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Relationship Between Maximum Basal Aarea

Carrying Capacity and Maximum Size-density Rrelationships

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Abstract

Two important concepts in forest stand density management — the maximum basal area carrying capacity and the maximum size-density relationship (MSDR) for individual stands — are mathematically related. For stands with a MSDR slope less than 2, maximum basal area carrying capacity will occur after a stand has reached its MSDR stage of stand development, or after Reineke's SDI has been maximized. Maximum basal area carrying capacity and the MSDR stage of stand development will occur simultaneously in a stand that has a MSDR slope equal to 2. If a MSDR's slope is greater than 2, a stand will reach its maximum basal area carrying capacity prior to reaching its MSDR stage of stand development.

Keywords: Reineke, SDI, Stand density, Stand density index

1. Introduction

Maximum basal area carrying capacity and Maximum Size-Density Relationships (MSDRs) are commonly applied concepts in the management of forest stand density. This note elucidates the relationship between individual stand maximum basal area carrying capacity and individual stand MSDRs — what Weller (1990) called a dynamic thinning line. For this paper, our definition of maximum basal area carrying capacity is a modification of The Dictionary of Forestry's (Helms 1998) definition for carrying capacity:

"The maximum amount of basal area of a given species that can be sustained on a long-term basis within a stand"

Herein the tree per hectare — average stem diameter MSDR, commonly referred to as Stand Density Index (Reineke 1933), is examined rather than the tree per hectare — average tree volume MSDR, which is commonly referred to as the Self-Thinning rule. Stand Density Index (SDI) is expressed as:

$$SDI = TPH*[QMD/25.4]^b \quad (1.1)$$

Where:

TPH – trees per hectare,

QMD – quadratic mean diameter (cm), and

b – the MSDR dynamic thinning line boundary slope

Reineke (1933) originally determined *b* to be 1.6. However, studies have showed substantial variation in the MSDR dynamic thinning line *b* (Tang et al. 1994, del Rio et al. 2001) and reported that *b* could exceed 2.

Some growth and yield models have constrained stand development using basal area (Wykoff et al. 1982, Somers and Farrar 1991, Zhang et al. 1993) while others have constrained stand development using MSDRs (Maguire et al. 1990, Cao et al. 2000, Donnelly et al. 2001, Mack and Burk 2002). An interesting question is whether a stand that has reached its maximum basal area carrying capacity will also simultaneously have reached it's MSDR dynamic thinning line. If the two points occur simultaneously then limiting stand development using either of the two measures will produce the same constraints on yields (assuming both measures are correctly quantified). However, if the two concepts don't occur simultaneously, then

using one measure to constrain stand development could produce different estimates of stand development across a rotation than if the other measure was used to constrain stand development.

Others have briefly commented on the relationship between the two measures but, to date, a clear and reasonably complete discussion of the relationship does not appear to have been documented. The observation of Strub and Bredenkamp (1985) that "… asymptotic basal area implies that the SDI must eventually decrease and asymptotic SDI implies that the basal area must always increase…" applies only when the *b* is less than 2.

In their model describing MSDR dynamic thinning lines, Lloyd and Harms (1986) fixed the slope at 0.5. By rotating the axes from lnQMD over lnTPH to lnTPH over lnQMD, the *b* becomes 2 (same as basal area) where ln is the natural logarithm ($\log_{10}$ can also be used). The authors stated:

"Further, 0.5 is the value [the MSDR dynamic thinning line *b*] must take for basal area to remain constant, which is the expected response of stands after they have reached the carrying capacity of the site."

In order for the maximum basal area carrying capacity to be maintained across time, for a given change in tree density, QMD must change consistent with a *b* value of 2. Stated differently, the change in TPA given a change in QMD on the ln-ln scale must be -2.

Usually, basal area per hectare is a measure of the total stem cross-sectional area at breast height for a stand of trees. Basal area per hectare is a composite measure of two components; individual tree basal areas and numbers of trees per hectare. MSDRs express the relationship of the maximum number of trees per hectare that can be obtained for a given QMD (conversely, MSDRs can also be the maximum QMD that can be obtained for a given number of trees per hectare). MSDR dynamic thinning lines quantify how maximum numbers of trees per hectare for a given stand change with a change in QMD. Maximum basal area carrying capacity provides no information about limiting tree size-tree density relationships — only the maximum of the combination of the tree of average basal area and tree density. So, what are the mathematical and temporal relationships between these two measures of limiting stand density?

