis about various provinces' total distribution of typical public goods' financial expenditure, we get a "Lorentz Curve" which reflects the evenly distributed condition.

Why the conclusion is contrary to our ordinary subject impression? I think there are several reasons.

First, the requirement for public goods has a quality of rigidity. Unlike Public revenues are changed with economic development and situation change, Public requirements for education, medical, health and other typical needs for public goods have less flexibility on public revenue. This reduces the gap between the less developed areas and developed areas in the investment scale of public goods, even to completely close. So for the whole country on a macro level, the regional distribution of the

investment is more balanced than we thought. Let investment scale of typical public goods from public finances in Guangdong Province in 2007 as a benchmark, the assignment is 1, then the value of Tibet is 2.6, Ningxia is 1.4 and Xinjiang is 1.3. It can be seen that the investment into public goods is not limited by the level of their economic development and public revenue, the less developed regions may overdraw financial revenue to guarantee the supply of basic public goods.

Second, this balance is related to the regional development strategies implemented by our central government, such as the projects of western development, revitalizing old industrial bases in northeast China and rise of central China, etc, From 2001 to 2005, our country has invested 170 billion in western health and education.[2] Meanwhile, the central Finance has carry out the generalized financial transfer payment system in underdevelopment areas, so that the perfect inequality phenomenon of regional public income which is caused by difference of economic level. Such policies and measures all contribute to optimizing regional distribution structure of national public expenditure and to narrowing the gap of public expenditure level between different regions.

Third, it is related to the sample unit selected by this paper. The paper chooses the province's financial expenditure as the sample unit, whose advantage is the data can be easily got and has higher reliability. But its' disadvantage is the sample is too macroscopic to be subdivided, which will inevitably affect the fitting results and cause error. If taking county's financial expenditure as the sample unit, we may get more actual results. But this kind of data collection and arrangement will be very difficult and trivial.

The results show that the regional distribution of our country's typical public goods' financial expenditure is relatively qual. So some relative policies should be continued, such as the regional development strategies like Western development and rise of central China and so on. It is necessary to strengthen central finance's generalized financial transfer payment on less developed areas, and some policies should be shaped as law, which can consolidate the achievement of balanced regional development, and create conditions to build a socialist harmonious society and realize common prosperity.

[2] Guanshi Qiu, Five years of western development, economic and social development went into the best period in history, [EB/OL]. China News Net, 2005-01-16. http://www.chinanews.com.cn/news/2005/2005-01-16/26/ 528932.shtml

The System of Simulation and Multi-objective Optimization for the Roller Kiln

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Abstract. It is somewhat a difficult researching problem, to get the building parameters of the ceramic roller kiln simulation model. A system integrated of evolutionary algorithms (PSO, DE and DEPSO) and computational fluid dynamics (CFD), is proposed to solve the problem. And the temperature field uniformity and the environment disruption are studied in this paper. With the help of the efficient parallel calculation, the ceramic roller kiln temperature field uniformity and the NO*x* emissions field have been researched in the system at the same time. A multi-objective optimization example of the industrial roller kiln proves that the system is of excellent parameter exploration capability.

Keywords: ceramic roller kiln; multi-objective optimization; evolutionary algorithm; CFD.

1 Introduction

Roller kiln has been widely used in the industrial production in these days. In today's advanced ceramics industry, innovation is more important than ever in maintaining a competitive market position [1, 2]. The potential effect of this modification is evaluated using NO*x* emissions data and the temperature field uniformity data. In the process of combustion research, either experimental or numerical calculation will make a large amount of data. It contains large and complex information which is not easy to understand and analyze. The multi-objective optimization of the ceramic roller kiln is a complicated procedure combined with computational fluid dynamics. In this paper, the study aims to find the most suitable design parameters for ceramic roller kiln on condition of production costs and environment disruption. Through out model building and optimization procedure of ceramic roller kiln, some stages method is adopted which follows the steps of model building, optimization and redesign. In each stage suitable means are utilized to make sure that ceramic roller kiln simulation is even more practical. A large simulated and multi-objective optimization system has been developed; and uniform design, evolution algorithm and CFD are used to establish the system.

2 The Simulated and Multi-objective Optimization System

Roller kiln is recent decades developed new fast furnace, now it widely used in building ceramics and ceramic production. The ceramic roller kiln is a tunnel-shaped kiln,

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 368–373, 2011.
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whose cross-section is long and narrow, and products are set on an array of parallel rollers which have high temperature through the working zone of the kiln. The emissions quantities contained in the report should flow from empirical observations and be expressed in calculated statistical parameters with acceptable confidence limits. The NOx emission data is collected at the lab by our team with continuous emission monitors. It is analyzed using our system. Fig. 1 shows one part of the ceramic roller kiln. Fig. 2 shows the modified ceramic roller kiln in our system.



Fig. 1. The real ceramic roller kiln

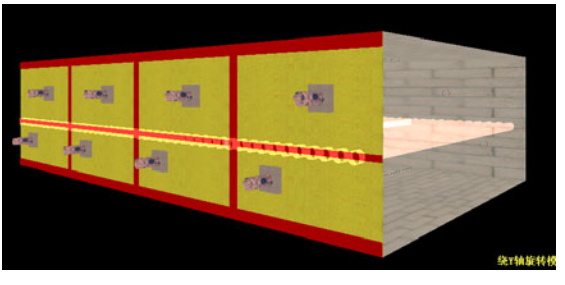


Fig. 2. The simulation model of ceramic roller kiln in the system



Fig. 3. The interface for the user

The total system includes the interface for user, the background calculation software, simple database and classified forecast subsystem. The interface for the user is displayed in Fig. 3.

The optimization of the ceramic roller kiln is a multi-object problem. In our study, the temperature field and pollutant emissions in the ceramic roller kiln are the two key factors of the ceramic roller kiln. Firstly, the temperature field uniformity is one of the main principles. We need that the ceramic product burning temperature scope is between 1500K and 1800K. The quality of firing kiln products depends on the temperature, while temperature has a link with many factors of the furnace structure, including air-fuel velocity ratio of the burn fuel, the arrangement of the burner, fuel properties and so on. The less NOx emissions is the other main principle. In the system, numerical simulation method is used to simulate the temperature field and the NOx emissions filed in the ceramic roller kiln.

So such steps are used to get the two fileds. Firstly, the geometry and mathematical models of roller kiln are built. Secondly, the geometry models are divided and set boundary conditions to calculate. Then, the thermo-chemical calculation is carried out in the prePDF. Later the SIMPLE(Semi- implicit Method for Pressure Linked Equations) is been taken to solve the problem and the calculation is achieved by FLUNET software. FLUENT is the world's leading supplier of computational fluid dynamics (CFD) software and services. FLUENT products enable engineers and designers to simulate fluid flow, heat and mass transfer, and a host of related phenomena involving turbulent, reacting, and multiphase flow. FLUENT uses the continuous, momentum, energy and component equations of the mathematical model. After calculation, in the firing zone of ceramic roller kiln, the central measure tendency and dispersion measure tendency of NOx emissions field and the temperature field are adopted to measure that whether internal NOx emissions field and the temperature field reach uniform criteria.

All the equations can be described as a general equation, which is carried by CFD. The central measure tendency function is used to measure internal temperature's distribution and NOx emissions' distribution of ceramic roller kiln. For each simulation model, the situation and model building parameters may be different, so the problem is central tendency measure function reflects different values of central tendency. A lot of algorithm such as DE algorithm, PSO algorithm and DEPSO algorithm [3-5] are proposed to solve this problem of local optimum possibilities. However, it lowers down the velocity as increasing the complexity of computation. Thus, the method of parallel computation is applied to improve the computing speed and precision. In this system, parallel computation refers to parallel—evolutionary algorithm computation which is applied to get the best parameters. Our workgroup have developed a Parallel Computation System on COW platform [6, 7]. It attains higher computing efficiency with lower cost by setting up the COW with a number of popular PCs to replace the costly parallel supercomputer. Therefore, the research in intelligent optimization of parallel evolutionary algorithm is carried out on the platform. It is proved that the parallel system of COW connected by high-speed network is of excellent computing capability. The optimum algorithm adopts the Master-Slave computing model.

3 Implementation for the Ceramic Roller Kiln

Facing of today's rapid economic development, energy consumption situation, reduce energy consumption, save costs and improve economic performance will be the first

task and the urgent need of each enterprise, and building ceramic kiln has become the protagonist of the furnace market by the advantage in this area.

$$CH_4+O_2 \xrightarrow{\text{combustion}} CO_2+H_2O \tag{1}$$

Eq. 1 is the chemical reaction equation. In this paper, we use the uniformity design, which is gained with experimental design point uniformly distributed in the trial stretch. A lot of models of different parameters, which impact the satisfactory temperature filed and the NOx emissions field, have been calculated by the CFD software. The length, width and height factors are correlative; the relative locations of burner factors (the h_postion of the burner and the v_postion of the burner) are correlative; the fuel speed and oxygen content factors are mutually independent.

In Eq.2 and Eq.3 , x_1 represents the length of kiln, x_2 represents the width of kiln, and x_3 is the height of kiln , x_4 is the h_postion of the burner , x_5 is the v_postion of the burner , x_6 is the fuel speed and x_7 is the oxygen content. While y_1 is the temperature filed judgment, y_2 is the *NOx* emissions field judgment.

The modern mathematical theory of uniform design is used for the experiment arrangement to select the least sample with the most comprehensive information in the whole system. After uniform design and multivariate linear regression, the basic nonlinear regression equations are as Eq.2 and Eq.3.

$$\begin{aligned} y_1 = f_1(X) = {} & 6.0296 - 1.0444x_1 + 0.0988x_1^2 - 2.3962x_2 + 0.5418x_2^2 \\ & - 2.4454x_3 + 0.4547x_3^2 + 0.1091x_1x_2 + 0.2829x_1x_3 + 0.4126x_2x_3 \\ & - 0.1563x_4 + 0.0087x_4^2 - 4.9967x_5 + 8.0625x_5^2 + 0.1513x_4x_5 \\ & - 1.1412x_6 + 4.1816x_6^2 - 2.0577x_7 + 2.7616x_7^2 \end{aligned} \tag{2}$$

$$\begin{aligned} y_2 = f_2(X) = {} & 0.1094 + 0.0007x_1 + 0.0017x_1^2 - 0.0267x_2 + 0.0084x_2^2 \\ & - 0.0837x_3 + 0.0284x_3^2 - 0.0068x_1x_2 + 0.0001x_1x_3 + 0.0189x_2x_3 \\ & - 0.0004x_4 - 0.0001x_4^2 - 0.2111x_5 + 0.3327x_5^2 + 0.0052x_4x_5 \\ & - 0.1454x_6 + 0.3069x_6^2 - 0.0578x_7 + 0.0887x_7^2 \end{aligned} \tag{3}$$

The mathematical models of the furnace combustion science are scientifically selected such as turbulent model, radiation model, combustion model and pollutant model. Besides, the finite volume method is used for discrete each mathematical model, eventually the SIMPLE algorithm is used for the solving. According to the kiln thermal characteristics and actual design experience, the CFD technique is selected as an appropriate method. CFD turns a computer into a virtual laboratory, providing insight, foresight, return on investment, and cost savings.

The method of uniformity design is adopted in this paper, and it is gained with experimental design point uniformly distributed. The structure of ceramic roller kiln multi-objective optimization is studied, after a lot of models of different parameters have been modified by the system.

Fig.4 is the meshes of Ceramic Roller Kiln of one model. As there are many relevant factors which can not be exhaustive test affect the study objectives, it's necessary to select the appropriate sample by an effective way. The ceramic roller kiln optimization model is regressed by multiple regression theory in the mathematical theory of statistics. The objective optimization problem is carried by the evolutional algorithm as PSO, DE and DEPSO.

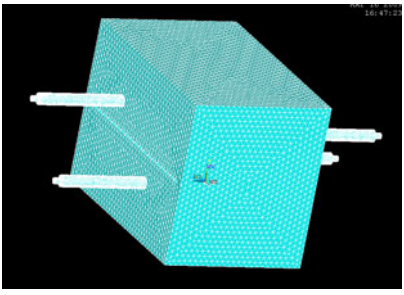


Fig. 4. Meshes of Ceramic Roller Kiln

By multivariable nonlinear optimization and computation, a group satisfactroy results are obtained, with a more satisfactory temperature filed and NOx emissions field are got (see Fig.5.). The structure of ceramic roller kiln can be got by the multi-objective optimization system. The length of kiln is 3.15m, the width of kiln is 1.34m, the height of kiln is 1.02m, and the h_postion of the burner is 0.35m, the v_postion of the burner is 0.18m. From what have been studied, lowering ceramic burning rate of temperature's increasing or through the improvement of kiln body structure, it can increase gas velocity in the furnace flue and improve its uniformity, reduce smoke in the drier retention time and thereby reducing NOx formation. The kiln is designed to provide both excellent combustion homogeneity and low energy consumption. These objectives are achieved through the use of several state-of-the-art features. Energy consumption is reduced by the flow of preheated combustion air and by the increasing the oxygen content of airflow through the kiln (the product is cooled under radiation and not convection). The fuel speed is 7.81m/s, and the oxygen content of airflow is 40.5%.

From numerical simulation of data and graphic displayed, we know that methane and oxygen-enriched combustion in nozzle. Due to the entrance's space is narrow; it can carry on the part of combustion. Then methane and rich oxygen rapid spray to kiln internal and complete combustion. And the kiln mostly section is in 1520K -1740K, while the average temperature in 1700K around (see Fig.5.).

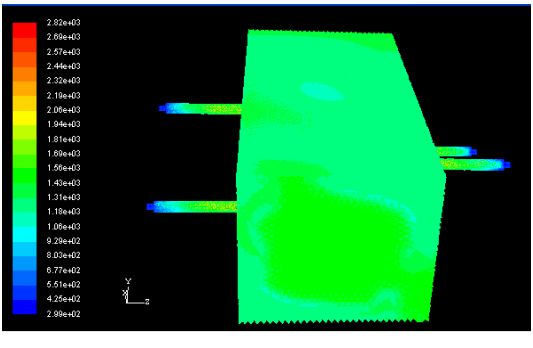


Fig. 5. The temperature field of the optimal Ceramic Roller Kiln

4 Conclusion

The multi-objective optimization of the designed modeling of temperature field and the pollutant emissions field in the ceramic roller kiln are researched. According to the structure of ceramic roller kiln, the modern method of applied mathematics called the uniform design is used to obtain suitable samples. The software called FLUENT is used to simulate the combustion in ceramic roller kiln. Besides, the parallel technique and the evolutionary algorithms (PSO, DE and DEPSO) are also used to explore the design optimization case. Thus, a large simulated and multi-objective optimization system has been developed. On the basis of a large number of simulations, the appropriate mathematical model for the ceramics kiln is found. Having a large number of observed data in the work field, the structure of the ceramic roller kiln as well as various process parameters are optimized to complete the validation of the simulation model. It demonstrates that combining of computer tools and scientific method can effectively improve the Ceramics equipment level and marketability.

Acknowledgment

This research is supported in part by the major science and technology fund of Hubei Province (NO. 2007DA111) and is financially supported by self-determined and innovative research funds of WUT. The author gratefully acknowledges the suggestions and encouragement of all members of the simulation laboratory in the Green Building Materials and Manufacturing Engineering Research Center of Ministry of Education at Wuhan University of Technology.

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Computer Simulation for the Determination of Optimal South Window Overhang Dimension

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Abstract. Overhang design is critical for energy efficiency building design in hot summer and cold winter zone. This paper carried out computer simulations to determine optimum overhang dimensions based on annual energy savings potential. Results show that the optimal window overhang dimension is about 600 mm with annual energy savings potential of 1%. Moreover, shading coefficient as a function of the gap length between window and overhang is given to simplify shading designs.

Keywords: shading coefficient; overhang; dimension; simulation.

1 Introduction

Ningbo, a typical city in hot summer and cold winter zone in China, is sultry in summer and cold in winter. The temperature is high and the solar radiation is relatively intense in the summer as shown in Figs.1 and 2. This kind of climate brings huge load to the air conditioning system, and the building sector accounts for about 46.7% of the total energy use in this area [1]. Improving the energy performance of building envelope, including the adoption of wall and roof insulating materials, energy efficient windows and shading devices etc., is one of the most important energy efficient measures to reduce building energy consumption. As the low temperature in winter in this area, the need for solar radiation entering rooms to reduce heating energy consumption leads to a trend to design buildings with large glazing areas. However this results in the solar heat gain through a window 20 times higher than through the neighbouring wall in summer [2], which causes overheating problems and high cooling energy consumption as well as glare problems. Windows are thus identified as an important area for energy-efficiency improvements in hot summer and cold winter zone

Therefore, shading devices are useful for reducing energy consumption and controlling daylighting levels, privacy and avoid glare from windows. The building's energy performance can be reduced by using different shading designs, such as overhangs [3], external roller shades [4], and venetian blinds [5]. Although many studies have been done on building energy efficiency [6-7]. However, they did not focus on shading devices.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 374–379, 2011.
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Overhangs are most effective over windows located on the west and east sides of the house. Particular attention should be given to properly sizing overhangs on the south elevation to allow shade in the summer, while still allowing winter sun exposure as shown in Fig. 3. South window overhangs should be sized for the height of the windows. Thus the design of shading devices can be quite complex. Computer programs however can do accurate building energy simulation and thus address this need. Therefore, this paper used computer simulation software to make sizing overhangs.

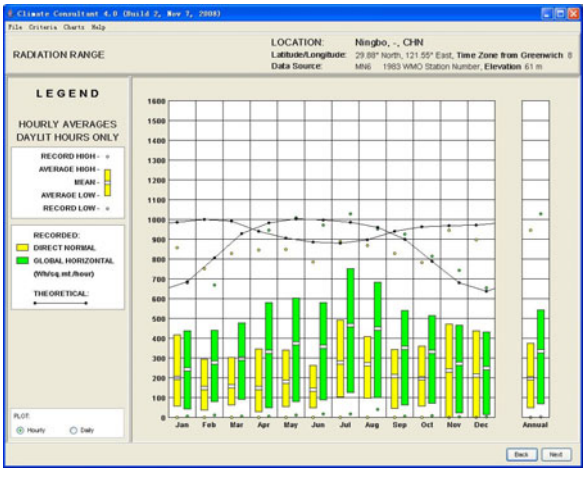


Fig. 1. Monthly temperature range in Ningbo

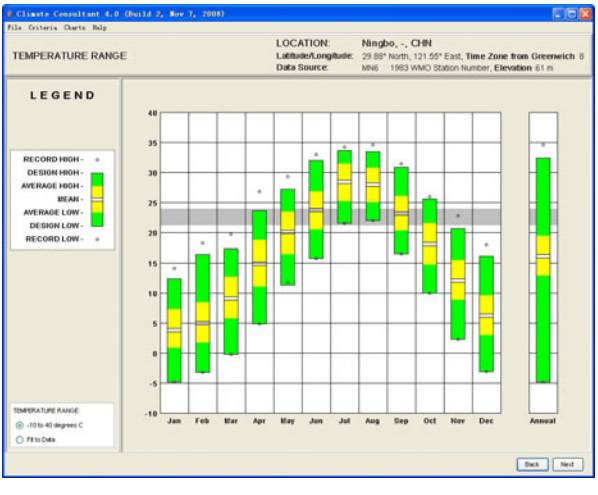


Fig. 2. Monthly solar radiation range in Ningbo

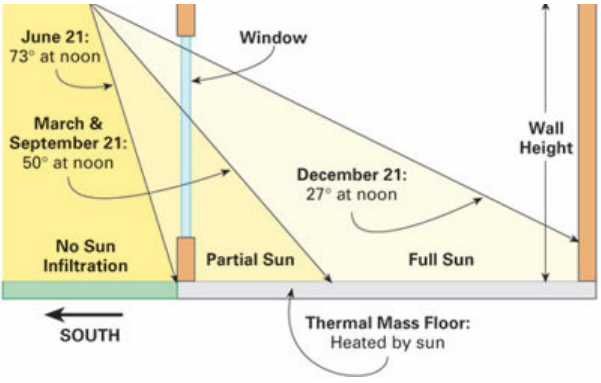


Fig. 3. An optimal overhang design

2 Methodology

2.1 Base Model

The base model is a representative six-floor and three-unit building in Ningbo city with total area of 3544.56m^2. The height of each floor is 2.8m as well as the area of each household is 100m2. The thermal design for envelop of this model is set to comply with the standard "hot summer and cold winter region residential building energy efficiency design standards". In this base model, the heat transfer coefficients are 1.5W/(m^2•K) and 1.0 W/(m^2•K) for exterior wall and roof, respectively. The area ration of window to wall is 0.5 in south, 0.45 in north, and 0.3 in east and west. In south and north orientations, the heat transfer coefficients of window are 2.5 W/(m^2•K), and their shading coefficients are 3.2 W/(m^2•K). In east and west directions, the heat transfer coefficients of window are 3.2 W/(m^2•K), and their shading coefficients are 0.8 W/(m^2•K). The HAVC systems for BASECASE model are configured as continues system single zone heat pump, whose EER is 2.3 when cooling, and COP is 1.9 when heating with the air change rate of 1.0 times/h. The room temperature is set 26℃ for cooling and 18℃ for heating. The cooling and heating period is from the beginning of Jan. to the end of Dec. Fig. 4 shows the base residential building.