The answer depends on the MSDR dynamic thinning line *b*. Since it can be assumed that MSDR dynamic thinning lines are linear on the ln-ln scale, the value of SDI is constant when a stand is at its MSDR dynamic thinning line stage of stand development. Assuming a *b* of 1.6 and that the stand is at its MSDR dynamic thinning line stage of stand development, for a given change in tree density the change in QMD is consistent with a *b* of 1.6. Since basal area is composed of QMD raised to the second power:

$$BA = TPH*[0.00007854*QMD^2] \quad (1.2)$$

Where:

BA – square meters of basal area per hectare

basal area would continue to increase in this stand at the MSDR dynamic thinning line stage of stand development (Figure 1). Alternatively, by taking logarithms of eqn. [1], eqn. [3] is obtained:

$$lnSDI = lnTPH + 1.6*lnQMD - 1.6*ln[25.4] \quad (1.3)$$

And taking the logarithm of both sides of eqn. [2] results in:

$$lnBA = lnTPH + ln[0.00007854] + 2*lnQMD \quad (1.4)$$

For a MSDR dynamic thinning line *b* of 1.6, in order to keep lnSDI constant for any change in lnTPH, lnQMD must change consistent with a slope of 1.6. Thus, during the MSDR stage of stand development, or when lnSDI is constant, lnBA cannot remain constant since the slope on lnQMD is equal to 2 in eqn. [4].

If a stand's MSDR dynamic thinning line *b* is equal to 2, then the period of maximum basal area carrying capacity and the period when the stand is at its MSDR dynamic thinning line stage of stand development would coincide. Some MSDR models have fixed the *b* at 2 (Lloyd and Harms 1986, Voit 1988, Cao 1994). If a stand has a MSDR dynamic thinning line boundary *b* greater than 2, then basal area will decline when the stand is at its MSDR dynamic thinning line stage of stand development. Thus, for a stand with a MSDR dynamic thinning line *b* greater than 2, the period of maximum basal area carrying capacity would occur prior to the MSDR dynamic thinning line stage of stand development. Analogous to this, if a *b* value was 2, for the ages at which a particular stand would be at its MSDR dynamic thinning line stage of stand development SDI would be flat when plotted over age. If the *b* was not 2, then basal area per hectare would either increase or decrease depending on the value of *b*.

2. Conclusion

Maximum basal area carrying capacity and MSDR dynamic thinning lines are commonly used stand density measures and are also used to verify and regulate growth and yield models. In this note, the relationship between the two concepts for an individual stand was examined. For those stands that have a MSDR dynamic thinning line *b* of 2, the period at which the two measures occur will be the same. Thus, using either of the two concepts to constrain stand development would produce the same limits. If an individual stand's *b* is less than 2, a stand will reach its MSDR dynamic thinning line prior to reaching its

maximum basal area carrying capacity. Conversely, if a stands MSDR dynamic thinning line *b* is greater than 2, then a stand will reach its maximum basal area carrying capacity prior to reaching its MSDR dynamic thinning line stage of stand development. For either of the two latter cases, when exclusively using one of the two measures as a limit, the two density measures will produce different constraints on stand development and estimated yields should be different across a rotation.