Fig. 4. The base residential building

2.2 Overhang Setting

We carried out the simulation of this model, using the energy simulation software DeST-h, to obtain the optimum dimension of overhang. A typical overhang construction is shown in Fig.5. The window height is fixed at 1800mm which is a common height for windows in China. The parameter d increased from 0-600 mm with a internal of 100 mm. Then for each d the parameter L was increased from 0-1500 mm in simulation to determine the most energy efficient dimension.

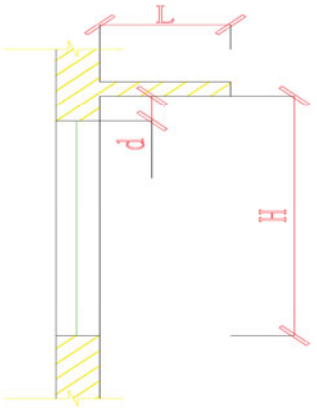


Fig. 5. A typical overhang construction

3 Results and Discussion

Table 1 shows the optimal overhang dimensions for different d. The term SD indicates the shading coefficient of overhang and PF is equal to L/H. The annual energy savings potential (E) is also illustrated in the table. It can be seen that L has a nearly linear increase as d rise (see Fig. 6). The optimal overhang dimension L is between 300 to 1060 mm for different d. The annual energy savings potential is also increased significantly. It is increased by 4 times from 0.34 to 1.31. SD is reduced from 0.88 to 0.73, indicating a increased solar shading performance as d increased. Whereas PF has a opposite change, it is increased from 0.17 to 0.44. This means that d should be not too large, and its suitable value is about 300 mm because the length of L commonly designed is near 600 mm. In order to make the adoption of this result simply for designers, SD as a function of d is obtained, and the equation for this function is determined according to the simulation results as follow:

$$SD=0.4PF^2-0.8PF+1 . \quad (1)$$

where

$$PF=-13.735d^2+11.149d-0.9813 . \quad (2)$$

Table 1. The optimal overhang dimensions for different (mm)

H	*h*	*d*	*L*	*SD*	*PF*	*E/%*
1800	1800	0	300	0.88	0.17	0.34
1900	1800	100	330	0.87	0.174	0.65
2000	1800	200	420	0.85	0.21	0.86
2100	1800	300	570	0.81	0.27	1.04
2200	1800	400	740	0.78	0.336	1.17
2300	1800	500	900	0.75	0.39	1.23
2400	1800	600	1060	0.73	0.44	1.31

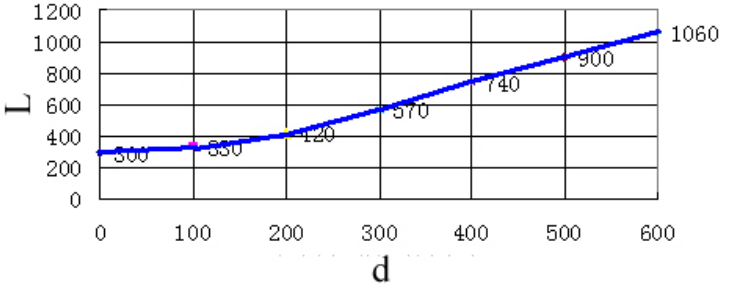


Fig. 6. L as a function of d

4 Conclusions

In this paper a computer simulation based optimization of overhang dimensions was performed. The results show that an optimal overhang length is about 600mm with annual energy savings potential of 1%. Moreover, shading coefficient as a function of the gap length between window and overhang is given to simplify shading designs. This results can help architects design overhang effectively without complex building simulation.

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Reliability Design to Circuit System in Hard Target Smart Fuze*

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Abstract. Hard target smart fuze can adaptively control the the burst point of penetrating projectile. How to improve its circuit working reliability to fit the fuze harsh high-g working environment is studied in this paper. A series of practical measures are taken, such as, propose buffer to fuze circuits; use high quality electronic components; and take circuit redundancy technique. Then the conclusions will provide valuable reference for engineering applications of hard target smart fuze.

Keywords: Hard target smart fuze; encapsulation; high quality electronic components; circuits redundancy.

1 Introduction

In order to cause the greatest damage to targets, hard target smart fuzes regards overload acceleration transducer as their core components, test the penetration acceleration and control burst, make projectiles detonate in the predetermined position accurately. Hard target smart fuzes, used in Penetrators, are accurate key weapons that attacked to important goal.

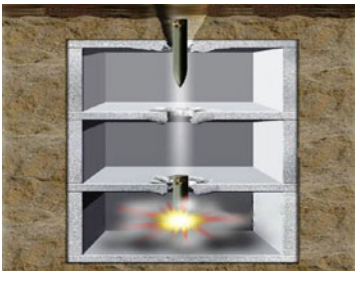


Fig. 1. The target smart projectile working process

The challenge is how to design a high reliability fuze circuit system can fit hard target smart fuze harsh high-g working environments, then adopt comprehensive measures——to encapsulate fuze circuit boards, improve the quality of fuze electronic components, adopt circuits redundancy technology to solve this problem are discussed in this paper.

* The work is supported by the Foundation of Chinese defence department.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 380–384, 2011.
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2 Encapsulation Measures to Fuze Circuit Boards

On hard target penetration process, the projectile and fuze will be subject to tens to several hundreds times of gravity. If the fuse circuit does not take appropriate measures to buffer, components will be damage, execution of MCU program will be error, detection and control detonation functions of the fuze are failure. To protect the fuze system to work properly, the following ways can be taken by test proved:

The circuit should be packaged with epoxy resin stuff, which good liquidity at room temperature, low curing shrinkage to avoid curing stress, when fuse bear mechanical force over 50, 000g, for example, when the projectile penetrating into concrete or steel, the body needs two-stage buffer, the first stage circuit module with sealing material set in an aluminum shell, the shell fixed by the secondary buffer —a V-type or W-type rigid spring body buffer. When the overload exceeds a certain limit, the rigid spring have a greater plastic deformation to reduce the overload peak force.

Epoxy is a thermosetting polymer formed from reaction of an epoxide "resin" with polyamine "hardener". Epoxy has a wide range of applications, including fiber-reinforced plastic materials and general purpose adhesives. In general, epoxies are known for their excellent adhesion, chemical and heat resistance, good-to-excellent mechanical properties and very good electrical insulating properties. Many properties of epoxies can be modified .

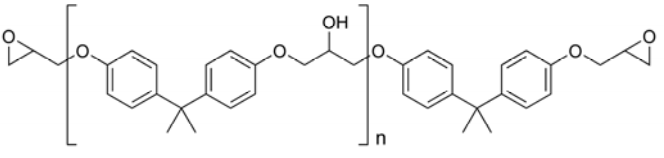


Fig. 2. Structure of unmodified epoxy prepolymer resin. n denotes the number of polymerized subunits and is in the range from 0 to about 25.

3 Requirements of High Quality Electronic Components

Component quality can keep the problems from occur, of high quality components can resistant overload impact should be selected. Such as SMD (Surface Mount Technology) ICs and SMD resistors and capacitors are selected in stead of THT(Though-hole Technology) components, and integrated clock generators replace conventional quartz crystal oscillators.

Large quantity dynamic testing experiments are carried out to testing the parameter of electronic components in high over loading impact condition with a standard hammer machine and a high speed data collection system. And the experiments were performed for about 5000 times to more than 30 types of resistors, capacitors, transistors to test their main parameter in different stress level and fixing mode. The parameter of some electronic components appears more or less unstable, namely temporary failure, and it is sensitive to different stress level and impact direct in experiments, which can offer important value of references for reliability lifespan. It is known from the high over loading impact experiments to in to resistances, capacitances, transistors, that is:

a. The parameter of most electronic components is unstable on over loading impact, This phenomena of unstable increases when the stress level added, and it gradually comes back to initial value after impact.

b. More regard to the influence on characteristic parameters due to the different experiment conditions (means impact direction) should be given when circuits designing.

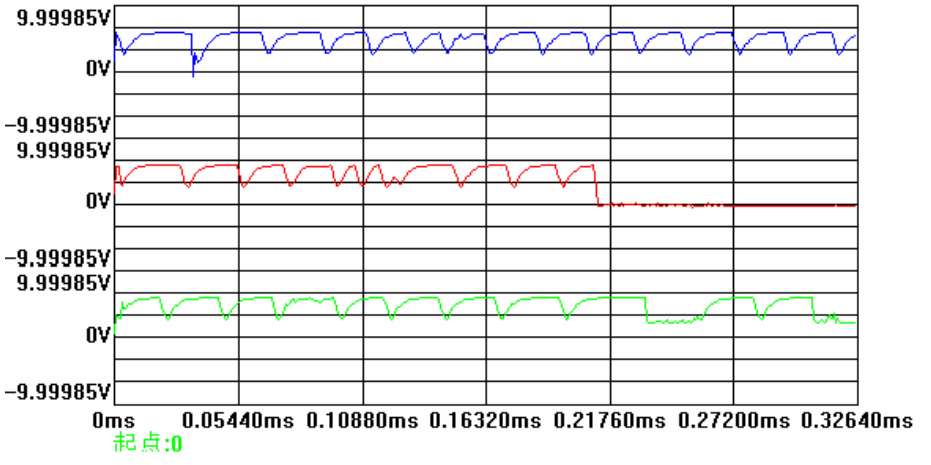


Fig. 3. Typical temporary failure of a capacitance in RC circuit when high impact occurring

4 Circuits Redundancy

High quality components represent fewer problems, but quality can be hard to quantify (what makes a part "better" in a given situation); and higher quality typically means higher cost; and very high quality can be hard to achieve and demonstrate. So, component redundancy can be adopted, which can tolerance fault and enhancement reliability for Parallel Systems Increase Event Probability.

Redundancy can be designed into a circuit system to increase circuit system reliability. A parallel circuit system provides more than one path for system success, as shown in Figure 4. An active redundancy system has subsystems on line that can individually perform the functions required for system success. If a subsystem fails, system success can be accomplished with the successful operation of a remaining subsystem. The system fails only when all the redundant subsystems fail.

A redundant system will fail only if all subsystems fail. If a redundant system consists of n independent subsystems, and if the reliability of each subsystem is known, then system reliability can be calculated as:

$$R_{System}(t) = 1 - [1 - R_1(t)] \times [1 - R_2(t)] \times \ldots \times [1 - R_n(t)]. \quad (1)$$

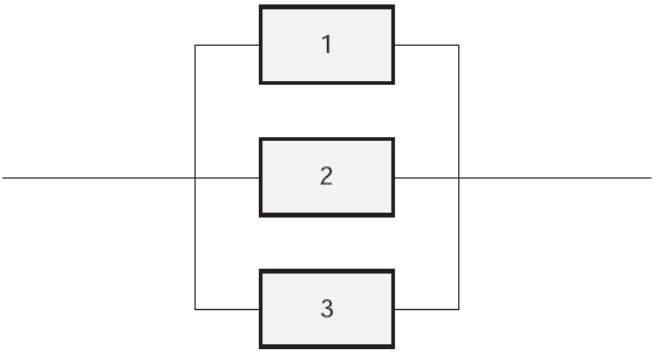


Fig. 4. The parallel subsystem

An active parallel fuze circuit system has three independent circuits (subsystems). The reliability for each subsystem for a mission time of t is:

$$R_1(t) = 0.72$$
$$R_2(t) = 0.73$$
$$R_3(t) = 0.74$$

The reliability of the system for mission time t is equal to
$R_{System}(t) = 1 - (1 - .72)(1 - .73)(1 - .74) = .98$

It should be noted that the reliability of the system is greater than the reliability of any of the redundant subsystems. $R_{System} > R_i$ for all $i = 1$ to n

Active redundancy is an important reliability tool available to the system designer. It should not, however, be used to improve the reliability of a poor design. It is much more efficient to engineer the design for the highest possible reliability and then use active redundancy if the desired reliability is still not achieved.

Table 1. Functional Reliability Requirements of Individual redundancy circuit

Functional Reliability Requirements of Individual redundancy circuit						
Number of redundancy =	1	2	3	4	5	6
If $R_{System}(t) \geqq 0.99, R_i(t) \geqq$	0.99	0.9	0.785	0.684	0.602	0.536
If $R_{System}(t) \geqq 0.98, R_i(t) \geqq$	0.98	0.859	0.729	0.624	0.543	0.479
If $R_{System}(t) \geqq 0.97, R_i(t) \geqq$	0.97	0.827	0.689	0.584	0.504	0.443
If $R_{System}(t) \geqq 0.96, R_i(t) \geqq$	0.96	0.8	0.658	0.553	0.475	0.415
If $R_{System}(t) \geqq 0.95, R_i(t) \geqq$	0.95	0.776	0.632	0.527	0.451	0.393
If $R_{System}(t) \geqq 0.94, R_i(t) \geqq$	0.94	0.755	0.609	0.505	0.43	0.374
If $R_{System}(t) \geqq 0.93, R_i(t) \geqq$	0.93	0.735	0.588	0.486	0.412	0.358
If $R_{System}(t) \geqq 0.92, R_i(t) \geqq$	0.92	0.717	0.569	0.468	0.397	0.344
If $R_{System}(t) \geqq 0.91, R_i(t) \geqq$	0.91	0.7	0.552	0.452	0.382	0.331
If $R_{System}(t) \geqq 0.90, R_i(t) \geqq$	0.9	0.684	0.536	0.438	0.369	0.319

Since the work reliability of single hard target smart fuze is low, R_i (t)≈0.7,due to harsh environments, then using three parallel circuits in fuze more easily obtains the reliability requirements, R_{System} (t)=0.99～0.98.

5 Conclusion

Hard target smart fuze can adaptively control the the burst point of penetrating projectile. Its key technologies -working reliability technology is studied: propose a series of practical buffer measures to fuze circuits; use high quality electronic components; and take circuit redundancy technique. The paper conclusions will provide reference works of hard target smart fuze for engineering applications.

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Study on the Reliability Data Analysis Method for Electric Fuze*

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Abstract. Some key points of reliable data collection and analytic technology of the electric fuze are discussed in this paper. The produce, collection methods, note proceedings of the reliable data of the electric fuze are also discussed, so reliable database of every component in the electric fuzes should be established, the primary and secondary method——an analytical method which uses the reliable data of the electric fuze with the application of the fuze products, then the key components which have influences on the reliability can be found.

Keywords: Electric fuze; reliability; database; failure analysis; primary and secondary diagram.

1 Introduction

The reliable data of the electric fuzes is every kind of data of the reliability level and condition, it can be such forms as digit, diagram, sign, character and curve, to collect reliable data is to use effectively the data in the life of the electric fuzes, which can offer the information to improve the design and produce of the electric fuzes, can offer decision-making criterion for administrator, can guarantee the reliability of the electric fuzes.

2 Source of Reliable Data

The reliability of each life phase of the electric fuzes is the source of the reliable data, so the source of the reliable data covers the whole process which comprises the design, manufacture, test, storage, use, for example, reliability test in research, reliability appraise paper, reliability check and accept test, manufacture, mount, checking record, screening and checking and accepting record of component, raw material etc. The collection range of information is particularly explained in GJB1686-93《Quality and reliability Information of the Weapon Equipment Administration requirement》, it can be referred as data source.

The reliability data of the ammunition can be got from two ways: reliability test in laboratory, electric fuzes. Data from laboratory is called experiment data, data from

* The work is supported by the Foundation of department of Chinese defence.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 385–390, 2011.
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the products is called spot data, they are from the different life phase. These two data is the important source to assess the reliability of each phase, data collection, analysis method is different according to the condition which has important meaning to analyze the reliability of the electric fuzes combined with these two methods.

3 Collection of Reliable Data

3.1 Determination of Collection Points of Reliable Data

The electric fuze can be divided into production, check and accept, storage and using according to the different life phase of the electric fuze, at the same time, can be divided into fuze, charge projectile body, launch charge, cartridge case, ignition tool etc. according to the composition of the electric fuze, each composition can be also be divided into components, according to the function and structure of the component, it can be divided into such forms as tube, shank, flake, spring, resistance, capacitance, battery. We can write the failure affairs names to each kind, at last, the failure mode of each component can be determined as the reliable data collection points of the electric fuze. New developed electric fuzes should possibly tracked from the beginning to reflect the characteristic of the different life phase.

3.2 Drawing of Data Collection Tables

The unifying and standardizing table can be established according to the bleeding points of the reliability data which is convenient to collect data, run computers, and circulate in the same trade. It has been testified through practice that unification and standardization of the table is a better data collection method.

Data collection table of the electric fuzes can be classified into performance experiment, production check, shooting range test tables etc. according to test phases.

Now, we can establish the table taking the example for the component of the electric fuze—performance experiment of fuze, only for reference, shown as Tab.1 other tables are similar to Tab.1.

Table 1. Stable1 the collection card of the reliable data of the electric fuze

Part sort	Event name	Number of test	Failure number	Test condition	Experimental condition	Test time
resistance						
capacitance						

3.3 Modes of Data Collection

Data can be circulated in the formal way by it's own approach after establishing the perfect data collection system. Two methods can be used when data collection system in not perfect: information person can be retained who can fill in the table item by

item according to required collection contents, feed back at regular time; assigned person by information system collects information on the spot according to pre-established plan. These two methods have the same effect.

3.4 Quality of Data Collection

The quality and quantity of the data has large effect on data analysis, the more large data, the more real the results from statistics.

Quality and quantity requirement are very important in the data collection process of the electric fuzes. At first, data collection should reflect the reality: recorded data should embody the real condition of the electric fuzes, especially for the failure production, failure time, reason, mode, effect of the products should be recorded definitely. Secondly, the continuity of the data, reliable data has the characteristic of retroaction, reflect the tendency of the products reliability, so continual data records are required, primarily the beginning, failure occurrence, discontinuance time and the description of the failure condition, repair, rejection are important data. Thirdly, the completeness of the data, recorded data should possibly be complete to assess the reliability of the electric fuzes using sufficiently data and to better establish monitoring measures of the products.

4 Establishment of Reliable Database

Reliability database of the electric fuze is an important approach to standardize reliability data, Reliability database of the electric fuze with reporting forms, inquiring, counting, opening, saving quickly which applies MIS system can be established to administrate scientifically data and to offer particular data criterion for calculating quantificationally and to offer reliability design reference platform for scientific researchers of the electric fuze. It has very important meaning.

Database of pre-launching cycle, in-launching cycle, within safety distance and operating period should be established at first according to using phases of the electric fuze when reliable database is established, the safety of the ammunition is primarily considered pre-launching cycle, in-launching cycle, within safety distance, but the reliability of the ammunition is primarily considered operating period, component database of fuze, charge pellet, launching charge, tube, ignition tools etc. are secondly established according to the composition of the electric fuze. Analogy in turn, to parts and components, failure data is filled in according to the failure modes of the parts and components. Reliability database will be gradually enriched and complete at each using process of the electric fuze.

5 Analysis of Reliable Database

5.1 Determinant Criterion of Failure Data

Failure data is the description of the failure modes of the electric fuze, following examples are confined in non-functioning required: one or some parameter can't maintain between the upper and lower limits, structural parts, components groupware

become fracture and rupture in working conditions. Failure criterion is determined according to concrete characteristics of the electric fuze, at the same time related and non-related failure should be distinguished. Non-related failure data will not be considered because non-related failure happens in the not-required condition.

Data should be classified, analyzed, disposed after determinant criterion is determined. Coefficients (weights) are respectively given and basic value ranges are given to affairs to operate easily for the users according to the characteristics of the parts and components structure, function, and technology.

5.2 Reliable Data Analysis

Reliability analysis is aimed to the failure of the products, products failure is resulted from the disfigurement and function of the products, of course, sometimes by man. Failure analysis is to find the failure mode, failure reason, and possible effect by failure to the products and sub-system which can find the improving measures.

Reliability data analysis of the electric fuzes has primary and secondary and life-span distribution analytical method. The first method is to find the biggest factor of the electric fuze failure using statistics, we can analyze from failure frequency, reason, effect, time to electric fuzes, frequency which have effects on the failure of the electric fuzes is arranged from big to small, from the electric fuze to sub-system, components, parts step by step. Safety factors are prior to reliability ones in analysis. The second method is to find life distribution law of the products from statistics of the electric fuzes, it is compared with failure phenomena to determine the rationality of the life distribution, it can also forecast the failure of the products from its law and offer theoretical criterion for reliability increase of the electric fuzes.