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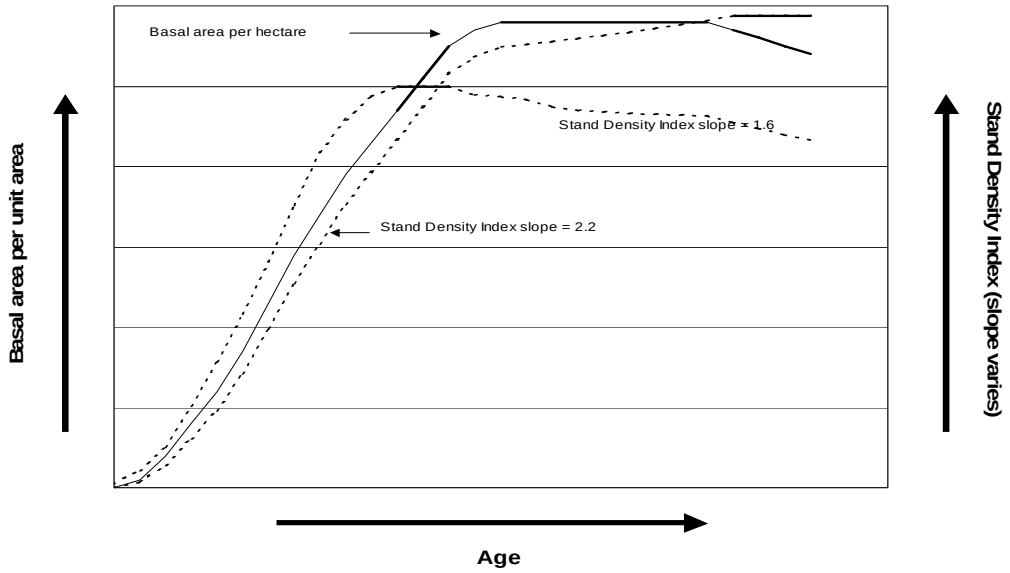

Figure 1. The Trend of Stylized curves of basal area per unit area (BA — solid line) and Stand Density Index (where $b = 1.6$, $b = 2$, and $b = 2.2$ — dashed lines) over age. Stand Density Index (SDI) with a $b = 2$ basically mimics the growth pattern of BA and for clarity was not included in the figure. For the BA growth trajectory, the first black bolded component corresponds to the maximum SDI value using a $b = 1.6$, the second bolded component corresponds to the maximum SDI value using a $b = 2$, and the final bolded component corresponds to the maximum SDI value using a $b = 2.2$. For the SDI growth trajectories with $b = 1.6$ and $b = 2.2$, the bolded components correspond to the period of maximum SDI.

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The Way to Internationalization for Small & Medium-sized Enterprises — Industry Cluster

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Abstract

With the globalization of the world economy, especially after China entering the WTO, it is an unavoidable trend for China's small & medium-sized enterprises to join the international competition. According to the analysis on the advantages and disadvantages of China's small & medium-sized enterprises, industrial cluster should be an efficient way for the small & medium-sized enterprises to reach the target of internationalization. By establishing and improving specialized industry clusters with regional uniqueness, China's small & medium-sized enterprises could have formed their core competing power in global competition and carry out their strategy of internationalization.

Keywords: Industry cluster, Specialization, Global supply chain, Internationalization

1. The analysis on the advantages and disadvantages of China's medium-small enterprises in international exploration

With the globalization of world economy, especially after China entering WTO, China's medium-small enterprises have to face the competition with multinational corporations and it is unavoidable for them to fight a way in the fierce global competition. The key point in global market exploration for any enterprise is to make the best use of its comparative advantages which can lead to core competing power in international competition. In the view of modern economics theory, there is probability for medium-small enterprises to survive and develop in international market because China's small & medium-sized companies have comparative advantages.

First of all, China's small & medium-sized enterprises are highly centralized in responsibilities, power and benefits, and thus they have a quick responding system in decision-making process. They usually start with primary products with low technology content and low added value. Therefore, they have a place in the segmented international market or in the global supply chain. Secondly, China's modern small & medium-sized enterprises have a short developing history and most of them have the features characterized by small scale of investment and unitary variety of products, which can meet the need of modern large-scale production. Finally, low-cost, low-price and high cost performance are the main competitive advantages in global market.

However, besides restraint from the external factors such as market, governmental and non-governmental system, China's small & medium-sized enterprises have also come across the restraints resulted by internal factors:

A. Shortage of capital and difficulty in financing. The shortage of finance resources not only holds back small & medium-sized enterprises in their exploring international market, but also stops them from strengthening their technological innovation or improving abilities of market exploration.