5.3 Failure Analysis Using Primary and Secondary Diagram

The failure analysis of the electric fuzes can adopt the primary and secondary diagram, it is also called Ballet and arrange diagram. It is a intuitionictic diagram by finding the primary factor, these factors are arranged as horizontal axis from the left to the right, accounted and cumulated percent of each factor are arranged as vertical axis, the primary and secondary failure reason will be got from the figure.

Failure frequency is analyzed using the primary and secondary by some fuze, so the key components affecting reliability can be found.

Fig.1 is the primary and secondary diagram of the primary components which have influence on some fuze, Fig2 is the primary and secondary diagram of higher failure frequency components. We can see that engine is the primary component which has influence on the reliability of some fuze, and safety component is also an important factor. From Fig.1. we can also get comparing Fig1 with Fig.2 that electrical source is the core component affecting the normal function of the fuze, but failure frequency is very low; whereas safety structure is the key component with failure frequency highest and affecting reliability; low-frequency is second component in the arrange of the failure frequency. The conclusion is different from the different primary and secondary analysis.

So far, reliable data collection and analysis of the electric fuze is completed.

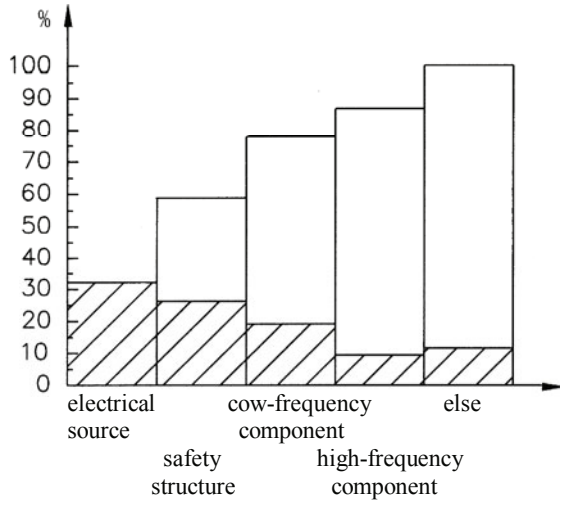


Fig. 1. The primary components array diagram which can function normally of some fuze

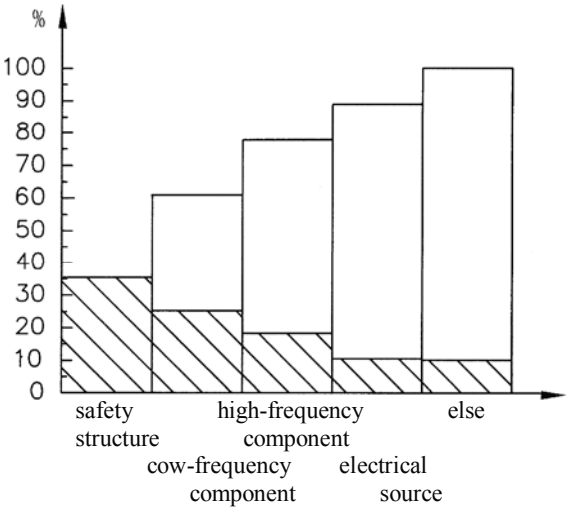


Fig. 2. Failure frequency arrange diagram of the primary components of some fuze

6 Conclusion

The electric fuze reliability has the priority in the quality of the modern weapons equipments, the collection and analytical technology of the electric fuze is a basic work. It has been shown that the weak link of the electric fuze reliability can be found through the collection and analysis of the reliable data, it has important meaning to increase the safety and reliability of the electric fuze through the improvement of the concrete problems.

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Application on Internet of Things Technology Using in Library Management

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Abstract. Following the computer, Internet and mobile communication network, the Internet of Things (IOT) will bring a new development of information industry, and moreover is a global technology revolution that is bound to have a profound impact on the economic development and social life. This paper analyzes the key technology and working principle of IOT, its development at home and abroad, its application in the library management, and proposes its development direction in the field of library management and promotion programs.

Keywords: RFID technology, library management, Internet of Things (IOT), electric tag.

1 Introduction

Currently, the applications of information technology have a great impact on all aspects of people's social life. The field of school library also faces new challenges and opportunities for development. Especially in recent years, the Internet of Things rise quietly, which will absolutely bring about the next information technology revolution, just as the Internet was. Some experts assert that: once a micro sense is embedded in whatever objects such as watches, keys, trains, automobiles, buildings, the object can "talk" automatically. With wireless network technology, people can "talk" directly with objects, and objects can "communicate" with each other at any time.

2 What Is Internet of Things (IOT)

Internet of things (IOT), known as the Internet of objects, refers to the networked interconnection of every object, which is composed of all kinds of information sensing devices, such as radio frequency identification (RFID) devices, infrared sensors, global positioning systems, laser scanners and various other devices. When embedded with chips and sensors, these objects can "think", "feel", and "talk" with each other. Together with the infrastructure of the Internet and mobile networks, these objects can communicate with humans, and enable us to monitor and control them anytime

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 391–395, 2011.
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anywhere and enjoy their intelligent service, making the idea of a "Smart Planet" a dream come true. It is described as a self-configuring wireless network of sensors whose purpose would be to interconnect all things. The concept is attributed to the former Auto-ID Center, founded in 1999, based at the time at the Massachusetts Institute of Technology (MIT). Its original definition is very simple: connects all kinds of objects through radio frequency identification and other sensor equipment to the Internet, to achieve intelligent identification and management. In 2005, in Tunis World Summit on the Information Society (WSIS), the International Telecommunication Union (ITU) formally proposed the "Internet of Things".

3 Working Principle and Key Technologies of Internet of Things (IOT)

“Internet of things” is based on network technology, in which RFID (Radio Frequency Identification) tag technology is the key Technology. RFID system generally consists of the following two components: electronic tags and readers. Electronic tags can be attached to objects to be identified while readers can read or read / write, which depends on the memory structure and technology. Main modules are integrated into a single chip, complete communication with readers. With embedded EEPROM, chip can store the identification codes or other data. EEPROM capacity changes from a few bits to tens of thousands bits. Just connecting the external antenna (and batteries), the chip can serve as a personal identification card or identification card of goods. Electronic tags have many advantages, such as non-contact, long working distance, being suitable for harsh environments, identifying moving targets, etc. In most RFID systems, the reader sends out electromagnetic waves within a region (which depends on the operating frequency and antenna size), while electronic tag has a LC series resonant circuit and its frequency is same with the transmitting frequency of the reader. When the electronic tag passes through the region, with the excitation of electromagnetic waves, LC resonant circuit resonates, so that the capacitor has been charged. On the other end of the capacitor, there is a single-direction electronic pump, which transmits this capacitor charge to another capacitor. When the accumulated charge reaches a certain value, this capacitor can be used as power supply voltage provided to other circuits, so electronic tag data can be transmitted or accept the reader data. When reader receives the RFID data, decoding and error checking are carried out to determine the validity of data, then, to transfer data wirelessly to a computer network. The basic working principle of RFID technology is not complicated. When the tag enters the magnetic field, it begins to accept the RF signal emitted from readers, and send out the product information stored in the chip by the energy obtained from induced current. Reader reads the information and decodes, then sent to the relevant central data processing information systems.

The Internet of things should encode 50 to 100,000 billion objects and follow the movement of those objects. Each person is surrounded by 1,000 to 5,000 objects.

4 Development Status of Internet of Things (IOT)

The IOT is likely to have a staggering impact on our daily lives and become an inherent part of areas such as electricity, transportation, industrial control, retail, utilities management, healthcare, water resources management, and petroleum. It can greatly improve productivity and our lives. Unsurprisingly, its great market potential is attracting investments from governments, telecom operators, manufacturers, and industry users.

Western developed countries attach great importance to IOT, and make it an important part of future development. The United States will make micro-nano sensor technology as critical technologies in economic prosperity and national security. The "wisdom of the Earth" program, with IOT application as its core, also received positive response and support from the administration. Their economic stimulus package will invest 11 billion U.S. dollars for the smart grid and related projects. The European Union published fourteen points plan of action including develop standard, research projects, pilot projects, management and international dialogue in June 2009. Japan's U-Japan plan regards IOT as one of four key strategies. South Korea's IT839 strategy regards the USN as one of the three infrastructures. Besides these, Singapore's "Next Generation I-Hub" plan, Taiwan's U-Taiwan plan, all regard the IOT as an important strategic objective to develop.

China is speeding up on development of "IOT", making it a new engine for economic growth and an opportunity to catch up with the developed countries.

The ambitious project involves several research institutes, including Shanghai Institute of Micro-system and Information Technology (SIMIT), Chinese Academy of Sciences (CAS), Nanjing University of Aeronautics and Astronautics, Northwestern Polytechnic University of China, with strong support from Chinese government. Researchers reveal that they have made certain achievements in the research.

"Internet of Things" is a number of technologies and research disciplines that enable the Internet to reach out into the real world of physical objects. Technologies like RFID (Radio Frequency Identification Device), short-range wireless communications, real-time localization and sensor networks are now becoming increasingly common, bringing the Internet of Things into commercial use. They foreshadow an exciting future that closely interlinks the physical world and cyberspace - a development that is not only relevant to researchers, but to corporations and individuals alike.

5 Internet of Things (IOT) in the Library

Presently, nearly 100 organizations in more than 10 countries like Singapore, Australia, India, Netherlands and Malaysia have been using RFID technology in the library automated management system.

Singapore National Library is the first to implement the "radio frequency identification" (RFID) system in the world. The library has a RFID tag on each book. In Singapore National Library, to borrow and return books are self-help. When borrowing books, you only insert the ID card or library card into the reader, and then put the books you borrow on the scanner to scan. To return book is even simpler. Just drop the book into the mouth for returning books. Equipment will send the book automatically

to the stack room. Similarly, with scanning device, staff can quickly know the type and location of the book to be sorted.

Because each book has a label at the back cover, metal coil affixed to the label has stored basic information about the book, the scanner will send a weak radio wave coil, then the coil will give feedback to the scanner. In this way, information can be exchanged and identified instantly. In China, the new library officially opened at July 2006 in Shenzhen is China's largest RFID project and the first full use of RFID equipment. From literature, interviews, sorting to cataloging, processing, distribution, collection and reader card, RFID tags and readers have completely replaced the original bar code, magnetic stripe and other traditional equipments. The application of RFID technology in Shenzhen Library involves three aspects: first, the introduction of RFID technology and equipment; second, innovative application in library operations, such as digital library systems interfaces, compatibility and extending application; third, independent and innovative development of shelf labeling and document navigation, which have been already put into application. These applications and innovations can resolve the common problems in the library development and operations, showing a broad prospect for the popularity of RFID applications in libraries.

6 The Broad Prospects of IOT Used in the School Library Management

Library management is an important aspect of IOT technology. Although most libraries have adopted bar code recognition, computer networks, computer software and other modern management and technology, there are still many problems for the library staff. For example, self-service borrowing and returning books, quick inventory, organize books disordered and other issues are still not well resolved, hindering the library to further improve its management and service level. To apply the IOT technology in library management can solve the above problems.

1) Self-help borrowing / returning books. By using self-service subsystem of RFID technology, people no longer need to open the title page and scan the button bar of each book, can borrow / return more books, complete the process automatically, simplifying borrowing / returning procedure, will greatly improve working efficiency. Because RFID self-service machine can work 24 hours with no staff, this technology will greatly enhance the library services and book circulation efficiency.
2) The formation of the reader circle. Books, shelves and borrowing information can be stored in the electronic tag, which will integrate RFID technology into existing central library systems. Tag can not be easily damaged and has dirt-resistance, will not affect the efficiency of borrowing and returning books. Also, according to the storage capacity of electronic tags, electronic tags can also store other information, such as previous borrower information, review of books, and other similar books to help readers assess the book and can set up a book "Readers Circle", for more reference information.
3) To find books fast. There are mobile search and fixed search. Mobile search is to input the search information of multiple books into the handheld RFID terminal to find the related information. Fixed search is to search for books by RFID

readers, the computer and wireless LAN connections. With the use of RFID wireless location technology, you can quickly find the specific location of books in the library, thus avoiding "wrong frame" — books can be retrieved, but can not be found.

4) To complete long-distance, rapid, bulk and accurate inventory of books. At the same time, IOT can improve inventory efficiency, reduce the workload caused by the handling books, achieve graphical user interface management, data download, pre-alarm function, fully showing the great advantages of the RFID technology.
5) To achieve book theft detection. You can detect books security through automatically detecting software installed on the computer. Its hardware includes RFID circuits, sound and light alarm, and security door type antenna. It can have functions as long-distance recognition (generally up to 2 meters), quick recognition, sound and light alarm, zero false report.
6) The use of RFID technology enables activation of second-generation ID card as library card to use library services at any time, without worrying about whether they carry reader cards or not and is more convenient, safer, more reliable and easier to manage.

7 Conclusion

Although IOT has just started and its key technology is still at the exploratory stage, its momentum is great. At present, the "Long-term Scientific and Technological Development (2006-2020)" has regarded this as a priority research area, and mastered a large number of key technologies, getting speech rights for making international standards. Its application in the field of library management has also won initial success. In the near future, people in China will absolutely notice the profound changes brought about by IOT at any time and anywhere in the field of library management.

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Observability of Multi-rate Networked Control Systems with Short Time Delay

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Abstract. Feedback control systems wherein the control loops are closed through a real-time network are called networked control systems. Multi-rate networked control systems mean the sampling rates of notes in networked control systems are not the same.The observability of multi-rate networked control systems are investigated in this paper for the first time. Based on the mathematic model of multi-rate networked control systems with short time delay, some sufficient or necessary conditions for observability of multi-rate networked control systems are presented using stochastic systems approach.

Keywords: Multi-rate networked control systems, time-driven, observability.

1 Introduction

In complex dynamic processes, using computer networks may be the only efficient and reliable way for communication among distributed control components. Instead of utilizing messy point-to-point hardware, a multiplex network produces a clear way coordinate different components. The defining feature of an networked control systems (NCS) is that information (reference input, plant output, control input, etc) is exchanged using a network among control system components (sensors, controller, actuators etc.). The primary advantages of an NCS are reduced system wiring, ease of system diagnosis and maintenance, lower cost and greater flexibility [1-2].

Recently, NCS has been a hot research topic, and has attracted much research interests. Many new problems such as network-induced delays, packet dropouts, data packet disorder and data-rate constraints have emerged and become a topic of significant interest to the control community. Among these problems, network-induced delay is of prior importance, and is usually the major causes of the deterioration of system dynamic performance and potential system instability. Many efficient approaches, such as queue approach [3], stochastic systems approach [4-6], model predictive control approach [7-8], delay-dependent approach [9-10], sampled-data approach [11-12], and hybrid systems approach [13-14], have been presented in the literature to deal with the delay issue.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 396–401, 2011.
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The observability of a system is the basic question of a system. The observability of a system was investigated by some researchers [15]. But it is worth pointing out that the observability of single-rate networked control systems only is reported in [16,17]. Switched system approaches are used to analyze the observability of single-rate NCS in [16]. Stochastic system approaches are used to analyze the observability of single-rate NCS in [17]. To the best of our knowledge, the observability of multi-rate NCS has not been reported in the literature. In this paper, the sufficient or necessary conditions for observability of multi-rate NCS are presented for the first time.

2 Problem Statement

It is assumed that the controlled process is linear time-invariant system, which can be expressed as

$$\begin{cases} \dot{x}(t) = A^c x(t) + B^c u(t) + v(t) \\ y(t) = C^c x(t) + w(t) \end{cases} \tag{1}$$

where $x(t) \in R^n, u(t) \in R^m, v(t) \in R^n, w(t) \in R^q$ and $y(t) \in R^q$. $A, B, C, v(t)$ and $w(t)$ are matrices of appropriate sizes, $v(t)$ and $w(t)$ are white noise with zero mean. The sampling period of sensor is noted as T_s, the sampling periods of controller and actuator are the same and noted as T_c. $T_c = T_s / N$ and N is a positive integer not less than 2. That is to say, the controller and actuator have a higher sampling period than the sensor.

For convenience of investigation, we make the following rational assumptions:

1.Sensor, controller and actuator are all time-driven.

2.The network-induced delay τ^k is shorter than a sampling period of sensor and has a known probability distribution function.

3.Statistics of plant disturbances and sensor noise are independent of those of network-induced delay.

4. The initial state of the system is deterministic.

5. $E(v_i v_j^T) = R_1 \delta_{ij}, E(w_i w_j^T) = R_2 \delta_{ij}, R_1 > 0, R_2 \geq 0$, $\delta_{ij} = 1$ when $i = j$, $\delta_{ij} = 0$ when $i \neq j$.

From the assumption 1 and 2, we know $\tau^k = h_k T_c$ (h_k is a positive integer and $1 \leq h_k < N$). Integration of (1) over a sampling interval $[kT_s, (k+1)T_s)$ gives

$$x_{k+1} = Ax_k + \begin{bmatrix} B_{N-h+1} & \cdots & B_N & B_1 & \cdots & B_{N-h} \end{bmatrix} \begin{bmatrix} u_{k-1} \\ \vdots \\ u_{k-1} \\ u_k \\ \vdots \\ u_k \end{bmatrix} + v_k$$

$$= Ax_k + \Gamma_{0k}u_k + \Gamma_{1k}u_{k-1} + v_k \tag{2}$$

$y_k = Cx_k + w_k$

where

$$\Gamma_{0k} = \sum_{i=1}^{N-h_k} B_i, \Gamma_{1k} = \sum_{i=N-h_k+1}^{N} B_i, B_i = \int_{(i-1)T_c}^{iT_c} e^{A^c s} B^c ds\ ,\ x_k = x(kT_s) \tag{3a}$$

$$x_k = x(kT_s), y_k = y(kT_s), A = e^{A^c T_s}, C = C^c \tag{3b}$$

$$v_k = \int_{kT_s}^{(k+1)T_s} e^{A^c[(k+1)T_s - s]} v(s)ds, w_k = w(kT_s), u_k = u(kT_s) \tag{4}$$

In system (2) we introduce a new state variable $z_k^T = \begin{bmatrix} x_k^T & u_{k-1}^T \end{bmatrix}^T \in R^{n+m}$, and then the system (2) can be expressed as follows

$$\begin{cases} z_{k+1} = \Phi_k z_k + \Gamma_k u_k + Hv_k \\ y_k = C_0 z_k + w_k \end{cases} \tag{5}$$

where

$$\Phi_k = \begin{bmatrix} A & \Gamma_{1k} \\ 0 & 0 \end{bmatrix}, \Gamma_k = \begin{bmatrix} \Gamma_{0k} \\ I \end{bmatrix}, H = \begin{bmatrix} I \\ 0 \end{bmatrix}, C_0 = \begin{bmatrix} C & 0 \end{bmatrix} \tag{6}$$

It is assumed that $u_k = -L_k z_k$ and L_k is a deterministic matrix, and then system (6) can be expressed as follows

$$\begin{cases} z_{k+1} = (\Phi_k - \Gamma_k L_k) z_k + Hv_k = \Psi_{L,k} z_k + Hv_k \\ y_k = C_0 z_k + w_k \end{cases} \tag{7}$$

where $\Psi_{L,k} = \Phi_k - \Gamma_k L_k$

The initial state of the system is deterministic from the assumption 4. As L_k is a deterministic matrix, so matrix Φ_k, Γ_k and v_k are all independent of $z_j, j \le k$. Matrix $\Psi_{L,k}$ is independent of $z_j, j \le k$ too. And because $\{\tau^k\}$ is an independent sequence with the same statistics, so $\{\Phi_k\}$ and $\{\Gamma_k\}$ are all independent sequence with the same statistics from the definition of $\{\Phi_k\}$ and $\{\Gamma_k\}$.

3 The Observability of NCS

The sufficient or necessary conditions for observability of multi-rate NCS will now be derived. Similar to definitions in [15,18], the following definitions for multi-rate NCS can be given.

Definition 1. For multi-rate networked control systems (5), (Φ_k, C_0) is called mean value observable if $\exists k \ni Ey_i = 0, i = 0,1,\cdots k-1 \Rightarrow z_0 = 0$.

Definition 2. For multi-rate networked control systems (5), (Φ_k, C_0) is called mean square observable if $\exists k \ni E(\| y_i \|^2) = 0, i = 0,1,\cdots k-1 \Rightarrow z_0 = 0$.

Now we give the main results of this paper.

Theorem 1. (Φ_k, C_0) is mean value observable $\Leftrightarrow$

$\exists k \ni$ rank of $\begin{bmatrix} C_0^T & (E\Phi)^T C_0^T & \cdots & ((E\Phi)^{k-1})^T C_0^T \end{bmatrix}$ is n $\Leftrightarrow (A_s, C)$ is mean value observable.

Proof. For system (5), using the assumption 4 we obtain

$$E(y_i) = E(C_0 z_i + w_i) = C_0 E(\Phi_{i-1} z_{i-1}) = C_0 (E(\Phi))^i z_0$$

then

$E(y_i) = 0, i = 0,1,\cdots k-1 \Leftrightarrow \begin{bmatrix} C_0^T & (E\Phi)^T C_0^T & \cdots & ((E\Phi)^{k-1})^T C_0^T \end{bmatrix} z_0 = 0$,as $u_{-1} = 0$, the last equation implies $z_0 = 0 \Leftrightarrow$

rank of $\begin{bmatrix} C_0^T & (E\Phi)^T C_0^T & \cdots & ((E\Phi)^{k-1})^T C_0^T \end{bmatrix}$ is n, we know $z_0 = 0 \Leftrightarrow x_0 = 0$, the proof is completed.

To describe the mean square behavior of z_i, one needs the transformation $\varsigma_L : M^{n+m} \to M^{n+m}$ defined by $\varsigma_L X = E\{\Psi_{L,0}^T X \Psi_{L,0}\}, X \in M^{n+m}$ [15].

Lemma 1. $E(z_i^T X z_i) = z_0^T \varsigma_L^i X z_0 + \sum_{j=0}^{i} tr[(\varsigma_L^j X)^{11} R_1]$.

Proof. As $\Psi_{L,k} = \Phi_k - \Gamma_k L_k$ and L_k is deterministic, $\{\Phi_k\}$ and $\{\Gamma_k\}$ are all independent sequence with the same statistics, we obtain

$$\begin{aligned}
E\{\Psi_{L,k}^T X \Psi_{L,k}\} &= E\{\Psi_{L,0}^T X \Psi_{L,0}\} \\
E(z_i^T X z_i) &= E\{(\Psi_{L,i-1} z_{i-1} + H v_{i-1})^T X (\Psi_{L,i-1} z_{i-1} + H v_{i-1})\} \\
&= E\{z_{i-1}^T \Psi_{L,i-1}^T X \Psi_{L,i-1} z_{i-1}\} + E\{v_{i-1}^T H^T X H v_{i-1}\} \\
&= E\{z_{i-1}^T E(\Psi_{L,i-1}^T X \Psi_{L,i-1}) z_{i-1}\} + tr(X^{11} R_1) \\
&= E\{z_{i-1}^T E(\Psi_{L,i-1}^T X \Psi_{L,i-1}) z_{i-1}\} + tr(X^{11} R_1) \\
&= E\{z_{i-2}^T \varsigma_L^2 X z_{i-2}\} + tr[(\varsigma_L X)^{11} R_1] + tr(X^{11} R_1) \\
&= z_0^T \varsigma_L^i X z_0 + \sum_{j=0}^{i} tr[(\varsigma_L^j X)^{11} R_1]
\end{aligned}$$

Proof is completed.

Theorem 2. For multi-rate networked control system (5), (Φ_k, C_0) is mean square observable $\Leftrightarrow$

$$z_0^T(\sum_{i=0}^{k-1}\varsigma_0^i C_0^T C_0)z_0 + \sum_{i=0}^{k-1}\sum_{j=0}^{i}[tr(\varsigma_0^j C_0^T C_0)^{11} R_1] + k(trR_2) = 0$$

Proof. From lemma 1 with $X = C_0^T C_0$ and using ς_L with $L = 0$

$$E(\| y_i \|^2) = E(y_i^T y_i) = E(z_i^T C_0^T C_0 z_i) + trR_2$$
$$= z_0^T[\varsigma_0^i (C_0^T C_0)]z_0 + \sum_{j=0}^{i} tr[(\varsigma_0^j C_0^T C_0)^{11} R_1] + trR_2$$

$$E(\| y_i \|^2) = 0, i = 0,1,...k-1 \Leftrightarrow \sum_{i=0}^{k-1} E(\| y_i \|^2) = 0$$
$$\Leftrightarrow z_0^T\{\sum_{i=0}^{k-1}[\varsigma_0^i (C_0^T C_0)]\}z_0 + \sum_{i=0}^{k-1}\sum_{j=0}^{i}[tr(\varsigma_0^j C_0^T C_0)^{11} R_1] + k(trR_2) = 0$$

Proof is completed.

4 Conclusions and Future Work

In this paper, the observability of multi-rate networked control systems are investigated for the first time. Based on the mathematic model of multi-rate networked control systems with short time delay, some sufficient or necessary conditions for observability of multi-rate networked control systems are presented. But the results of this paper only work for multi-rate NCS with short time delay. The observability of multi-rate NCS with long time delay and data packet dropout will be investigated in the future.

Acknowledgments. This work was partly supported by National Nature Science Foundation of China (60964004,60864004,60804066,60904049), the High Technology Research and Development Program of China (2008AA04Z129), China Postdoctoral Science Foundation (20100480131), Young Scientist Raise Object Foundation of Jiangxi Province, China (2010DQ01700), Science and Technology Support Project Plan of Jiangxi Province, China (2010BGB00607), Natural Science Foundation of Jiangxi Province, China (2009GZS0014, 2009GZS0016, 2010GZC0118), and Scientific Research Foundation of Jiangxi Provincial Education Department, China(GJJ10456, GJJ11558).

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A Hybrid TDOA/RSS Localization Algorithm Based on UWB Ranging in Underground Mines

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Abstract. Ultra-Wideband technology is regarded by many as one of the future key technologies in communications and positioning. In this paper a TDOA/RSS hybrid positioning algorithm is described for accurate underground mine localization of a sensor in a network of known beacons. The sensor measures the range to the beacons using an Ultra-Wideband (UWB) signal and uses statistical inference to correct for the error due to multipath and NLOS in underground mine. It shows that a TDOA/RSS algorithm can be used to improved positioning accuracy over beacon measurement. Simulation results show perfect performance with UWB ranging and TDOA/RSS hybrid localization algorithm.

Keywords: UWB, TDOA/RSS, localization algorithm, underground mine.

1 Introduction

Mine safety management is a complicated systematic engineering, its managed object is the environment, machinery, equipment, products, raw materials and related integrated systems. Its function is to protect the person and production in harsh environments. Therefore, in the underground mine we set up a wireless communication network using a suitable wireless communications technology and to complete real-time communication and positioning is very important.

UWB is a wireless technology used in the last decades to transmit digital data for military purposes, and more recently also used for civil communications. A UWB signal is characterized by its very large bandwidth compared to the conventional narrowband systems. UWB works by transmitting a radio signal over a wide band between 3.1 and 10.6 GHz, by means of short pulses. Since the duration of pulses is in the order of nanoseconds and they are usually spread over a wide spectrum, the energy of each transmitted pulse is very low. Hence, UWB can be considered as a safe system for wireless transmission and can coexist, theoretically without interference, with other radio communication technologies [1].

As a result, UWB is capable of achieving high-resolution ranging, as well as high-speed data transmission. The basic concept is to communicate using very bandwidth signals which spread the signal energy over frequency and time. Since UWB signals have extremely wide bandwidth, the signals can provide very precise distance

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 402–407, 2011.
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measurement as long as the transmitter and receiver are synchronized. The characteristics of the UWB signal transmission provide this technology with a high material penetrability, making it suitable for indoor applications [2, 3, 4].

2 UWB Localization Approaches

2.1 Angle of Arrival (AOA)

In the concept of AOA, the location of an object is determined from the measured angles to fixed reference node. One or multiple sensors on the object to be located capture the direction from which a signal emitted by a reference node originates. The exact locations of the reference nodes are known a priori, so that the object's position can be calculated from the angles to multiple reference nodes. Commonly, antenna arrays are employed in order to measure the AOA of a signal. The angle information is obtained at an antenna array by measuring the differences in arrival times of an incoming signal at different antenna elements. The physical techniques for angular measurements are rather complex.

2.2 Time of Arrival (TOA)/Time Difference of Arrival (TDOA)

The TOA/TDOA localization is illustrated in Figure 1. Let A,B,C be the reference node and X be the target node. The geometric relationship turns into a hyperbola in TDOA method, and with two reference nodes as the foci. Conventionally, TOA-based range measurements require synchronization among the target and the reference nodes. However, TDOA measurements can be obtained even in the absence of synchronization between the target node and the reference nodes, if there is synchronization among the reference nodes [4].



Fig. 1. Localization sketch of TOA (a) and TDOA (b)

One way to obtain a TDOA measurement is to estimate TOA at each reference node and then to obtain the difference between the two estimates. The TDOA measurement can be obtained as

$$\hat{\tau}_{TDOA} = \hat{\tau}_1 - \hat{\tau}_2 \tag{1}$$

where $\hat{\tau}_1$ and $\hat{\tau}_2$ denote the TOA estimates at the first and second nodes, respectively.

Another way to obtain a TDOA measurement is to perform cross-correlations of the received signals $r_1(t)$ and $r_2(t)$, and to calculate the delay corresponding to the largest cross-correlation value.

In the case of TDOA-based positioning, each TDOA measurement determines a hyperbola for the position of the target node. For a few reference nodes, two range differences (obtained from TDOA measurements) can be expressed as follows:

$$d_{ij} = ct_{ij} = \sqrt{(x - X_i)^2 + (y - Y_i)^2} - \sqrt{(x - X_j)^2 + (y - Y_j)^2} \tag{2}$$

Here, c stand for the propagation speed of signal, t_{ij} is time difference from two reference nodes to target node, for i, j =1,2, 3,..., N, $i \neq j$.

2.3 Received Signal Strength (RSS)

The main idea behind an RSS-based approach is that if the relation between distance and power loss is known, the RSS measurement at a node can be used to estimate the distance between that node and the transmitting node, assuming that the transmit power is known[4].

A UWB signal experiences multipath (small-scale) fading, shadowing and PL while traveling from one node to another. Ideally, average RSS(equivalently, power) over a sufficiently long time interval would exclude the effects of multipath fading and shadowing, and would result in the following model

$$\overline{P}(d) = P_0 - 10n \log_{10}(d / d_0) \tag{3}$$

where n is the path loss exponent, $\overline{P}(d)$ is the average received power (dB) at a distance d and P_0 is the received power (dB) at a reference distance d_0.

However, the shadowing effects are usually present in the received power $P(d)$, which are modeled as log-normal random variables with mean $\overline{P}(d)$ given by (3) and variance σ_{sh}^2 i.e.

$$10 \log 10 P(d) \sim N(\overline{P}(d), \sigma_{sh}^2) \tag{4}$$

3 Position Principle and Method in Underground Mines

3.1 Position Principle in Underground Mines

Mines may run many kilometers underground, making the access to various locations time consuming and difficult [5]. The requirements for localization in a mine relate to people and machines as well. The way the galleries are interconnected induces a natural hierarchical structure taking into account the organization of the mine. In the case of machinery, for some applications, the ideal solution would be to locate them with great precisions in order to make remote control by radio possible. In this case, UWB based localization could be appropriate for an underground mine application, because of the great precision of this type of technology and the robustness of UWB communication systems in underground mine.

A typical setup for UWB-based positioning consists of a number of fixed transceivers, or beacons, placed at known locations in the environment and a mobile transceiver on-board the mobile object. Assuming that the known beacon positions are error-free, the position of a mobile object or a person can be estimated by triangulation with an accuracy only related to that of the range measurements as show in fig.2.

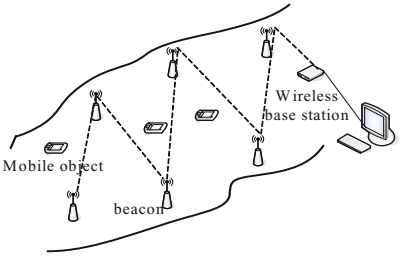


Fig. 2. Wireless network distribution instruction in underground mine

3.2 TDOA/RSS Hybrid Algorithm

Instead of performing a single measurement such as AOA or TOA, a node can estimate a combination of position-related parameters. Such hybrid schemes can provide more accurate information about the position of the target node than the schemes that estimate a single position parameter. For the TOA /AOA localization method, the two nodes must have a common clock, or they must exchange timing information via certain protocols, meanwhile, the antenna array and beamforming technique used in AOA leads to high complexity in positioning devices. So the TOA/AOA localization algorithm is not a good method in underground mines.

Accord to cost of the device and accuracy requirements, we propose a hybrid TDOA/RSS location algorithm, which has at least two advantage. Firstly, TDOA measurements can be obtained in the absence of synchronization between the target node and the reference nodes, if there is synchronization among the reference nodes. Secondly, in the known the transmitter power, the receiver only measure the received signal power, this can be easily attained in the modern communication system. We can calculate the distance between the receiver node and the transmitter node based on the known path loss model. However, RSS measurements cannot provide very accurate range estimates for UWB systems. Owing to low cost, as an auxiliary positioning means, RSS is the appropriate method.

In the light of TDOA measurement methods, we can infer the equation as follows

$$r_i = \sqrt{(X_i - x)^2 + (Y_i - y)^2} \tag{5}$$

$$r_{i,1} = r_i - r_1 = \sqrt{(X_i - x)^2 + (Y_i - y)^2} - \sqrt{(X_1 - x)^2 + (Y_1 - y)^2} \tag{6}$$

Using these two basic equations, we get the following formula

$$r_{i,1}^2 + 2r_{i,1}r_1 = K_i - 2X_{i,1}x - 2Y_{i,1}Y - K_1 \tag{7}$$

Here $K_i = X_i^2 + Y_i^2$, simplify the above equation

$$X_{i,1}x + Y_{i,1}y + r_{i,1}r_1 = \tfrac{1}{2}(K_i - K_1 - r_{i,1}^2) \tag{8}$$

x, y, r_1 are unknown variable, then $K_i, K_1, r_{i,1}$ are given constant, the equation(8) is linear .

In the light of RSS measurement methods, we can also infer the equation as follows

$$X_j x + Y_j y + \tfrac{1}{2}r^2 = L \tag{9}$$

Here $r = \sqrt{x^2 + y^2}$ x, y, r^2 are unknown variable, then L are constant about the transmitter power and receiver power, the equation (9) is linear about x, y, r^2.

We combine equations (8) and equation (9), solved equations with redundant, then average the *x, y* value with weight w_k , therefore, the average *x, y* are follows

$$\overline{S} = \sum_{k=1}^{M} w_k S_k, k = 1, 2, \ldots \tag{10}$$

where $S_k = [x_k, y_k]^T$ and $\overline{S} = [\overline{x}, \overline{y}]^T$ are the vectors which define the solver of different equation (8) and (9) and the estimate value of the target node position respectively.

We describe our simulation and then compare the results for two different cases. We had attained UWB signal data for three simulated beacon. In order to analysis location performance of particle filter, we compared with TDOA/RSS hybrid algorithm and general TDOA algorithm. As can be seen from fig.3 and fig.4, localization accuracy of TDOA/RSS is superior to general TDOA and Localization standard deviation of TDOA/RSS hybrid algorithm is smaller than general TDOA.

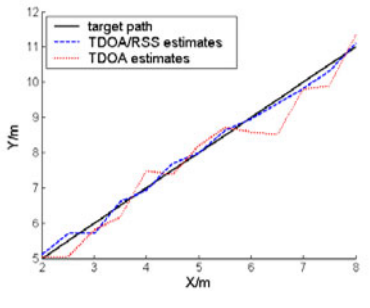


Fig. 3. Localization accuracy of TDOA/RSS and TDOA

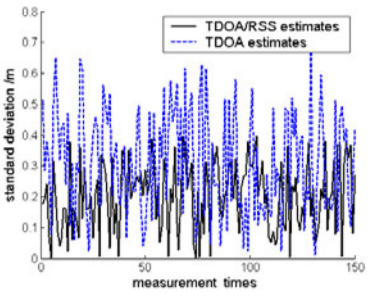


Fig. 4. Standard deviation

4 Conclusions

A method based on UWB ranging beacons has been proposed to improve underground mine geolocation. It has been shown to overcome the two main difficulties for

underground mine localization. Using UWB signals resolves problems due to multipath fading. The remaining issue (NLOS propagation) adopt TDOA/RSS hybrid positioning algorithm to improve target node localization accuracy and robustness. It showed that a TDOA/RSS hybrid positioning algorithm can be used to simultaneously estimate the position of the agent and the beacon measurement biases. We believe that this method simulation results shows the validity of our concept to provide a realistic solution to the challenge of accurate underground mine geolocation.

Acknowledgment

This work was partial supported by Scientific Research Program Funded by Shaanxi Provincial Education Commission (NO. 2010JK666) and Xi'an university of Science and Technology Research foundation (NO. 2009024). The authors would like to thank KANG Xiaofei and LI Xinmin, for their encouragement and for helpful discussions.

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Spectrum Handover Mechanism Based on Channel Scheduling in Cognitive Radio Networks

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Abstract. In this study, we address the spectrum handover mechanism for proactive-decision in cognitive radio networks. Spectrum handover occurs when the primary users suddenly appear and the secondary users are using the particular primary user's licensed channel. The proactive-sensing spectrum handover which the target channel is pre-determined. And handover avoid the sensing time, but the pre-determined target channel may not be available. So we develop a spectrum handover mechanism by using an efficient channel-scheduling algorithm to reduce disabled channel. Its basic idea is in that a new packet is scheduled by migrating some packets to other channels if none of any idle channels can accommodate it; otherwise repeating the other migrate or stay channel processes.

Keywords: Spectrum Handover, Cognitive Radio Networks, Channel Scheduling.

1 Introduction

Cognitive radio (CR) is a key technology to realize dynamic spectrum access (DSA) that enables an unlicensed user (or, secondary user) to adaptively adjust its operating parameters and exploit the spectrum which is unused by licensed users (or, primary users) in an opportunistic manner. It can improve spectrum efficiency through intelligent spectrum management technologies[1]-[3]. Cognitive radio (CR) system requires four important functionalities: (1) spectrum sensing (detecting unused spectrum); (2) spectrum management (selecting the best channel); (3) spectrum sharing (coordinating the channel access among multiple users); and (4) spectrum mobility(or called spectrum handover, switching to other available channel when a licensed user appears) [4]. One of the most important functionalities of CR networks is spectrum mobility. Compared to other functionalities (spectrum sensing, spectrum management, and spectrum sharing), spectrum mobility is less investigated in the research community. Spectrum mobility gives rise to a new type of handover called spectrum handover, which refers to the procedure that when the current channel of a CR user is no longer available, the CR user needs to pause the ongoing transmission, vacate that channel, and determine a new available channel to continue the transmission.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 408–413, 2011.
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In cognitive radio networks, spectrum handover is essential for opportunistic spectrum access. However, spectrum handover may affect the quality of service (QoS) of secondary users significantly and adversely. This is because changing frequency not only imposes a burden on the system due to signaling overhead, but may also even cause cell outage due to the difference in path loss. Therefore, it is very important that cognitive radio networks provide link maintenance for secondary users

Currently, only a few papers address the spectrum handover issue. One approach is that CR users perform spectrum switching and radio frequency (RF) front-end reconfiguration after detecting a PR user [5]–[11], namely the reactive-decision spectrum handover approach. Another approach is that CR users predict the channel availability status and perform spectrum switching and RF reconfiguration before a PR user reoccupies the channel based on previous channel usage statistics, namely the proactive-decision spectrum handover approach.

1) proactive-decision spectrum handover: make the target channels for spectrum handover ready before data transmission according to the long-term observation outcomes. In this case, secondary users periodically observe all channels to obtain the channel usage statistics, and determine the candidate set of target channels for spectrum handover according to the long-term observation outcomes [6], [7].
2) reactive-decision spectrum handover: determine the target channel according to the results from on-demand wideband sensing. In this case, the instantaneous outcomes from wideband sensing will be used to determine the target channel selection for spectrum handover [8]–[11].Although the concept of this approach is intuitive, there is a non-negligible sensing and reconfiguration delay which results in unavoidable disruptions to both the PR and CR transmissions.

Compared to the reactive-decision spectrum handover, the proactive-decision spectrum handover may be able to reduce handover delay because the time-consuming wideband sensing is not required [12]. Furthermore, it is easier to let both transmitter and receiver have a consensus on their target channel for the proactive-decision spectrum handover than for the reactive-decision spectrum sensing. Nevertheless, when the spectrum handover process is initiated, the proactive-decision spectrum handover needs to resolve the issue that the pre-selected target channel may no longer be available. Hence, one challenge for the proactive-decision handover is to determine the optimal target channels sequences to minimize percentage of disruptions and total service time.

In this paper, the main objectives are described as follows. We develop a Spectrum Handover Mechanism by using an efficient channel-scheduling algorithm to reduce disabled channel. Its basic idea is in that a new packet is scheduled by migrating some packets to other channels if none of any idle channels can accommodate it; otherwise repeating the other migrate or stay channel processes.