B. Lack of information. Because of the restriction of the limited manpower and material resources in small & medium-sized enterprises, most of them have invested little in establishing information system, still depending on primary ways in getting information, and thus, they could not get the useful information about the international market by using modern computer technology, which limited their abilities of exploring the global market.

C. Lack of core competing power due to limited technology and low innovating ability. Because most of China's small & medium-sized enterprises are lack of capital and talents, they are weak in technological innovation and can not have monopoly advantages which can be only obtained by high technology.

D. Lack of high-qualified international talents. When investing abroad, China's small & medium-sized enterprises usually

come across the problem of shortage of talents. The shortage of international talents has seriously blocked the way for the small & medium-sized enterprises to internationalization.

E. Low ability to withstand risks. According to statistics, less than one third of China's small & medium-sized enterprises are successful in exploring international market. The failure of their internationalization is mainly because of their small scale, shortage of capital and lack of talents. However, besides the reasons above, they don't have strong ability to withstand risks, especially the risks such as anti-dumping duty, political instability, fluctuation of exchange rate and etc.. Because of their weak ability to withstand risks, once they come across problems, they have to withdraw from international market.

2. Establishing strategy of internationalization based on industrial cluster of small & medium-sized enterprises

According to the features of China's small & medium-sized enterprises, they should consider the situation and capitalize on their strengths, avoiding following the large-sized enterprises, in exploring the international market. The current developing trend of international business and global supply chain requires not only international perspective but also localization, which provides good opportunity to China's small & medium-sized enterprises in international market exploration. Industrial cluster of small & medium-sized enterprises is characterized by "small enterprise, broad cooperation", "small product, big market", "small cluster, great achievement" and will be the mainstay in international market competition. Therefore, establishing industrial cluster of small & medium-sized enterprises should be efficient way in the global market fight.

2.1 The features of industrial cluster and its relation with the development of small & medium-sized enterprises

Industrial cluster is a group of enterprises which are close geographically and technically related. They are in the same industrial field and they come together due to their commonness and complementarity. They are a new form of enterprises, which are a new configuration of industrial development and new economic phenomenon in the developing process of modern industry. The enterprises in the clusters are distributed regionally which are characterized by specialized operation, market-oriented linkage and social cooperation, of which specialization is the most remarkable feature. The industrial cluster has very strong internal motive force of development and sustainable vitality with the close cooperation between enterprises within the same cluster.

The past 20 years witnessed the birth of China's modern industrial clusters, which are distributed mainly in Guangdong, Zhejiang, Jiangsu, Shandong, Fujian and etc. Zhejiang province covers 40% of the number of industrial clusters while Guangdong stands for 28.8%. Those clusters are mainly composed of small & medium-sized enterprises, which are concentrated in the same industry, such as the clothing industry in Ningbo and Wenzhou, the home electric appliance industry in the area of the Pearl River Delta in Guangdong, the textile industry in the area of circum-Taihu and etc. Zhejiang is famous for its clusters of small & medium-sized enterprises, such as the low voltage apparatus in Liushi, ties in Chengzhou, net rack in Xiaoshan and etc.. In 2004, Zhejiang had more than 150 clusters whose total production value exceeded 1 billion yuan, among which 30 exceeded 10 billion and 7 exceeded 20 billion yuan. Thus it can be seen that there is a natural inherent relation between the development of small & medium-sized enterprises and the Industrial clusters.

2.2 The advantages for small & medium-sized enterprises in joining international competition as clusters

Joining the international competition is helpful for the small & medium-sized enterprises to overcome their defects and thus generate competitive advantages.

2.2.1 Industrial clusters can help to improve the production efficiency of small & medium-sized enterprises

The clusters can help to obtain scale of economy in a certain industry in a specific region because the small & medium-sized enterprises cooperate with each other and thus form a loosely united cluster. Correspondingly, the cluster explores a larger market demand for specialized products and services. Scale of economy and opportunities of survival make the enterprises enter a benign circle and the efficiency of the whole cluster will be well improved.

2.2.2 Industrial clusters can help small & medium-sized enterprises to share the same brand

Most of China's small & medium-sized enterprises have weak brand consciousness and they can not afford for expensive advertising and establishing a brand. However, clusters can utilize the population effect and increase the advertising investment and establish their cluster brand. All the enterprises within the same cluster can share the cluster brand and benefit from it. Compared with the single brand of a certain brand, the cluster brand is more living and effective because it is the essence of all the enterprises in the cluster. The small & medium-sized enterprises can make the best use of the cluster brand in exploring international market. They cannot only distribute their products through wholesalers, but also can establish monopoly sale through franchised stores and thus gain the advantage of vertical integration.

2.2.3 Industrial cluster can help the small & medium-sized enterprises to reach information sharing and gain advantage of information

Due to the geographical nearness, the enterprises in the cluster can share the information about the products, market and competition in a convenient way. The cluster can establish one information center focusing collecting and processing

information. They can also set up offices abroad and get the first-hand information and send it back to the enterprises. Of course, all the enterprises will share the cost of it. In this way, the enterprises of the cluster will easily gain information advantage in an economic way and defeat the small & medium enterprises not belonging to any cluster.

2.2.4 Industrial cluster of small & medium-sized enterprises can help to develop core business and obtain core competing power

In the market competition, the industrial clusters are usually characterized by specialized industry with the cluster strategy of "one village, one product" and "one town, one industry" (see table 1). The enterprises do not take an all-out attack, but select one specific series of products, or become an important sub-contractor in the product value chain of transnational corporations. Each of the enterprises concentrates on its core business, focusing on the business at which it is best. In this way, the small & medium-sized enterprises of the same cluster have different advantages, different segmented markets with different specialties. And the enterprises can find their positions in the global supply chain and develop their core competing power.

2.2.5 Industrial cluster can help the small & medium-sized enterprises to strengthen the strain capacity and the ability to withstand risks

The industrial clusters provide opportunities for the small & medium-sized enterprises to develop together and help to reinforce the tie and relationship with the large corporations and thus strengthen their ability to withstand the risks.

In general, industrial clusters can help the small & medium-sized enterprises to bring their own advantages into play, foster strengths and circumvent weaknesses to find their own position in international market.

3. The starting points for clusters of small & medium-sized enterprises to realize successful internationalization

In order to enter the industry chains of transnational corporations and realize their successful internationalization, small & medium-sized enterprises must pay enough attention to the following:

First, the clusters must definite their goals and positions in exploring global market based on their own regional industrial characters and their advantages. If China's industrial clusters of small & medium-sized enterprises want to reach the target of internationalization, they have to choose a unique way and take their own specific advantages to enter the global market, which requires that the clusters should develop their own industry with uniqueness and build their own brand reputation. The key point of forming the characteristics of industrial clusters requires that the administrative department of clusters should not only utilize their specific material resources of their region, but also make their cultural resources integrated with the industry and develop a localized industrial environment, which can not be imitated by others. Meanwhile, technological innovation should be enhanced to support the regional brands. After gaining the advantage of regional brand, they could easily find their way of internationalization.

Secondly, the enterprises should adjust their production according to the market demands and the need of key customer. The enterprises in the cluster must get rid of their traditional mode of arranging production by plan. Instead, they should arrange production according to what the international customers demand, that is to say, establishing customer-oriented system. In cooperation with multinational corporations, high product quality and good credit standing are very important. The enterprises must keep contacted with large customers in order to develop supporting industry.

Thirdly, the enterprises should perfect the intermediary service system to foreigners and improve the services. The institutes of intermediary service system to foreigners plays very important role in dealing with multilateral affairs and supporting exploring international market. First, they are very important channel for the government to help the native enterprises indirectly exploring international market. Next, they play very important role in helping the native enterprises with complaining and defending affairs, such as anti-dumping, anti-subsidy, protection and etc. Then, they can help collecting information about other members' discriminatory action towards China's enterprises. Finally, they can provide information of international market, human resource training.

Fourthly, the role of government should be well definited and government support should be made best use of. International competition is not only just between enterprises, but between governments which the clusters and foreign market. Therefore, the government plays an irreplaceable role in helping the native enterprises exploring international market. First, the government should adjust its industry policy, taking the strategy of industry cluster into serious consideration. Secondly, the government should provide perfect community services and improve the local infrastructure, improving the local industrial environment.