The rest of this paper is organized as follows. In Section 2, we perform a spectrum handover mechanism to deduce disabled channel. Next, we analysis and evaluate delay for Spectrum Handovers in Section 3. Finally, we give our concluding remarks and acknowledgements in Section 4 and Section 5, respectively.

2 Spectrum Handover Mechanism for Cognitive Radio Networks

Spectrum handover occurs when the primary users suddenly appear in the licensed channel occupied by the secondary users. In this situation, the secondary user shall immediately handover from the current channel to the target channel.

The spectrum handover mechanism has been discussed in many literature [13]–[15]. However it is not enough for spectrum efficiency to reduce spectrum hole in certain situation, where the new packet cannot be handover to any channels even though some hole intervals are wide enough to accommodate it, as illustrated in Fig. 1. So we proposed a scheduling algorithms to reduce disabled channel for new packet after migrating the scheduled packet to other available channel, as illustrated in Fig. 1.They consist of four key steps as follows.

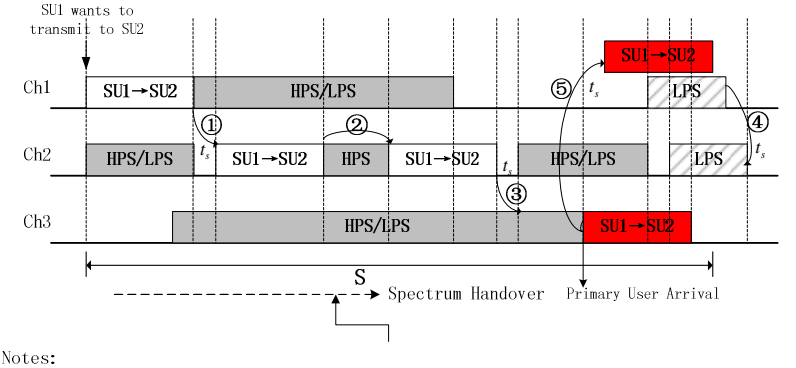


Fig. 1. Spectrum Handover Mechanism for Cognitive Radio Networks

1) Firstly, we assume the secondary users SU1 and SU2 communicate on the channel Ch1 as shown in Fig. 1. And, when primary users appear on channel Ch1, SU1 can detect this appearance event and prepare to perform spectrum handover procedure as shown in Fig. 1.
2) Furthermore, SU1 pauses its current communication within a pre-defined duration as shown in Fig. 1. It must also announce SU2 of the interruption event before another pre-defined time interval.
3) Then, SU1 and SU2 can resume its transmission on the selected target channel as shown in Figs.1. When the other channel is idle, secondary users resume their transmission by the idle target channel(*for example ① of Fig.1)*; By the contrary, secondary users come back their transmission by the busy target channel waiting for a minutes(*for example ③ of Fig.1)*; On the other hand, when choosing the target channel, the current channel can be also one

of candidates *(for example ② of Fig.1)*;When the other channel is busy, but channels is "dynamic idle" state, the other secondary user migrate the packet to "dynamic idle" channel*(for example ④ of Fig.1)*, and secondary user resumption their transmission by the new idle target channel*(for example ⑤ of Fig.1)*.

4) Finally, because a frame may be interrupted many times during its transmission duration, the similar spectrum handover procedure may be performed many times.

Note that the target channel can be selected by different target channel selection methods for spectrum handover as discussed. The different selection will lead to different handover time-delays. This literature default the target channel selection methods based on random algorithm.

3 Time-Delay Analysis for Spectrum Handovers

The handover time-delay*(denoted by TD_s)* of the interrupted user is dominated by the selected target channel. In this literature, handover time-delay is defined as the duration from the instant of pausing packet transmission until the instant of resuming the transmission.

Figure 1 shows the handover delay for different selections of target channel under a three-channel system. In this figure, HPS and LPS stands for the high-priority users *(i.e., primary users)* and the low-priority users *(i.e., secondary users)*, respectively. In general, when SU1 is interrupted by primary users, it will change its operating channel to the other channels, like Ch2. Hence, the remaining packet of SU1 will be a newly arriving secondary user of Ch2. In this situation, there are two possible cases. In case 1, if the target channel Ch2 is idle(*the other secondary user migrate the data packet from Ch1 to Ch2 channel(Fig.1④), and also considering that the target channel Ch3 is idle(Fig.1⑤).*), SU1 can immediately start transmitting(*The handover time-delay in this case is the channel switching time (denoted by t_s).*) its data packet as shown in Fig. 1(①). However, in case 2, if Ch2 is busy, SU1 needs to wait until all the other secondary users waiting for Ch2 in queue have been served as shown in Fig. 1(③). On the other hand, when choosing the target channel, the current channel (Ch2) can be also one of candidates as shown in Fig. 1(②). Hence, the remaining transmission of SU1 will be a newly arriving secondary user of Ch2. In this situation, SU1 can continue accessing the channel only after the primary users finish the transmission because it is in the head of low-priority queue. Note that the similar procedure will be applied if this secondary user is interrupted again on the selected target channel.

And so, the handover time-delay of the interrupted user(TD_s) is :

$$TD_s = \begin{cases} t_s \ , & \text{If ① or ③ is happen} \\ nt_s + \delta \ , & \text{If ② is happen} \\ 2t_s \ , & \text{If ④ and ⑤ is happen} \end{cases} \quad (1)$$

In (1), n is the numbers of t_s in staying busy channel, and $\delta \le t_s$.

4 Conclusions

In this literature, we develop a spectrum handover mechanism by using an efficient channel-scheduling algorithm to reduce disabled channel for proactive-sensing spectrum handover. This mechanism can handle the case when the interrupted secondary users need to change their operating channels, the interaction between different channels can be elaborated exactly.

Acknowledgements

This research work has been partially supported by the National Natural Science Foundation of China under grant No.60872037, the Science & Technology Research Program of the Municipal Education Commission of Chongqing of China under Grant No. KJ090506, and the Natural Science Foundation of Chongqing of China under Grant No. CSTC 2010BB2415, CSTC 2008BB2411, and the Foundation of Chongqing Key Laboratory of Computer Network and Communication Technology of China under Grant No. CY-CNCL-2010-02.

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Design of Ontology-Based Sharing Mechanism for Web Services Recommendation Learning Environment

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Abstract. The number of digital learning websites is growing as a result of advances in computer technology and new techniques in web page creation. These sites contain a wide variety of information but may be a source of confusion to learners who fail to find the information they are seeking. This has led to the concept of recommendation services to help learners acquire information and learning resources that suit their requirements. Learning content like this cannot be reused by other digital learning websites. A successful recommendation service that satisfies a certain learner must cooperate with many other digital learning objects so that it can achieve the required relevance. The study proposes using the theory of knowledge construction in ontology to make the sharing and reuse of digital learning resources possible. The learning recommendation system is accompanied by the recommendation of appropriate teaching materials to help learners enhance their learning abilities. A variety of diverse learning components scattered across the Internet can be organized through an ontological process so that learners can use information by storing, sharing, and reusing it.

1 Introduction

Rapid developments in computer technology and information networks have provided a great deal of information to the global population, and the amount of data available on websites continues to grow [1, 2]. However, contradictions in this diverse and abundant information may confuse users, who often fail to find the data they are seeking. Tools for data indexing, accessing, searching, and filtering have been developed in quick succession to address this problem [3-6]. Such tools usually have the common weakness of providing a great deal of uncorrelated information while neglecting information that is relevant [7]. Therefore, the concept of a recommender system has been proposed and implemented to make recommendations based on different sources and help users make appropriate selections that meet their information requirements.

The amount of e-learning content is steadily growing, and increasing numbers of people are beginning to obtain knowledge from e-learning platforms. The traditional teaching methods have limitations. For example, students study the same lesson content in different backgrounds and learning situations, and this may be only a part of the entire program. Most current e-learning content is composed of long web pages

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 414–419, 2011.
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without descriptions. Such learning content may not provide any particular extra benefit to the learners and is unlikely to be reused by other e-learning systems. The application of web services technology will enable e-learning systems to employ learning objects that can be reused for e-learning resource sharing. These learning objects may be provided by remote e-learning systems using XML. Web services technology will enable e-learning systems to determine the proper provider, automatically integrate web services, and use these services immediately to provide learning objects in the execution phase.

The concept of construction-based ontology knowledge in this study allows the ontological construction of subject knowledge for e-learning teaching materials, which are distributed over different learning websites, for the sharing and reuse of digital teaching materials and learning resources. This concept enables a recommender learning mechanism to recommend suitable learning materials to learners online. This enhances the learning effectiveness. Based on learning-content-oriented recommendation websites, this study incorporates the mechanism of ontology-oriented digital learning objects into an algorithm for learning resource selection with the aim of categorizing and recording web services with the same learning subjects so that one subject can be substituted for another. This avoids creating a gap between popular and unpopular web learning websites, and lends itself to the creation of a platform with shared digital resources. A variety of diverse learning components scattered across the Internet can be organized through an ontological process so that learners can use information by storing, sharing, and reusing it.

2 Web Services Recommendation Learning Environment

Learning web services are usually defined and stored by the universal description, discovery and integration (UDDI) according to classification, records and management to accelerate subsequent selections of learning web services [8]. As shown in the learning web services architecture of Figure 1, UDDI stores all jointly registered learning web services in databases, describes web services links, and defines the request and reply mechanisms. The learning service provider registers its learning services with UDDI through the web services description language (WSDL). The learning service requester then searches for available web services from the learning resource manager using WSDL. The learning service provider or the learning service requester engages in an XML information transfer to provide or request web services using the simple object access protocol (SOAP).

From a more practical perspective, different learning web services providers will have web services with the same subjects [9]. To prevent popular subjects from creating non-uniform learning web services, web service execution engines classify and record identical or similar learning web services according to a learning resource selection algorithm, and can substitute learning subjects. Therefore, each learning web service is classified according to the learning resource selection algorithm. The learning resource manager determines the learning objects contained in the network as well as the required execution costs, and selects the optimized learning web services for execution.

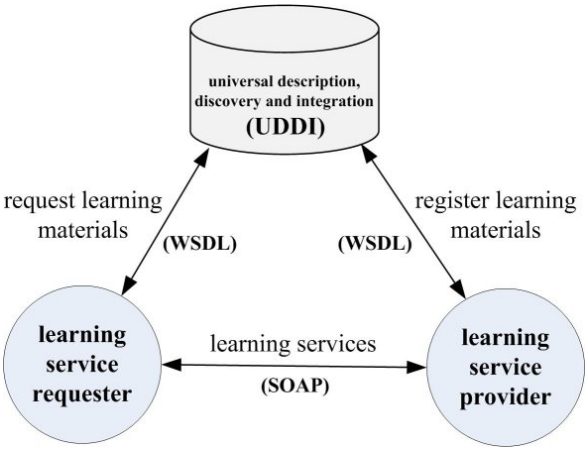


Fig. 1. Learning web services architecture

3 Ontology-Based Sharing Mechanism for Learning Objects

In discussion of ontology topics, the concept of knowledge ontology can represent anything in the real world. It is usually organized as a tree-like classification structure, i.e., the ontology consists of classification and principles [10-12]. The ontology of knowledge management was used in this study to describe the concept of learning field knowledge. The relationships between concepts can be expressed using related knowledge. The management concept of learning objects based on ontology can effectively classify and record the learning objects with learning content substitutability among the learning webs as well as sharing e-learning resources. The objective of ontology-oriented e-learning object-sharing mechanisms is to integrate the learning objects of different e-learning websites and thus enrich the quantity of learning objects and diverse teaching materials available in the e-learning resource network. The relevant learning objects are stored in e-learning websites by adopting the subject knowledge ontology construction concept. Learners on websites can access learning objects distributed across different websites by sharing and reusing digital teaching materials and learning resources.

The objective of ontology-oriented e-learning object-sharing mechanisms is to integrate the learning objects of different e-learning websites and thus enrich the quantity of learning objects and diverse teaching materials available in the e-learning resource network. The relevant learning objects are stored in e-learning websites by adopting the subject knowledge ontology construction concept. Learners on websites can access learning objects distributed across different websites by sharing and reusing digital teaching materials and learning resources. The detailed procedure in such a sharing mechanism is as follows.

Step 1: The e-learning websites distributed across the Internet register their learning objects in ontology-oriented learning object-management websites through a network connection.

Step 2: Expert examination procedures are created for the learning objects registered by the websites; these are recorded by the ontology-oriented learning object-management website. Three subject experts are selected from expert and academic databases to review the learning object subjects for appropriate knowledge content.

Step 3: Based on the evaluation by the subject matter experts, a decision is made whether to approve the registration of the learning objects and provide this learning content to learners of other e-learning websites. If the learning object does not meet the required standard, the ontology-oriented learning object-management website will provide suggestions for improving the learning materials for eventual registration of the learning object.

Step 4: The learning object is recorded in the database of the ontology-oriented learning object management website system, and the related data are updated with the subject knowledge ontology.

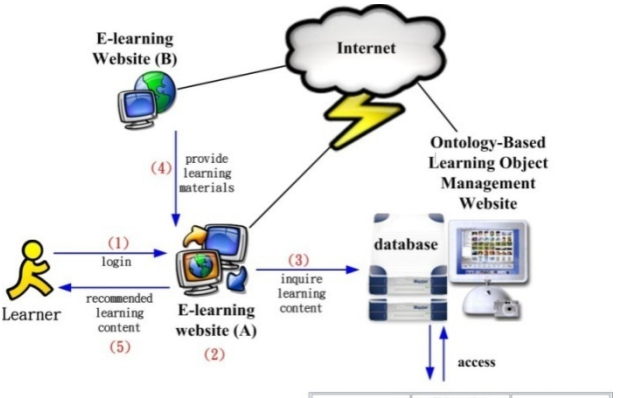


Fig. 2. An example of ontology-based learning object sharing mechanism

In Figure 2, assume that the learning object data as provided by many websites have been recorded in the database of the ontology-oriented learning object management website, such as e-learning website (A) that provides Normal Form learning objects, e-learning website (B) that provides join theory and E-R Model learning objects, and e-learning website (C) that provides join theory and transaction process learning objects, see Figure 2. After a learner login e-learning website (A), as calculated by the service algorithm the learning objects of the join theory are the most suitable for the learner, and this website has no such learning objects. The learner makes inquires to the ontology-oriented learning object management website regarding which e-learning websites provide the join theory, and it is found that e-learning websites (B) and (C) have the teaching materials, and the resource selection algorithm

calculates that the e-learning website (B) has web learning services at the lowest execution cost. Therefore, e-learning website (A) can ask e-learning website (B) to provide the learning objects of the join theory for their learners. Meanwhile, the service state of the join theory learning objects as provided by e-learning website (B) is changed to unavailable, meaning they are being read by learners. Such an ontology-oriented e-learning object sharing mechanism can effectively solve the problem of non-uniform services of popular learning subjects, which is to say, if a learning subject is very popular, and it is frequently browsed, it can be retrieved by the ontology-oriented learning object management website for the e-learning websites, and to ask the website to directly provide the required learning objects. Take Figure 2 as an example, if the E-R Model learning object provided by e-learning website (B) and the transaction process learning object provided by e-learning website (C) are being read by learners, and thus cannot be provided, it is required to wait for a period of time before the next application for web learning services.

4 Conclusions

This study implemented ontology-based sharing mechanism for learning objects, which recommended service websites that discuss using ontology to integrate the recommendation services of learning content to recommend learning more efficiently. Such a learning platform can: (1) satisfy real-time and fitness of the learning interaction modes of learners so that suitable learning content can be quickly recommended to learners; (2) integrate diverse learning objects in e-learning websites distributed across the Internet for the ontological construction of subject knowledge. This will permit learners on different websites to access learning objects and also facilitate the sharing and reuse of digital teaching materials and learning resources; and (3) ensure that different learning object providers with web services and the same learning subjects can be managed by a learning resource selection mechanism, to prevent popular learning subjects from becoming unavailable during the learning process.

Acknowledgement

This research was partially supported by the National Science Council in Taiwan through Grant NSC98-2511-S-142-005.

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Face Image Gender Recognition Based on Gabor Transform and SVM

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Abstract. In order to overcome the disturbance of non-essential information such as illumination variations and facial expression changing, a new algorithm is proposed in this paper for face image gender recognition. That is, the 2-D Gabor transform is used for extracting the face features; a new method is put forwards to decrease dimensions of Gabor transform output for speeding up SVM training; finally gender recognition is accomplished with SVM classifier. Good performance of gender classification test is achieved on a relative large scale and low-resolution face database.

Keywords: Gender Recognition; 2-D Gabor Transform; SVM.

1 Introduction

Face image gender recognition is an extensively concerned problem in machine vision domain. Early gender recognition in computer vision was mainly based on machine learning of neural network, among which was a two-layered neural network SEXNET designed by Gollomb [1] , its input face image size was 30×30, and the classification accuracy was 91.9% tested with 90 face images that were 45 man face images and 45 woman face images respectively; Another neural network designed by Edelman [2] was trained with 3 different part of face images, which were top half part and bottom part of face image and the whole face image. Linear nerve cells were used inside, and 3 different classification results were compared. Tamura's neural network [3] was consisted of multiple lays, and gender recognition test was carried out on face images of different resolutions, among which got 7% error recognition rate for 8×8 ultra low resolution face images. In short, all these neural network based methods need large amount of training samples but result in low generalization; further more its recognition speed is quite slow. In the recent years Baback Moghaddam and M.H.Yang [4] begin to adopt SVM (Support Vector Machine) for gender recognition, and have made recognition comparisons among RBF network and FLD and Minimum Vicinity classifiers based on FERET face image database, which conclude that SVM classifier performs the best. So SVM is our choice in this paper. But these tests are conducted with gray image directly which are not robust to illumination variation and of high dimensioned data. Therefore PCA is used to in some methods [5-6] to decrease its dimension, but PCA requires a square face image as input, while face

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 420–425, 2011.
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shapes are essentially rectangle. Additionally PCA ignores information among different patterns [7]. In order to overcome the above shortcomings 2-D Gabor wavelet transform is used instead to extract face image feature in this paper. The whole paper is organized as following: part 2 introduces 2-D Gabor transform and its advantages; part 3 gives an explanation of SVM for gender recognition; part 4 describes face gender feature extraction and recognition test, and part 5 finally gives test result and its analysis.

2 Visual and Biological Features of 2-D Gabor Wavelet

Tai Sing Lee [8] extended 1-D compact wavelet to 2-D Gabor wavelet in 1996. Its application on face image recognition is originated that coefficients of 2-D Gabor transform are of better visual characteristics and biological background.

Gabor is a complex sine function modulated by Gaussian function, which can extract local frequency feature within a specific region. 2-D Gabor core function can be defined:

$$\varphi_{u,v}(x,y)=\frac{k^2}{\sigma^2}\exp\left(\frac{k^2(x^2+y^2)}{2\sigma^2}\right)\cdot\left[\exp\left(ik\cdot(x,y)^T\right)-\exp\left(\frac{\sigma^2}{2}\right)\right] \tag{1}$$

Thereinto, i is a complex operator; (x, y) is a column vector, which specifies vector norm; parameter σ / k decides the size of Gaussian window, and let σ equal $\sqrt{2}\pi$; K is the wave vector, different K will consist different wavelet function, k defines as $k=\begin{pmatrix}k_x\\k_y\end{pmatrix}=\begin{pmatrix}k_v\cos\theta_u\\k_v\sin\theta_u\end{pmatrix}$, and $k_v=2^{-\frac{v+2}{2}}\pi$, $\theta_u=u\cdot\frac{\pi}{K}$, frequency coefficient v determines Gabor filter wavelength; while direction coefficient u decides the orientation of Gabor core function, k_v is filter central frequency. The second item in square brackets of formula (1) is direct current which is subtracted, so that Gabor is robust to illumination; $\exp\left(-\frac{k^2(x^2+y^2)}{2\sigma^2}\right)$ is Gaussian function, which is a window function and limits the bound of oscillation, and this makes it valid in a local area, so Gabor filter is adaptable to image deformation somewhat. Let $v=0,1,2,3$; θ stands for different direction, and Let $\theta=0,\frac{\pi}{8},\frac{\pi}{4},\frac{3\pi}{8},\frac{\pi}{2},\frac{5\pi}{8},\frac{3\pi}{4},\frac{7\pi}{8}$. So there are 32 (that is 4×8) Gabor wavelets for human face feature extraction.

Gabor wavelet transform is realized via convolution computation between face image and each of 32 different Gabor core functions respectively, which is:

$$G=\varphi_{u,v}*I(x,y)=\iint\varphi_{u,v}I(x,y)dxdy \tag{2}$$

Herein, $I(x, y)$ is gray face image, Convolution result is complex, so its modulus can be regarded as Gabor transform result.

3 Support Vector Machine

SVM is a strong classifier which can identify two classes, and face image gender classification is to tell this face picture is man or woman. Therefore SVM is suitable for this problem. In fact, SVM is also of some advantages.

SVM is on the basis of VC dimension theory in SLT (Statistic Learning Theory) and structure risk minimization principle [9]. In order to achieve the best generalization, SVM makes the compromise between model complexity (in view of learning accuracy trained by the specific samples) and generalization (that is to recognize any face image without error).Compared to other classical learning methods, SVM can overcome traditional learning flaws, such as over-learning and less-learning and driven to local minimum as well. For the situation which input samples can not be separated in a linear space, SVM can carry on a non-linear transform and change this inseparable problem into a divisible question in a high-dimensioned space and figure out its optimal classification surface in this space. Classification can be realized through inner product computation with SVM core function in a high dimensioned space, furthermore computation complexity is not increased. Core functions usually used are linear core function and polynomial core function and RBF core function and sigmoid core function.

4 Gender Classification Test and Analysis

BioID face image database is chosen for SVM training. First of all, face images in this database are of large part background and big-sized, so they are normalized to the size of 21*18 and background parts are removed. Then Gabor transform is carried out on normalized image and face feature is extracted to form training vector for SVM; 1520 feature vectors totally are used to train SVM in this paper. Finally face image gender recognition tests are performed with SVM which is of different core function each time.

4.1 Face Image Normalization

There are 976 man and 544 woman face images in this face image database, which are from different illumination, different gesture, different facial expression and different face making up (glass on/off, beard or non-beard etc.), each is 286×384 of size. Figure1 are some examples of this face image database.

All these images are manually located the eyes and mouths positions and are histogram-equilibrated and rotated and scaled and also cut, finally the size of these images become 21×18 pixels. One normalized face image is shown in figure 2.

4.2 Face Image Feature Extraction with Gabor Transform

For each normalized face image, Gabor transform is carried out by computation formula (2), there are 32 Gabor wavelet filters with different frequencies and directions, so one input face will have 32 times of convolutions and 32 output images which each output is of the same size of 21×18. These 32 real parts and norms are shown in figure 3.



Fig. 1. Some examples of face image in BioID database



(a) (b) (c)

Fig. 2. Face image normalization
(a) Original image; (b) Eyes and mouth manually located position for normalization; (c) Normalized image

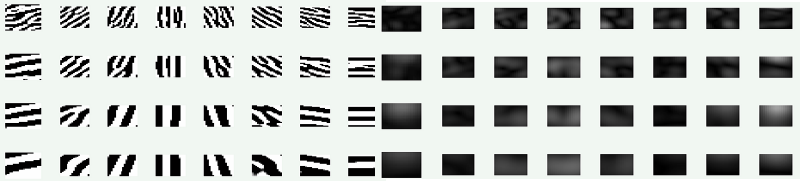


Fig. 3. Real part and norm images of 32 Gabor Wavelet output features

One face image will generate 32 feature images, So SVM training data are increased to a great steal, in order to reduce SVM training time, A new method is proposed herein, that is to calculate the variances of each column in a face image and the mean value of the whole image, so 32 feature images of an input face image will become a smaller feature vector of 1×608. In all, 1520 such vectors are used for SVM training.

4.3 Gender Recognition Test and Analysis

There are two schemes of gender recognition test. In order to prove the validity of Gabor transform, one test is carried out with different SVM core functions for both pixel-based image which is not transformed with Gabor wavelet and the transformed image; another test is to use different sized face images to make out how face image size influence recognition accuracy. They are illustrated as follows.

1) Gabor transform validity test for gender recognition in face image.

Test is accomplished on Matlab platform, and 120 face images are used for test. The results are shown with Table 1. Through the data comparisons, gender recognition accuracy for Gabor transformed images is obviously better than that of pixel-based images when using polynomial and linear core functions of SVM; and for the core functions of RBF and Sigmoid core functions the correct recognition rate is the same for both Gabor transformed images and pixel-based images. Conclusively the proposed method in this paper is valid and outperforms than pixel-based images and the best situation is polynomial core function with parameter d of 3.

Table 1. Gabor transform validity test with different core function of SVM （C=32）

Core function	Parameters in core function	Number of error classified images (Gabor transformed image /pixel-based image)	Correct ratio (Gabor transformed image /pixel-based image)
Linear core	\	27/28	77.5%/76.67%
Polynomial core	d=3	15/20	87.5%/83.33%
RBF core	Gamma=0.0078125	30/30	71.67%/71.67%
Sigmoid core	Gamma=0.0078125	30/30	71.67%/71.67%

2) Gender recognition test for different sized face images.

Different sized face images of 21×18 and 35×30 and 49×42 are as tested, they are firstly transformed with Gabor wavelet and then recognized with SVM, In this test polynomial core function is used and its parameter d is 3. Their test results are shown in Table.2. The chart of correct recognition rate variation with image size is shown in figure.4.

It is clear that correct recognition rate goes higher as face image size becomes large, but their training cost time also increases. So there is a good compromise between face image size and correct recognition rate. In this paper test shows that image size about 50×40 will offer 90% correct rate while the training speed is also acceptable.

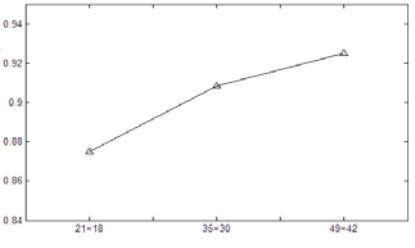


Fig. 4. Correct recognition rate variation with image size

Table 2. Correct recognition rate comparison

Image Size	Number of error recognized images	Correct rate
21×18	15	87.5%
35×30	11	90.83%
49×42	9	92.5%

5 Conclusions

Gender recognition for pixel-based image will be subject to illuminance change, while big sized face image usually incurs high-dimensioned data and endures slow training speed. PCA method is often used to reduce data dimension, but will lost face information between gender patterns, in order to solve these problems, Gabor wavelet transform is proposed to extract face features and to keep robust to image gray variation, different facial expression and face ornaments. Finally SVM classifier is used for recognition for generalization improvement. The proposed algorithm is

proved to be valid on the big face image database. This method is of high recognition rate for frontal face image, which can be used for video face image. That is, face image segmentation can be achieved via Adboost algorithm from video sequence, and gender recognition can be realized with the Gabor transform and well trained SVM. This method is not tested for side viewed face image or partly occluded face image, which will be our future work.

Acknowledgments. Our research is supported by Natural Science Fund of Shandong (ZR2010FL007 and ZR2009GM007) and the Project of Shandong Province Higher Educational Science and Technology Program (J10LG23 and J09LG12), and also partially supported by Doctorial Fund of Qingdao University of Science & Technology. We would like to thank BioID database for sharing their datasets.

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Unsupervised Posture Modeling Based on Spatial-Temporal Movement Features

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Abstract. Traditional posture modeling for human action recognition is based on silhouette segmentation, which is subject to the noise from illumination variation and posture occlusions and shadow interruptions. In this paper, we extract spatial temporal movement features from human actions and adopt unsupervised clustering method for salient posture learning. First, spatial-temporal interest points (STIPs) were extracted according to the properties of human movement, and then, histogram of gradient was built to describe the distribution of STIPs in each frame for a single pose. In addition, the training samples were clustered by non-supervised classification method. Moreover, the salient postures were modeled with GMM according to Expectation Maximization (EM) estimation. The experiment results proved that our method can effectively and accurately recognize human's action postures.

Keywords: posture modeling; posture recognition; GMM; EM.

1 Introduction

Recently, human behavior recognition are paid more and more attention due to it's applications on many fields, like video surveillance, navigation and video indexing [1]. So it has become one of the most valuable research directions. However, human behavior is a non-rigid and free moving style, as well as many uncertain factors, such as camouflage, illumination variation, shadow, dynamic background and the character of fuzzy moving [2], so human behavior recognition becomes a complex and challenging task.

For human behavior recognition, there are three main approaches [3] at present: (1) template matching method; (2) state space method; (3) the method based on modeling. These methods are usually compromised between the costs of calculation and the accuracy of behavior recognition. Consequently, we still need to find and develop a new algorithm, and it can not only improve the accuracy of recognition, but also reduce the computing complexity effectively. Polana [4] implemented human movement recognition using the characteristics of two-dimensional grid, which is an approach base on low-level features of motion, and it had a low rate of recognition. Davis [5] interpreted human movement in image sequence using kinetic energy images and historical images, and extracted 7 Hu matrixes as feature vectors used as template matching on recognition. Though it is simple, it has not completely extracted the image information; and the matrix is non-orthogonal with the redundancy information.

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 426–431, 2011.
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In this paper, we proposed a posture modeling method with Gaussian Mixture Model based on EM estimation. It can effectively solve the problems caused by interferences from foreground segmentation, like illumination variation and camouflage. In the following, part 2 introduces the extraction and classification of behavior properties, and it proposes how to describe human moving characteristics based on spatial-temporal interest points (STIP); in section 3, there is the posture modeling and recognition algorithm based GMM with EM estimation in detail; section 4 and section 5 are experiment data analysis and conclusion respectively.

2 Extraction and Classification of Movement Features

Human action features are located at the spatial temporal neighborhood, where the image values have large variations in both the spatial and the temporal dimensions [6]. We can use fewer feature points to identify human's movement behavior, without the need of segmenting and tracking human any more. Points with such properties will be spatial-temporal points with a distinct location in time corresponding to the moments with non-constant motion of the image in a local spatial-temporal neighborhood. For example, during the walking process, feet lift and land, knees bend and so on.

2.1 Extraction of STIPs

There are two methods to extract these spatial-temporal interesting points, which are proposed by Ivan Laptev and Dollar. The method of Ivan Laptev is to detect 3-dimensional Harris corner as STIPs, which are sparse and sensitive to scales, and it is not adaptive to posture modeling. So we choose the STIPs extraction method based on Dollar in this paper.

Compared to Ivan Laptev, Dollar's [8] method considered that any region with spatially distinguishing characteristics undergoing a complex motion can induce a strong response. The response function can be calculated as:

$$R = (I * g * h_{ev})^2 + (I * g * h_{od})^2 \tag{1}$$

Where I is input gray video, and $g(x, y; \sigma)$ is the 2D Gaussian smoothing kernel, applied only along the spatial dimensions, h_{ev} and h_{od} are a quadrature pair of 1D Gabor filters applied temporally. Fig.1 shows STIPs extraction method based on Dollar. From Fig 1, we can see that STIPs are located at the region of body's intense movement, so human behavior characteristics can be described by STIPs.



Fig. 1. STIP extraction based on Dollar

2.2 Descriptor of STIPs

In order to describe the distributions of STIPs for a posture, we need to design the descriptor of each STIP. Every STIP stands for a small area that is undergoing non-constant movement, so we choose an $5\times5\times5$ adjacent neighborhood which is called cuboids to model a STIP, where we calculate the 3D gradients $\left(L_x, L_y, L_t\right)$ for each pixel. so each STIP can form a 375-dimensioned vector as its descriptor. Here, it is emphasized that 3D gradients $\left(L_x, L_y, L_t\right)$ should be flattened as $\left(L_x/Norm, L_y/Norm, L_t/Norm\right)$, where $Norm$ is calculated as $Norm = \sqrt{L_x^2 + L_y^2 + L_t^2}$.

2.3 Gradients Histogram of STIPs in a Frame for a Posture

Because the posture can be described by the statistic distribution of its STIPs, we can classify these postures via clustering their distributions of STIPs. In this paper, we model a single posture by calculating the histogram of all its STIPs. That is, a STIP descriptor is 375-dimension, which is composed 3 gradient sub-vectors, they are 2 spatial gradients on x and y directions and 1 temporal gradient on t direction respectively, each of them is 125-dimension. Suppose there are N STIPs in a posture frame, we calculate a histogram of 16 bins respectively for 3 types of gradient sub-vectors, each histogram is derived of N sub-vectors; and then we combine these 3 histograms as a 48-bined histogram.

2.4 Non-surveillance Posture Clustering

We define the HOG similarity of two postures with histogram intersection method, which is:

$$S(p,q) = \sum_{u=1}^{B} \min\{p^{(u)}, q^{(u)}\} \tag{2}$$

Where p and q are 2 histograms with B bins, if they are the same, the similarity s is 1, so the dissimilarity can be defined as $d = 1 - s$. Consequently, the HOG dissimilarity of the total frame N can be calculated, and the whole HOG dissimilarity can form a dissimilarity matrix:

$$D = [d_{ij}]_N = \begin{bmatrix} d_{11} & d_{12} & \cdots & d_{1N} \\ d_{21} & d_{22} & \cdots & d_{2N} \\ \vdots & \vdots & \vdots & \vdots \\ d_{N1} & d_{N2} & \cdots & d_{NN} \end{bmatrix} \tag{3}$$

Where the value of diagonal elements d_{ii} is 0, the other elements value d_{ij} is the dissimilarity between i and j.

The N frames are then clustered into M clusters by employing a pair-wise clustering algorithm which takes the dissimilarity matrix of every pair of samples to be clustered.

The relation of HOG dissimilarity in our paper is fuzzy and Non-Euclidean, so we adopt the Non-Euclidean Relational Fuzzy (NERF) C-Means. Its classification result is the probability value of each sample belonging to the whole posture cluster samples, and the posture cluster is decided by the maximum probability. In this paper N is 3314 and cluster number M is 37. Some clustering results are show in Fig.2 and Fig.3.



Fig. 2. Example poses of cluster 8, which are from action Skip and Run, representing for their visual similarities



Fig. 3. Some example frames from cluster of 13, shared by 2 different actions consisting of frames with similar movement course , Upper column:Example frames of bending up action; bottom column Example frames of waving up action

It intuitively satisfies human senses that sample frames in Fig.2 are classified into the same cluster, because they are indeed of similar postures. But it is puzzled that sample frames in Fig.3 belong to a same cluster, for they are not visually similar. The reason can be explained as following, though bending up and handing up are not spatially similar, but they are of similar moving up course, that is, these two actions are temporally similar, just because that the STIPs are of temporal property.

3 Posture Modeling Based on GMM

In this paper, Gaussian Mixture Model is regarded as using several distributions to describe each type of posture [9]. In other words, we use K weighted sum of Gaussian distribution functions to close in the distribution function of each posture's observed values.

For a single sample x_i in each type of posture observation data set $X = \{x_1, x_2, \ldots x_N\}$, the Gaussian mixture distribution density function is:

$$P(x_i|\Theta) = \sum_{i=1}^{K} \omega_k \, p_k(x_i|\theta_k) \tag{4}$$

Where K is the number of Gaussian distributions, ω_k is the weight estimation of k th Gaussian in the mixture, and it satisfied with: $\sum_{k=1}^{K} \omega_k = 1$. p_k is the Gaussian probability density function, and $\Theta = (\theta_1, \theta_2, \ldots, \theta_K)$ is the parameter vector of mixture composition. $\theta_k = (\mu_k, \sum_k)$ is the Gaussian distribution parameter, that is, the mean and covariance matrix, which can be estimated respectively with EM.

4 Posture Recognition Theory and Test

The key question of posture is how to measure the similarity between the sample sequence and the test sequence. Give a frame, its STIPs can first be extracted, then we calculate the descriptor for each STIP and then posture histogram f can be figured out. The posture recognition is to find the best matching for f among all the cluster GMM models. That is:

$$p(f) = \arg\max_{\varphi \in \psi} \sum_{i=1}^{K} \omega_{i,\varphi} \cdot \eta_{i,\varphi}(f \cdot \mu_i \cdot \sigma_i) \tag{5}$$

Where ψ is the collection of all cluster models, φ is one of ψ, and φ has K sub-Gaussian models of GMM, $\eta_{i,\varphi}$ is the ith Gaussian probability density function, μ_i, σ_i are its mean and variance respectively, $\omega_{i,\varphi}$ is the weight of ith Gaussian model in cluster φ.If Maximum similarity ration larger than a threshold, then the input frame can be judged as one specific a cluster, otherwise it is a posture of a new action.

We take Weizmann databases as training samples, there are 8 types of action and each action has 9 action videos conducted by 9 different persons, in all there are 3314 STIP detected frames in our training experiments. The 8 types of action videos include walk, run, bend, jack, jump, skip, and wave by one hand, wave by two hands. After clustering, 3314 frames can be clustered into 37 posture class.

In order to verify the overall performance of the proposed model, we adopt Leave One Sample out Test. In the test, each of the 37 samples was taken as the test sample and the residual samples were used as training samples. Test results show the correct matching rate is above 86.6%.

5 Conclusions

In this paper, we have proposed an effective algorithm, which is posture modeling base on EM estimation on GMM, and it can obtain a high recognition rate. The experiments prove that our method is accurate and effective, which is robust to the interferences caused by video segmentation, such as, illumination variation and camouflage, and so on. However, there are still some disadvantages. For example, it is only effective for stable camera environment and simple background. Our next step work is to improve our algorithm to adapt to the dynamic camera environment and complex background. In addition, we will make action recognition with posture transitional graphic.

Acknowledgments. Our research is supported by Natural Science Fund of Shandong (ZR2010FL007 and ZR2009GM007) and the Project of Shandong Province Higher Educational Science and Technology Program (J10LG23 and J09LG12), and also partially supported by Doctorial Fund of Qingdao University of Science & Technology. We would like to thank M.Blank at the Weizmann Institute for sharing their datasets.

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Customer Loyalty and Customer Relationship Management

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Abstract. The contemporary company attaches great importance to marketing relationship and customer relations is the core of this relationship. Further, customer satisfaction and loyalty is the core of the customer relationship management. Sometimes, high customer satisfaction causes low profit because enterprises do not realize that strengthening the loyalty of the aimed customer is the key of customer relationship management.

Keywords: Customer loyalty; Customer relationship; Customer value.

1 Customer Relations Is the Core of Marketing Relationship

Contemporarily, Enterprises attach great importance to marketing relationship, which is a looked marketing activity as the process that a company interacts with customers, suppliers, distributors, competitors, government agencies and other publics. Its key is the establishment and development of good public relationship. Marketing relationship not only focuses on developing and maintaining relations with his clients but also expands the horizons of marketing. It involves all of the relationship between the enterprises and its stakeholders. Even so, among these relationships, the core is still between enterprises and customer. Wal-mart and Carrefour stores also attach great importance to the relations with suppliers, but comparably with customer relationship, supplier relationship's aim is to service customer relationship. The procurement system of Wal-mart and Carrefour is extremely harsh, which is the efforts of maintaining long and good relationship with customers. For this aim, we must pay attention to the followings:

1.1 Key of Customer Relationship

The key of customer relationship is the commercial relationship, not the personal relationship, and personal relationship serves the commercial relationship. Here, we have to distinguish the difference between customers and friends. Customers are business concepts. Good customers must have the demand, have decision-making power and have the ability to pay, and satisfied with the company. However, friend is an emotional concept, which refers to everyone has common interests, hobbies, and cares and helps each other, etc. When doing customer relationship marketing, managers must always clearly realize what we uphold are customer relationships, not

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 432–436, 2011.
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friend relationships. Although both can be gained at the same time, if not, managers must keep reminding themselves that customer relationship is the first, then friend relationship. Just as a business saying, some people can be friends without doing business, some people are the opposite.

1.2 Customer Value Is the Base That Enterprise Managers Value Customer Relationship

Customer value is the value sum that customers continuously bring to enterprise organization. Customer value includes: (1) the customer repeatedly purchase the same products; (2) extensions of purchase by the customer with other products that produced by the same company. For example, a customer bought a haier refrigerator, and very satisfied with haier's quality and service, then when this customer are considering buying a color television, he will still choose haier; (3) purchase of complementary goods by customers (middlemen). For example, if customers bought a printer, they have to keep buying the subsequent toner cartridge; (4) the recommendations of frequent customers to new customers. For example, a frequent customer bought a Gree air conditioner and were very satisfied with it, then he recommended this air conditioner to his friends who were going to buy a air conditioner and need some recommendations; (5) the customers are very satisfied with the products, then introduce initiatively the enterprise's advantages to other people; (6) increasing single purchase and consumption amount, etc. the more repeat purchase, the more outspread purchase; the more complementary purchase, the more recommendations to new customers; the more word-of-mouth marketing, the more single consumption amount and then the greater the customer value is, and vice is small.

1.3 Customers Are Divided into Different Classes in Relationship Marketing

Evaluation of customer class is based on the customer value. For example, three customers (named as A, B and C) go to a small restaurant for dinner. This is the first time for customer A to have dinner there. The customer B always has dinner there by himself. The customer C not only often come here by himself, but also often brings some his friends. So, if you are the boss of this restaurant, would you give all of them the complimentary food? If you do, would you give them the same complimentary food? Obviously, you will only give the best complimentary food to the customer C, because this customer value is the biggest. Then, we will grade the customers based on the difference of the customer value. According to Pareto's Principle or the 80/20 Rule, that 20 percent of something always is responsible for 80 percent of the results. Therefore, the relationship marketing only need to pay great attention to the superior customer and does not need equal level of attention and resource to all of the customers and market.