Finally, the cooperation between enterprises of the same cluster should be reinforced and the overall strength of the cluster should be enhanced. In the developing of the enterprises of the same cluster, coordination is required in order to make them cooperate with each other and therefore synergistic effect can be brought. The coordination refers to two things: coordination between entrepreneurs and administrative coordination, which can help develop a good environment within the cluster and ensure the overall capacity of the enterprises in the global supply chain.

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Table 1. The geographical distribution of industrial clusters in Guangdong and Zhejiang

Guangdong Province		Zhejiang Province
Zhongshan	Guzhen Town: illmination	Wenzhou: Shoes, clothing, glasses
	Xiaolan Town: Hardware	Yiwu: Smallware
	Shaxi Town: Clothing	Shaoxing: Textile, chemichal fibers
Nanhai	Jinsha Town: Hardwaire	Yongkang: Hardware
	Pingzhou Town: Shoemaking	Haining: Feather, clothing
	Luolin Town: Leather	Yuyao: Light industry, molds
	Gongyao Town: Toys	Yinxian: Clothing
	Xijiao Town: Textile	Fenghua: Clothing
	Lundun Town: Woodworker	Cixi: Fishhook, Plush toys
Shunde	Lecong Town: Furniture	Yongjia: Button, pump valve
	Humen Town: Clothing	Luqiao: Household smallware
Dongguan	Houjie Town: Furniture	Chengzhou: Ties
	Dalang Town: Wool Textile	Jinxiang: Band, packaging
	Shilong Town: Electronics	Datang: Hosiery
	Shixie Town: Electronics	Ouhai: Valves
	Zhangmutou:Real Estate	Liushi:low voltage apparatus
Foshan	Shiwan Town:Ceramics	Taizhou: Fine chemicals

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A Primary Study on Making the Decision of the Selection of Multimodal Transport

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Abstract

When you drink a bottle of Australian wine, probably you will never ask youself the question how it travels from Australia to your country? The simple answer is that the international supply chain makes it happen. There are several factors are very important when multinational enterprises make the decision to select multimodal transport.

Keywords: International supply chain, Multimodal transport, Finished-products

International supply chains involve the physical distribution between countries or continents. To provide door-to-door service, most finished-product international supply chains choose the multimodal transport. Why they make the decision in selection of multimodal transport? There are 7 main factors to be considered, they are 'the character of goods, geographical location, length of haul, value density, transit time, reliability and cost.'

When we talk about the transportation, we have to start from the goods. For most finished-products, compare to the raw material, they are usually high value, standard package, and they need to be on the worldwide retailer's shelf every day. They are high value, so they need a safe transport mode; they are regular packed, they can be filled in a container; they are selling every day, they need a short transmit time or delivery on time. As to the above feature, the best way for finished-product is to transport them in a container that ensures door-to-door transport of containerized cargo from its origin to its final destination with efficiency and least possible risk. 'Containerization facilitates multimodal transfer and removes the need for enclosed storage space at ports and other freight terminals. It also reduces the risk of the goods being damaged or stolen while in transit.' One of the characters of international multimodal transport is using container, so multimodal transport is applied to most of finished-product.

The geographical factor of origin and destination decides the mode of transport. If you transport goods from some island countries, for example Australia, British or Japan, sometime you have to use at least two different modes of transport. If the origin or the destination or the intermediate countries of transportation have different terrains and transport system, for example British has a very good road transport system, China has an excellent rail transport system, some south American countries have inland water-way advantage, you need to combined two or more than two modes of transport by using these developed transport system. From the above, we could know that the transportation between countries and continents inevitably involves two or more than two different modes of transport in the whole transit.

The global transportation is always long distance transit. Long-haul modes such as rail, ship and air play really important role in long distance transport. Road mode is usually taken in the short distance transport, so just the road transport mode cannot satisfy the requirement of global logistics chain. How about any other single mode? Can rail, air or ship transport undertake the whole task of international supply chain? The answer is no. Because the rail transport is limited in one continent, the ship transport just links the continents and the air transport cannot carry too many goods at one time. None of them can reach everywhere of the world. If we combine them together, we will find that the multimodal transport can really get to any point you need to get in the world.