1.4 Good Customer Relationship Is Based on Customer Files and Updated Data

Establishing excellent customer relationship, we are required to build customer files, and constantly update customer data. Only when we are quite familiar with our customers, we can provide customers with high-quality personalized service. When

the number of customers is fewer, such as big customer marketing, we are easier to build detailed customer files. When the number of customers is bigger, such as appliance retailing, we can build simple customer files which simply contain customer name and phone number. The higher grade customer got more detailed customer files and the lower grade customer got simple customer files.

1.5 Level of the Management of Customer Relationship Depends on the Number of Customers and Technology Level

When the number of customer is fewer, we can provide the more thorough management of customer relationship, including actively contacting customer, inquiring customer, and initiatively providing customer with great quality of service. When the number of customer is large, we can only provide primary customer relationship management, even passive customer relationship management, namely, waiting for the customers to find us. Only when customers come to us, we can provide the customer with good service.

1.6 Establishing High Cost of Transfer and Low Cost of Transaction for High Grade Customer Is the Essence of Customer Relationship Management

The transaction cost for old customer is low, because we know and trust each other. When we provide customers with the high quality of service and even value-added service, the chance we leave to competitors is little. Here, Microsoft OFFICE software is a vivid example. When we have become accustomed to use Microsoft office, we'll have huge obstacles in psychology, energy and finance to accept other office software.

1.7 The Key to Establish Good Relationship with Customers

The company staff that contact with customers, such as customer service, salesclerks and service personnel is the key to establish a good relationship with customers. The more company staffs that customer contact with, the higher chance that customers will be dissatisfied with. The customer dependence on the company is higher and the control of customer by enterprise is higher. Therefore, in the process of design for organization service, we must keep the balance on customer satisfaction and customer dependence on the company.

2 Customer Satisfaction and Customer Loyalty

The core of relationship marketing is customer relationship, and the core of customer relationship is customer satisfaction and customer loyalty. Therefore, we should keep monitoring and evaluating the degree of customer satisfaction, and constantly improve the customer loyalty.

The degree of customer satisfaction can be divided into the following six categories: (1) very satisfied. Customers must buy again; (2) satisfied. Customers are tend to buy again, (3) general. Customers hold indifferent attitude of continuing to

buy; (4) helpless. Customers will refuse to buy again the products and services of this company as long as customers can have a new choice or competitors enter, and customers probably try new products and services. Customer differently purchase behaviors in the marketing called pseudo loyalty; (5) not satisfied. Customers complain about this company, but think it is oneself to make a mistake. Then customers turn to competitors when they are looking for the reason; (6) very dissatisfied. Customers are determined to leave and turn to competitors, reminding the others to purchase the products of the other company.

When the customer satisfaction is higher, the customer loyalty is higher, especially when the repeated buying cycle by customers is shorter. When we found that the satisfaction level of customers is in or under "general", we must take some actions to remedy the customer defects, and in the meantime to improve customer satisfaction. Particular way is: (1) establishing tracking system for customer satisfaction such as setting up a rapid after-sales service system and asking a client about his consumption; (2) finding and improving the things that customers are not satisfied with. Especially for service industry, it is more important that finding what are the customers not satisfied with than discovering what the customers satisfied with was; (3) praising the choice that the customer made is correct and wise. If the customer satisfaction is high, we should congratulate and praise customers made the right choice. If the customer satisfaction is not high, we should lead the customer to correctly understand the problems and took active remedial actions; (4) analysis of satisfaction factor. Finally, the enterprise should do a statistical analysis to know what kind of factors that customer satisfied with can bring them come again and what kind of factors that customer dissatisfied with will take them away.

If companies want to satisfy the customers, companies should provide the customers with overvalued service. The overvalued service means the value of customer satisfaction that they feel far exceeds the value of expectations of customer satisfaction. We can have a way to reduce the value of expectations of customer satisfaction, but this way may also reduce the appeal to new customers. We also hope to provide the real overvalued services for the customers and make customers feel very satisfied. Here many companies need to avoid the following two misunderstandings.

The first misunderstanding is that the overvalued services necessarily mean higher costs. In fact, in many cases, without increasing costs can improve the overvalued services and make customers feel very satisfied. For example, employee smile, timely close enquiry, timely response of customer’s complaints and requirements to employees will make customers feel satisfied service and get the overvalued services.

The second misunderstanding is that the more customers receive the more services, they will be more satisfied. The overvalued services don’t mean that it is better for customers to receive the more services. The overvalued services don’t equal service quality excess. What is the Service Quality Excess? Service Quality Excess is that customers think that the value of services is massive residual after they get satisfied services. Therefore, providing services is to hold a degree. Give the customer a little amazed pleasure, customers often will be quite satisfied customer too many surprises, but often can backfire.

3 Essence of Customer Relationship Management Is Developing Customer Loyalty of Target Customers

Loyal customers are not necessarily to be a good quality and target customers of the enterprise. In an empirical investigation against Sweden bank, we found that customers had a high level satisfaction with this bank, but there was no profit of this bank. 80 percent of customers were satisfied with the services that the Bank offered, but this could not make the bank get profit. On the other hand, 20% of the customer contributed more than 100% profit to the bank, but they were dissatisfied with the bank service. Hence, as Han, Wei mentioned in their paper "research of interactive relationship between customer satisfaction and customer loyalty" that published in 2001 in Nankai management review that the correct way of improving customer satisfaction and loyalty is that trying your best to satisfy the customer who has more customer value on the basis of results of subdividing of customers. Image of say, for high quality target customers, the enterprises must initiatively contact the target customers. For the non-target customers, enterprise should wait for the customer to contact enterprise. If it does not involve the social responsibility of the enterprise, the essence of customer relations management is a restricted refusing to the non-targeted customers, centralizing resource cultivation and strengthening target customers loyalty.

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A New Method to Web Knowledge Searching and Organizating

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Abstract. One of the fundamental support of the web knowledge vision is a agent system that enables knowledge to be published to a searchable knowledge base and later retrieved by potential users. This is the basic motivation for the UDDI standard, one of the three standards fundation current web knowledge technology. However, this aspect of the technology has been the least successful, and the few web sites that today attempt to provide a web knowledge agent facility do so using a simple cataloguing method rather than UDDI. In this paper we analyze why the agent aspect of the web knowledge vision has proven so difficult to realize in practice and outline the technical difficulties involved in setting up and maintaining useful knowledge base of web knowledge. We then describe a practical method to web knowledge agent based on automated indexing and discuss the required technological foundations. We also suggest some ideas for improving the existing standards to better support this method and web knowledge searching in general.

Keywords: Web knowledge, searching, organizating, Agent, UDDI, search engines.

1 Introduction

Web knowledge is the knowledge which is updated rapidly and provided widely in web. Although web knowledge have received a great deal of attention over the last few years, and many companies have experimented with their use, the expected use of web knowledge as a medium for B2C and B2B interaction has failed to take off to the extent expected. Web knowledge were also touted as a way of boosting software reuse by encouraging developers to assemble new applications from reusable parts rather than by writing everything from scratch. However, examples of serious enterprise applications that use third party web knowledge to realize their functionality are few and far between. The vast majority of web knowledge applications today are within, rather than between, enterprise boundaries and most web knowledge are custom built for the purpose in hand. In effect, therefore, web knowledge are primarily used today as a convenient middleware and wrapping technology rather than as the basis for component-based development and software reuse. The basic problem is the failure of current technologies to successfully support

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 437–442, 2011.
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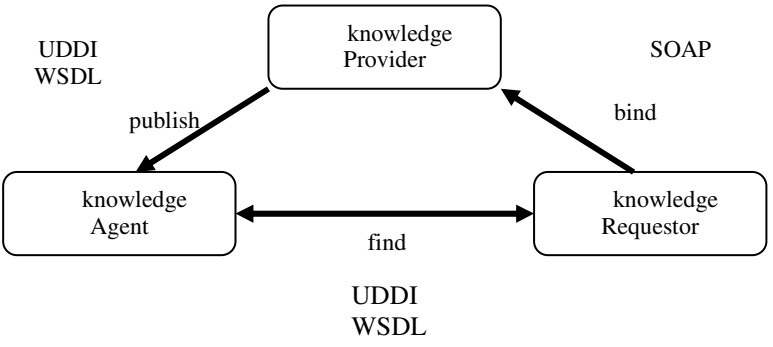


Fig. 1. Standard Web knowledge Agent Model

the "publish and find" element of the core web knowledge vision. As illustrated in Figure 1, which is a standard picture in most web knowledge literature, the idea of bringing together web knowledge providers and users via some form of agent knowledge has been a core part of the web knowledge vision right from the start. After describing the interface to their web knowledge using WSDL, the idea is that knowledge providers publish their knowledge in a UDDI knowledge base by providing appropriate "meta data" such as provider identity (white pages), a categorization of the provider's industry (yellow pages) and technical information necessary to invoke the knowledge (green pages). Developers interested in using web knowledge are then meant to be able to find components suitable for their needs by browsing the registry or using the keyword-based UDDI search facilities.

Attempts to provide public repositories based on this vision have not been very successful, however. The most well known attempt was the so called UDDI Business Registry (UBR) supported by IBM, Microsoft and SAP, which after several years of service was quietly closed down early in 2006 because it contained only a few hundred reachable web services, and the ratio of actual web services to "junk" was very low [5]. Moreover, the few web sites that specialized in providing a knowledge base for web services, such as xmethods.net or bindingpoint.com do not use UDDI anymore or have also recently been shut down. Instead, those remaining typically organize links to web services in a hierarchically-organized taxonomy designed for manual browsing. However, we believe the reasons for the failure of UDDI-based public repositories do not lie in the nature of the standard per se, but in the philosophy that lies behind it – namely the agent philosophy that relies on human maintenance of the knowledge base and the search method based on browsing the knowledge base for appropriate services.

2 Background

The idea of software reuse based on component markets has been around for almost forty years [8], and all the evidence to date suggests that repositories whose contents are managed by humans are doomed to failure [3], [4]. Typically, one of two things happens. Either,

- the quality of their contents quickly degrades and becomes unusable, or
- the overhead associated with managing and maintaining the quality of the knowledge base becomes so large that it far outweighs the benefits.

2.1 The Internet as a Component Knowledge Base

The idea of using open source software from the Internet as a reuse knowledge base is not new. Booch and Brown [2] already proposed this idea back in 2002, for example. The idea is superficially very appealing because the Internet can be viewed as a self regulating knowledge base that requires no explicit maintenance effort. However, turning the amorphous mass of information on the Internet into a practical vehicle for software reuse depends on three fundamental building blocks –

1. the number of downloadable software assets being above a "critical mass" needed to offer a reasonable chance of finding the required functionality.
2. indexing algorithms and tools that enable a map of all the available software assets to be efficiently generated and stored.
3. search algorithms that can effectively filter out unsuitable components and identify assets that match a user's need.

The size estimates shown in the table were obtained by sampling the code engines with special queries that essentially ask for "all components in a specific language".

Table 1. Overview of component search engines

	KOO	KCT	merobase	GCS
Number of comp	2.5M	6 M	10 M	6 M
Number of languages	37	32	48	46

2.2 Searching Components and Services

Achieving the third of the above three requirements (i.e. the query algorithms) is less straightforward however, and this is one of the main areas of competition between the search engines. The simplest and most direct way of searching for particular software components in Lucene indices (or some other similar technology) is to look for a particular string in the source code as Mili and Mili [9] pointed out in their survey almost ten years ago, and all of the engines identified above support this form of search.

Table 2. Comparison of organization techniques on a large component knowledge base

Organization Technique	Signature Matching	Keyword Searching	Name Matching	Abstraction Matching
Average Precision	1.1%	9.4%	14.9%	39.4%
Standard Deviation	2%	12%	15%	21%

3 Web Service Indices

There are two basic ways in which a web service agent engine can populate its index of web services. One way is through the explicit publication efforts of web service developers and the other is by means of some kind of “crawling” activity which is focused on finding and analyzing web services. Virtually all attempts to set up web service search engines to date have been based on the first method. As mentioned in the previous section, most of the public web service brokering services offer keyword-based search technology in which services are indexed by category. Crawling for web services presents some special challenges. Since WSDL files do not contain the additional metadata specified by UDDI, browsing by category will not be possible at all and hence such an index has to focus on the advanced organizating techniques described above.

4 For Example

The user of a web service often does not care about additional “management” parameters such as session or user IDs which have to be provided in service operation invocations but are not directly related to providing the desired functionality. Session IDs are particularly problematic because by definition most web service clients are designed to hide session ID values from the user. However, the whole point of client/server technology is to provide the user with the illusion that he/she is the sole user of a service whereas in fact there are usually many concurrent users. The session ID is thus a critical parameter of the operations in the server interface, but is hidden from the human user of the service. Nevertheless it is a common pattern to include session ID parameters in method signatures. Thus, simply matching an interface query as defined from the perspective of the user to the actual interface supported by the web service would not lead to the desired results. Since WSDL only allows web service descriptions at a low level of abstraction, we have introduced the notion of the “pan-client” and “per-client” views of a service [1]. Another frequently used pattern we identified in this context is the usage of authentication data parameters, e.g. username and password or license keys, which either have to be sent once or with every method call.

Study knowledge
startNewGame() return sessionID, Question continueGame(guessedAnswer, sessionID) return sessionID, Question queryStatus(sessionID) return sessionID, Status useFiftyFiftyJoker(sessionID) return sessionID, Answers useAudienceJoker(sessionID) return sessionID, Answers

Pan-client

Fig. 2. Pan-client view of a study web knowledge

As an example, consider the following web service which simulates the millionaire study. A user can start the study by calling the startNewGame() method. He then receives a session ID which has to be used to identify the game in subsequent method calls. Additionally, the user has the opportunity to start multiple games at any time by acquiring multiple session IDs. From the startNewGame() method call, he also receives the first question. The question can be answered by the continueGame() method. Two methods returning either a reduced set of remaining answers or answer probabilities (simulating the "fiftyfifty joker" and results from an audience survey) are also available. These methods can only be used once per session. Each method returns the session ID so that a service client, which could run operation at the same time, can assign the return messages from the provider to the corresponding study. The following figure summarizes the service's actual – i.e. the pan-client – interface in a graphical form.

Study knowledge
startNewGame() return Question continueGame(guessedAnswer) return Question queryStatus() return Status useFiftyFiftyJoker() return Answers useAudienceJoker() return Answers

Fig. 3. Per-client view of the study knowledge

Although it is necessary to provide the session ID parameters when invoking these methods, it is unlikely that a user of a search engine is either interested in session IDs or even running multiple operation simultaneously. From a client's point of view, only questions and answers are important in the StudyService abstraction. Thus a search request for a StudyService is more likely to utilize the per-client perspective as shown in the following figure.

As figures 2 and 3 illustrate, the per-client view is much simpler and more concise, so we believe that searches should be done with the per-client specification of the service. Even if the service does not always return a session ID, the session ID always has to be transmitted as an input parameter. A user not interested or aware of sessions would query a component search engine without the additional parameter (e.g. startNewGame(): Answers) and not retrieve the desired result (StudyService). An advanced user aware of session IDs could also fail to get the desired results because the position and the type of the session ID may vary. Although the merobase search engine supports permutations of parameter orders, no component search engine we know of directly supports different parameter variants. This would indeed be necessary since session IDs could be of various number or string types.

5 Conclusion

In this paper we have outlined the main issues that has lead virtually all previous attempts to set up public web service agent services to fail – the underlying reliance on the human management of knowledge base content. We then outlined the ingredients of an alternative, practical method which adapts the technology used in

emerging “code search” engines to provide useful searches over a knowledge base of web services. Using a combination of these techniques, our merobase search engine has been able to assemble a knowledge base of about 3000 existing web services. These are integrated into an index of several million source code components and around ten thousand binary components that are searchable using name and interface-based queries as well as simple text-based queries. Searches can also be restricted to web services using the “type:service” constraint.

Although 3000 may not at first sound like a large number, it is 10 times greater than the number indexed by the UBR at the time of its closure. In fact, to our knowledge it is the largest searchable knowledge base of web service currently available on the Internet. This has been assembled from web services that existed before the deployment of the search engine. Once its availability becomes more widely known we hope that the size of the knowledge base will be increased by the explicit publishing of components.

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Research on the Wireless Sensor Networks Applied in the Battlefield Situation Awareness System

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Abstract. In the modern warfare information is the crucial key of winning. Battlefield situation awareness contributes to grasping and retaining the intelligence predominance. Due to its own special characteristics Wireless Sensor Networks (WSN) have been widely used to realize reconnaissance and surveillance in the joint operations and provide simultaneous, comprehensive, accurate data to multiechelon commanders and the combatant personnel for decision making and rapid response. Military sensors have drawn great attention in the ongoing projects which have satisfied the initial design or research purpose. As the interface of the "Internet of Things" which will have an eye on every corner of the battlespace WSNs play the necessary role in the incorporated situation awareness system. WSNs, radar, infrared ray or other means work together to acquire awareness intelligence for the deployed functional units to enhance the fighting effect.

Keywords: wireless sensor network; battlefield situation awareness; intelligence acquirement; battelspace picture.

1 Overview

Information technology is boosting a new military revaluation. Information warfare needs timely accurate acquirement, transmission and processing of the information. The combat unit which can realize this aim can seize and retain control of information and achieve win.

Wireless sensor network [1] can meet the requirement by its unique advantage. With the recent rapid advances of micro electro-mechanical systems (MEMS) various kinds of sensors have been widely applied to the battlefield, diversifying the means of the battlefield situation awareness.

WSN can help realize effective battlefield situation awareness, meeting the requirement of "knowing the enemy, knowing yourself" brought by all of the combatant parts. The typical application is to scatter a number of smart nodes across the vast combatant area by the plane. By self-organizing the nodes collect, transmit and fuse the sensed data for the purpose of supporting the commander's precise decision-making and satisfy the requirement of providing comprehensive, detailed

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 443–449, 2011.
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accurate military information to the combatant personnel. Battlefield situation awareness information brings the operational advantage and convenience of coordinated joint military activities to all of the combatant units and enhances sharing of information among echelons of command.

Its successes provided valuable intelligence to the field commanders and demonstrated the simultaneous and synergistic possibilities of certain multiechelon intelligence operations.

WSN technology would produce revolutionary effect on the military defense and signify the arrival of the new electric eye and electric ear for the large scale battle, reshaping the battlefield coalition environment in the coming near future**.** And when the warfare is changing from the large scale, attack vulnerable pattern to the small, smart pattern accurate command and control is becoming increasingly important. Together with the increment of the task assigned to single war fighter situation awareness capability will be the necessity of coordinating the mobile fighting. A summery report from the Defense Advanced Research Project Agency shows that in the future warfare the combatant army will be deployed extensively in the every corner of the battlefield, ever more situation awareness data will be needed to enforce their fighting effect.

Wireless sensor networks can provide information acquirement anytime and anywhere by collecting, processing, analyzing and disseminating data [2]. Because of their reliability, accuracy, flexibility, cost effectiveness and ease of deployment, sensor networks are being used widely to build a self-organizing wireless networks for various battlefield situation awareness applications. Compared with the independent satellite and ground radar, wireless sensor nodes are distributed in the way of combining omni-dimension and full direction, enhancing the SNR (signal to noise ratio) effectively. Sensor nodes can be closely attached to the target, greatly reducing the noise influence to the system performance. Various kinds of sensor nodes can be used to realize the reconnaissance or surveillance of the different targets and the mix of sensor nodes can benefit the improvement of the capability index. By applying some mobile sensor nodes can adjust the network topology while eliminating the shadow and blind spot in the vast probing area.

2 WSN Architecture

The function and the elements of a sensor node are: sensing unit, processing unit, communication unit, and power unit, as shown in Fig. 1.

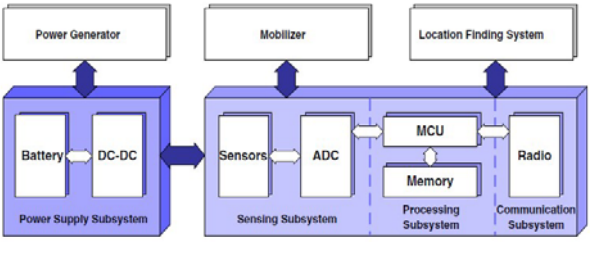


Fig. 1. The components of a sensor node

A sensing subsystem including one or more sensors (with associated analog-to-digital converters) for data acquisition; a processing subsystem including a micro-controller and memory for local data processing; a radio subsystem for wireless data communication; and a power supply unit. Depending on the specific application, sensor nodes may also include additional components such as a location finding system to determine their position, a mobilizer to change their location or configuration (e.g., antenna's orientation), and so on.