For high-value density products, which derive great benefit from rapid delivery, traditionally are carried by airline. 'For these products, high air-freight rates are more than offset by savings in inventory costs, yielding lower total distribution costs than movement by slower modes.' This kind of products also could be delivered by road transport. For example TNT and Federal Express, the trucks link the airport and the customer. For low-value density products, which benefit from the mass quantity of the products, the best way is rail or ship transport. This kind of products doesn't need a quick delivery, but a large quantity in one transit. The international supply chain system includes transporting both the high-value density products and the low-value density products. As to this situation, multimodal transport is necessary in an international supply chain.

The time and cost factor are the most important two of all the factors. When we talk about them we consider time and cost together. In making modal choices, we usually trade off one against another. The ship mode is cheap, but it takes too long. The air mode is the fastest one, but it costs too much. As to road and rail mode, you will find it is really difficult to balance the time and cost. The multimodal transport is the solution to the problem; it can trade off time and cost. Even for the multimodal transport itself, choosing different routes you will get different results. A good case is the UK-Greece corridor. In this case, if you combine the right modes of transport and choose the right route you will find a pleasant solution to transit the whisky from UK to Greece.

There is another case to show how the multimodal transport affects the time and cost and why the international supply chain depends on the multimodal transport. 'Carpet is exported from Nepal to European markets via Calcutta port. The carpets are containerized at Birganj, which is 165 kilometers from Kathmandu. The container trucks are cleared by Nepalese customs and, after an overnight wait at the Nepal-India border, enter Raxaul for clearance on the Indian side. The entire trip by road from Kathmandu to Calcutta port, plus the time in port averages eight days. This includes a two-day wait to enter the port. It takes an additional four days for clearing customs and loading the cargo on the vessel. The cargo is then shipped east to Singapore for transshipment to a larger ocean vessel heading west to Europe. The freight forwarders in Nepal are proposing the use of the port at Nhava Sheva (Jawaharlal Nehru Port Trust, or JNPT) on the western coast of India as an alternative to Calcutta once the Bhairawa ICD becomes operational (Map 8 at the end of this report). This would allow direct shipments to Europe instead of feeding through Singapore. The new route would be by truck from Kathmandu through Bhairawa to Nautanwa, India, where the cargo would be packed into containers. The containers would be transported to the ICD at Moradabad and placed on rail cars for shipment to Mumbai and the JNPT container terminal. Although the land transport distance is three to four times as far as the distance to Calcutta port, the ocean portion offers considerable savings in freight rates and shipping times.'

The following is the table for the comparison between the two different routs of multimodal transport.

Table 1.

Commodity: carpet ShipmentSize:1TEU Value: $90,000	Route: Kathmandu-Birgunj/Raxaul-Calcutta Port-Bremen		Route: Kathmandu-Bhairawa-Nautanwa-Moradabad-Mumbai-Bremen	
	Cost (US$)	Time (Hours)	Cost (US$)	Time (Hours)
Transport and handling				
Inland transport	480	117	740	88
Cargo Handling	260	74	463	155
Ocean Freight	1200	528	750	336
Cross-border Processing				
Cargo Transfer	261	164	125	37
Custom Inspection	405	20	202.33	7
Trade-related logistics				
Time cost	1252.45		864.09	
Insurance	675		675	
Documentation	450		450	
Bank fees	360		360	
Transport Cost	5343		4629	
Transport Time	903		623	