A sensor network usually consists of one command node, several base stations, known as the information sink [3] and a large number of sensor nodes, as shown in Fig. 2.

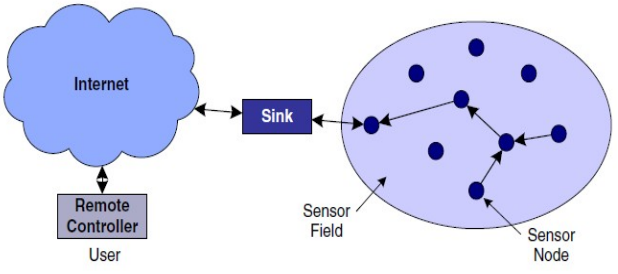


Fig. 2. The structure of a wireless sensor network

- Sensors - small, inexpensive, battery-powered devices that have limited residual energy, computation, memory, and communication capacities.
- Base station - a gateway that is computationally powerful and connects sensors to the command node, which is not constrained in energy, computation, or communication capacities.

WSN protocol stack [4] contains physical layer, data link layer, network layer, transport layer and application layer. Besides it also contains three platforms: energy management platform, mobile node management platform and task management platform.

3 WSNs Characteristics

Unlike wired and Mobile Ad hoc Networks, wireless sensor networks are infrastructure-less and can operate in any environment as compared to the traditional networks. Wireless sensor networks mainly consist of large number of tiny and simple nodes that are randomly deployed in operating areas unattended [5] [6]. Those nodes, known as sensors, collaborate to establish networks that are able to capture accurate and reliable information from harsh physical environments where the implementation of conventional measuring technologies is infeasible.

- Auto-configuration

A WSN will configure most of its operational parameter autonomously; independent of external configuration—the sheer number of nodes and simplified

deployment will require that capability in most applications. Nodes should be able to determine their geographical position only using other nodes of the network (self- location). And the network should be able to tolerate failing nodes or to integrate new nodes.

- Multihop wireless communication

While wireless communication will be a core technique, a direct communication between a sender and a receiver is faced with limitation. In particular, communication over long distance is only possible using prohibitively high transmission power. The use of intermediate nodes as relays can reduce the total required power, so multihop communication is a necessary ingredient.

- Energy-efficiency

Wireless sensor nodes can only have a limited power source, and their working duration largely relies on battery lifetime. So, one of the key challenges is how to efficiently disseminate the data from remote sensor nodes to the sink node through a network that is limited in power and prone to failures.

- Collaboration and in-network processing

In some applications, a single sensor is not able to decide whether an event has happened but several sensors have to collaborate to detect an event and only the joint data of many sensors provides enough information. Information is processed in the network to achieve the collaboration instead of having each node transmit all data to an external network and process it "at the edge" of the network.

4 WSN Supporting Technologies

After deployment another important factor of the sensed data is to know where it is. This is the basis of knowing the position where the interested event happens. Position information contributes to achieving the following purpose: target tracking, simultaneously monitoring of the target track, prediction of the target advancing track, routing coordination, network management and so on.

WSN operates in a distributed way. The synchronization of the sensor nodes is a key mechanism and it is the basis of estimating the target velocity and direction. Besides a small amount of sensor nodes have the synchronization hardware, such as GPS (Global Position System), most of them use time synchronization mechanism to exchange with other nodes in the network. The following factors should be taken into account when making the design: scalability stability, energy efficiency [7] [8], robustness, and convergence.

Generally the information collected by each sensor node will take in-network processing instead of being sent to the central node for analysis and processing. This will significantly reduce the energy consumption and prolong the lifespan of the network.

The sensor node would fail at any time and the network layer can only guarantee very limited QoS (Quality of Service). The constrained computability, memory and power supply urges utilization of some new inquiry and analysis technologies to deal with the continuous data flow produced by the nodes which work in a distributed and coordinated way.

It is not workable for each node to transmit the collected data to sink individually because of the bandwidth waste and low efficiency. Date aggregation technology

should be used in the process of data acquirement to save energy, secure more accurate information and enhance the overall efficiency.

In general, there are three main threats to wireless sensor networks [9] [10]:

- Eavesdropping

  An attacker gains access to confidential information by monitoring communications among nodes.
- Injection and modification

  An attacker injects malicious information into the network or modifies commands or data transmitted among nodes.
- Senor compromising

  An attacker captures and tampers sensors to extract cryptographic secrets, reprograms or replaces them under the control of the attacker.

5 Current Projects

In 2000 DARPA launched the SensorIT program which aims to provide support rapid deployment and high level adaptation to the dynamic coalition battlefield in the warfare by ad hoc sensor network. As a part of the program SSN (Smart Sensor Network) is composed of a number of computable low-cost low-power consumption sensors. It is deployed to surveillance the ambient temperature, lightness and vibration, even to detect the existing of the radiant materials or poisonous chemicals. In the target area these unattended sensors are deployed to detect the mobile target which contains a certain amount of heavy metal, an ability meaning the special military purpose, such as indirectly detecting and locating the mobile enemy tanks or other ground vehicles by sensing the acoustic waves or vibrating waves they produced while moving. SSN helps to improve the existence capability of the future combatant system.

Based on the research in 1997 DARPA began to implement the Situation awareness system plan and included it as a part of the small scale fighting unit. DARPA's SUO SAS (Small Unit Operations Situational Awareness System) has developed a self-forming, self-healing ad hoc communication system for dismounted war fighters operating in difficult and complex environments, such as urban and wooded terrains. The SUO SAS is an individual war fighter communications system that provides support for training, mission planning, mission rehearsal, mission execution, and post-action analysis activities. It provides each soldier access to comprehensive and shared situation awareness (SA) information, as well as access to battlefield applications.

Cooperative Engagement Capability (CEC) [11] brings revolutionary new capability to naval air and missile defense, not by adding new radars or weapon systems, but by distributing sensor and weapons data from existing systems in a new and significantly different manner. CEC fuses high quality situational awareness data from participating sensors and distributes it to all other participants in a filtered and combined state, using identical algorithms to create a single, common air defense tactical display ("air picture"). The result is a superior air picture based on all sensor data available that permits significantly earlier detection and more consistent tracking of air contacts.

CEC provides real time integration of fire control quality sensor data into a single composite data source which can be used by multiple CEC ships and airborne units for direct and remote missile engagements. CEC significantly improves battle force anti-air warfare (AAW) capability by coordinating all force AAW sensors into a single real time, fire control quality composite track picture. CEC, when integrated with Anti-Air Warfare (AAW) weapon systems in a Battle Force (BF) or Surface Action Group (SAG), results in a distributed AAW weapon system among participating Cooperating Units (CU's). Successful AAW in a BF or SAG relies on coordinating and controlling AAW assets among AAW-capable ships. As threat inventories increase and hostile counter-measures become more sophisticated, fleet AAW movements must address individual ship AAW capabilities and coordinate the sensors and weapons of individual ships into a cooperative BF or SAG distributed AAW system. Data sharing from primary AAW sensors of a BF provides timely, accurate data ensuring greater engagement decision and prosecution responsiveness in case of battle engagement. Further, coherent, high-quality sensor data and engagement status information shared among multiple ships automates engagement decisions.

6 Future Big Awareness in the Future Battlefield

Compared with the traditional battlefield situation awareness concept a new idea" big awareness" is presented. Big awareness [12] consists of not only battlefield intelligence awareness, but also battlefield ambient awareness, battlefield action awareness and battlefield information network situation awareness. And most importantly, including the awareness of all operational assets concerned in the actual battlefield.

Big awareness aims at the knowing everything of the battlefield. It shows that up to now US army has established the multisensor information network which has very strong operational awareness advantage, showing as an embryo of the Internet of Things appeared in the military application. DARPA (Defense Advanced Research Projects Agency) has developed the low cost semi-automatic ground sensors which can be rapidly deployed in the battlefield and integrated with all other sensors set in the satellites, aircrafts and ships or fleets, to realize reconnaissance, surveillance. Internet of Things can finish the information processing, transmitting and utilizing procedure which would take hours or longer time within several minutes, seconds or even in a synchronized way and achieving the purpose of being aware of every corner of the battlefield in the wartime.

Construction of the "awareness battlefield" contains the following points: 1) incorporate the ground, sea, sky, space reconnaissance surveillance system. 2) strengthen the connection between the battlefield information network and the system; 3) accelerate the comprehensive battlefield multi source data fusion 4) pay attention to the time-spatial accuracy and consistency which contribute to the uniform situation, thorough cooperation and accurate action, foundation of the joint operations.

7 Conclusions

Information warfare is the trend of the modern warfare. Battlefield situation awareness is the basis of the warfare operation. By WSNs which provide real time,

accurate intelligence operational advantage is seized by the combatant units for the rapid response or decision making. WSNs are self-organizing, easy of deployment and destroy-resistant. Its unique characteristic makes it widely applied for the battlespace intelligence acquirement task. And as an essential part of the incorporated information system, WSN technology would take larger share, dispelling "the heavy fog of war" which would cover the future battlefield.

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Study of ZigBee Wireless Communication Network Based on SPCE061A

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Abstract. To realize wireless communication among SPCE061As, studied construction of ZigBee wireless communication network and ZigBee protocol in the paper. Using SPCE061As and CC2420s designed ZigBee nodes and created a ZigBee wireless communication network. To make use of the ZigBee protocol, realized wireless communication among SPCE061As. It lays the foundation for developing ZigBee network using Micro control unit of SPCE061As.

Keywords: ZigBee; IEEE802.15.4; SPCE061A; CC2420; wireless communication.

1 Introduction

Since May, 2003 ZigBee protocol was approved, in just 7 years ZigBee has gained a rapid development because it has many characteristics of small field, short range, low power consumption and low cost etc. Physical layer and link layer protocol of ZigBee technique mainly adopt IEEE802.15.4 standard, but ZigBee alliance be responsible for the development of network layer and application layer, and draw up its safety agreement and market to expand etc.

IEEE802.15.4 defines three physical layer standards, they are 2.4GHz physical layer, 915 MHz and 868 MHz physical layer. 3 physical layers are all based on direct sequence spread technique (DSSS), use the same physical layer and data wrap format. Among them, 2.4GHz band is the free in world, there are 16 channels, it can provide 250 kb/s data transmission rate, and adopt Offset-Quadrature Phase Shift Keying (O-QPSK) modulation technique, 915 MHz and 868 MHz are ISM band of the United States and Europe respectively, the introduction of two segments avoided the mutual interference of various wireless communication equipments in the neighborhood of the 2.4 GHz. There are 10 channels in 916MHz band, the data transmission rate is 40 kb/s, but there is only a channel in the 868 MHz band, its data transmission rate is 20 kb/s, and two segments all adopt BPSK modulation technique. The effective overlay scope of three bands is about between 10~75 m. ZigBee network can adopt star type, tree type and mesh network structure. A master node can manage up to 254 sub-nodes in a ZigBee network; the master node can also be managed by previous network node. It at most can constitute a big network of 65000 nodes. There may be 100 ZigBee

G. Shen and X. Huang (Eds.): ECWAC 2011, Part II, CCIS 144, pp. 450–455, 2011.
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networks at the same time inside an area, and to constitute network is easy. One of its characteristics is safety; ZigBee provides a data package of Cyclic Redundancy Check (CRC), and integrality check function. It supports authentication and certification, using ASE-128 encryption algorithm. Safety attribute of each application can be confirmed flexibly. As a result, it will have a fine application prospect in family automation and building group network supervision and industry automation etc.

2 Zigbee Network

There are 3 kinds structure of star type, tree type and mesh network type in the ZigBee network. The simplest and common network is star type.

2.1 The Typical Zigbee Network Topological Structure

The Typical Zigbee Network Topological Structure is shown in Fig. 1. The work way is a master and slave type.

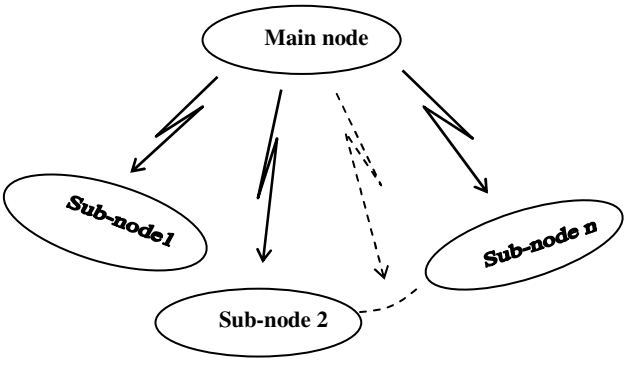


Fig. 1. Star type wireless network construction

Because its characteristic is low-power and portable etc, use core part is a low-power microcontroller. Therefore, study of wireless correspondence between low-power microcontrollers is the core contents of ZigBee communication.

2.2 The Typical Zigbee Node Structure

A typical ZigBee node mainly is composed of a Radio Frequency (RF) transceiver and a low-power microcontroller. According to ZigBee protocol stack request for microcontroller and RF transceiver. Many microcontrollers and RF transceivers can be chosen. In this design ZigBee node is composed of SPCE061A and CC2420 RF transceiver. They all have a Serial Peripheral Interface (SPI), can interconnect through this interface. The composition of ZigBee node is such as Fig. 2 shown. Among them, the controller SPCE061A is a master device of SPI, while the RF transceiver CC2420

is a slave device of SPI. Controller realizes IEEE802.15.4 Media Access Control (MAC) layer and ZigBee protocol layer.

Controller SPCE061A is a 16-bit Micro Controller Unit (MCU) produced by Sunplus Technology Company. Its characteristics are a small size, high integration, low voltage (3.3 V), and low-power etc. It embedded 32K words FLASH memory, provide with Integrated Development Environment (IDE) designed by Sunplus Technology Company oneself for 16-bit MCU. Using IDE can realize online real- time imitation and program writing. Use is very convenient.

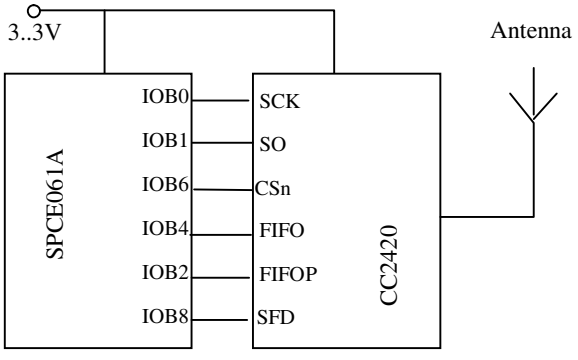


Fig. 2. ZigBee node receive circuit

CC2420 is produced by Chipcon Company with 2.4 GHz band RF transceiver. Its transmission rate is 250 Kb/s. its time waked is less than 30ms, low voltage (3.3 V), low power. It realize ZigBee physical (PHY) layer and MAC layer, with 65000 nodes channels and are free to expand and have the carrier sense multiple access with collision avoidance (CSMA-CA) channel status detection features.

CC2420 needs only a very few outer component and can work. Its outer circuit includes three parts of a crystal oscillation clock circuit, radio frequency input/output match circuit and microcontroller interface circuit. The chip oscillation signal can be provided by outer crystal oscillator; can also be provided by internal electric circuit. When oscillation signal is provided by internal electric circuit it needed addition a crystal oscillator and two load capacitors outside the chip. The size of capacitor was decided by the frequency of crystal oscillator and the capacitive impedance etc. parameter. Radio frequency input/output match electric circuit mainly uses to match input/output impedance of the chip. CC2420 with 4-wire SPI bus (SI, SO, SCLK, CSn), through this interface you can set the chip operating mode, and can achieve read/write operation for buffer and status register etc. By controlling the state of first in first out (FIFO) and FIFOP pin can control launch/receive buffer. In the data transmission CSn pin have to always remain low. In addition, through state setup of CCA pin can clear passage estimate. Through SFD pin setup can control the timed-input of information. Such as figure 2 shown is the connection circuit of CC2420 transceiver and SPCE061A MCU. Because CC2420 and SPCE061A all use 3.3 V power supply, entire circuit can use two 5# batteries, make the electric circuit designed easy and lower cost.

3 Zigbee Correspondence Protocols

ZigBee communication protocol is IEEE802.15.4 correspondence agreement. It is designed to construct the wireless communication network of a short range and low power.

3.1 IEEE802.15.4 MAC Data Package

The maximum length of IEEE802.15.4 MAC data package is 127 bytes. Each data package all is composed of the head byte and 16-bit CRC. 16-bit CRC validate the frame integrity. In addition, the IEEE802.15.4 can also choose the data answer mode. Make use of this method, frames that all ACK flag bit is 1 for all will be received by their receiver. If ACK flag bit is set when the frame is sent out, and didn't receive answer in a certain time, sender will repeat sending according to fixed times. If still no answer and then declare occurrence mistake.

3.2 Network Configures and Network Relevancy

ZigBee wireless network can use multiple types of network configuration. If use a star type network configure, it can be composed of a controller (master) and one or several terminal (slave). All terminals communicate only with controller. According to the system need, the controller is going to store all network relevancies in non-volatile memorizer. It is called as adjacency list. In order to connect a network, the terminal equipments probably carries out an isolation notice process to check the network connect with it before or perform connection process to add a new network. Under performing the process of isolation notice, controller will find its adjacency list to identify the terminal equipments connected with it. This design uses a star type network to realize communication.

3.3 The Endpoint, Interface and Endpoint Binding

The typical ZigBee node can have a variety of features and function, in order to transmit the data between the I/O node and two controller nodes, the applied program in all nodes have to retain multiple data link. For reducing cost, the ZigBee node only uses a wireless channel and multiple end/interface to establish multiple virtual link way or channels, there are 8 interfaces in each endpoint. Terminal equipments always correspond with coordinator in the star type network, coordinator send the data from a node to another node. So, while building up a new network, have to tell coordinator how to create link way between source endpoint and target endpoint, ZigBee protocol use a special process that is called as endpoint binding to realize the link connection of network.

3.4 The Data Transmission Mechanism

The mechanism of sending data to terminal equipments and data come from terminal equipments is different in different network type. In non-beacon star type network, while a terminal equipment want to send data frame it need to wait for the channel

becomes idle. When the idle channel is detected, it will send the data frame to controller. If controller wants to send this data to the terminal equipments, it will save the data in buffer, until the target terminal equipments specifically query the data.

3.5 Protocol Stack Architecture

In this design, the protocol stack is written in C language, and protocol stack use the internal flash memorizer to store MAC address, network list and binding list, therefore, have to use MCU with flash memorizer of self-programmable.

Table 1. ZigBee protocol architecture

5	Application framework	ZigBee device object
4	Application support layer	
3	Network layer	
2	Media access control layer	
1	Physical layer	

Table 1 is the protocol architecture. The protocol is divided into multiple layers according to the definition of ZigBee norm. The code to implement each layer is located in an independent source file, but service and Application Program Interface (API) is defined in the head document. To implement abstraction and modularity, the top layer always through a well-defining perfect API and followed the next layer API to interact. The layer C head files define the level supported the entire API. User application program always associate with the Application Support sub-layer (APS) and the Application Layer (APL) interaction. Typical application program always associate with the application layer (APL) and the application support sub-layer (APS), APL module provides management functions of high-level protocol stack. User application program use this module to manage protocol stack function APS layer mainly provides ZigBee endpoint interface. The application program will use this layer to open or close 1 and multiple endpoint, and obtain or send out a data. It yet provide original language for the Key Value Pairs (KVP) and message (MSG) data transmission When first programming the controller, the binding list is empty, the main application program have to call a correct binding API to create new binding entry. APS yet has an indirect sending buffer RAM, and uses to save an indirect frame, until the target receiver requests these frame. MAC_MAX_DATA_REQ_PERIOD compilation time option defines accurate request time. The longer the nodes data request time, the longer the data package to store in indirect buffer. The longer the data request time is, the greater the indirect buffer space need. The network (NWK) layer is responsible for creating and maintaining network link, it independently processing incoming data claim, correlation, discharge associated and isolation information request. The ZigBee Device Object (ZDO) is responsible for receiving and managing the different request of remote device. Media Access Control (MAC) layer realize function of IEEE 802.15.4 norm request, and be responsible for interaction with Physical (PHY) layer.

4 Conclusions

ZigBee is the standard wireless network protocol. It is designed for low rate control network. It has a number of applications in home automation, buildings safety, industry control, remote meter reading as well as PC peripherals. This paper use SPCE061A and CC2420 to realize ZigBee communication. From the ZigBee node hardware and ZigBee communication protocol and protocol stack, introduce the ZigBee network composition.

Acknowledgment. This work was supported by Natural Science Foundation of China, Grant No. 50372036. I am deeply grateful to my wife and daughter for helping to make this paper possible. Thank all people for helped us. I yet think to thank all persons for helping me.

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