'It has the additional advantage of better productivity and fewer delays at Nhava Sheva than at Calcutta port. Table shows the cost and time comparison of the two routes. Although there is about a 14 percent reduction in cost for the route via the JNPT, the more substantial benefit is a 30 percent reduction in travel time from nearly 38 days to 26 days. The land route to the JNPT is more costly because of the longer distance, but the travel time is reduced by more than one day because of the higher speed on the rail connection between Moradabad and the JNPT. The three-day time for transferring cargo from truck to rail at the Moradabad ICD and 1.5 days in Nhava Sheva port is comparable to the six days spent at Calcutta port. The reduction in ocean transport time is substantial because the route from Calcutta is assumed to include a three-day voyage to Singapore and a five-day wait at Singapore for connection to the mother ship. The JNPT route time could be reduced by one day through tighter coordination in the packing of containers and loading on the rail cars. Further efficiencies could be

obtained if the transshipment from road to rail could be avoided altogether at Moradabad. With the operationalization of the rail ICD at Birganj, it would be feasible to ship containerized carpets all the way by rail from Birganj across India to the JNPT. Although the new route through Nhava Sheva offers substantial savings in time and cost for cargoes shipped to Europe, the same does not apply for shipments to Asia. The latter would require shipping the cargo from Nhava Sheva back through Singapore. Surprisingly, the difference in costs and time with this doubling back would not be that much greater than the route through Calcutta.'

From the discussion above and the case study, it is easy to know that when a company selecting the transport mode for an international supply chain, it should compare various modes and modal combinations, consider different routes and circumstances. Undoubtedly the multimodal transport is best choice for international supply chain, it could provide a successful door-to-door service and trade off the transit time and the transportation cost.

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Structure and Property of Mulberry Fiber

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Abstract

In this paper, the chemical ingredients of mulberry bast was tested by quantitative analysis. Our objective was to substitute the slow and difficult to control retting process by a fast and well controlled process, i.e. the two-step boiled process treatment (TSBP) of mulberry bast which was treated by mechanism. During the TSBP treatment the pectin, Lignin and hemicelluloses are hydrolysed and rendered in water or alkali-soluble, the fibers being more easily degummed. The TSBP treatment was among the best conditions for the degumming and individualisation of the fibers. The two-step boiled samples were tested. The results indicated that the length of mulberry fiber is 23.0-35.0mm, fineness is 2.3-3.5 dT, breaking tenacity is 5.0-10.0cN/dT, breaking extension rate is 3.5-5.5%, moisture regain is 9-10%. The samples were observed by scanning electron microscopy (SEM), and the morphological aspects of the mulberry fibers are discussed.Structural disruption was observed by X-ray measurement.

Keywords: Mulberry fiber, Chemical composition, Degumming, Properties, Microscope, X-ray

1. Introduction

Considering to environment, more and more people pay much attention to the natural fiber resources. It is important to research new natural fiber resources, with the development of these conventional textile fiber resources (for example cotton and bast, silk, wool and so on). The mulberry fiber is a kind of natural cellulose textile fiber, which obtained from mulberry bast by degumming. In recent years, the domestic and foreign researchers pay much attention to the mulberry fiber.

It is the glorious history to plant the mulberry trees and raise silkworms in China. There are many kinds of mulberry and they are distributed a considerable extent. Since then, the mulberry leaves was carried to raise silkworms, but after the mulberry leaf was picked, the rest of mulberry branches must be cut down. It provides the massive raw material to extract the mulberry fiber. The natural mulberry fiber was named “green textile” or “ecology textile”, it both has cotton's characteristic and many hemp textile fiber's merits. It has the vital significance to develop the mulberry fiber.

2. Experiment

2.1 Materials

The material used in this study were supplied by Weifang Shandong province in China. The bast of mulberry were scutched by manual treatment in order to separate the shives from the fiber bundle strands. All the mulberry fibers used in this research were degummed by the following technology. The mulberry bast were subjected to pretreatment with hydrogen peroxide (7g/L) and urea (10g/L)at 75℃ for 1.5h using a material to liquor ratio of 1:15 and pH 9. The two-step boiled process were extracted with 10g/L NaOH (100℃,1h)and 12g/L NaOH, 8% sodium polyphosphate, 8%sodium silicate (100℃,4h) using a material to liquor ratio of 1:10. After alkali extraction, the samples were washed with running tap water followed by distilled water until no alkali was present in the wash water.

2.2 Chemical analysis.

The chemical ingredients of mulberry fiber were tested according to the GB5889-86 Method of quantitative analysis of ramie chemical components.

2.3 Scanning electron microscopy

The original and steam exploded mulberry samples after several successive extractions, were observed using a KYKY-2800 scanning electron microscope operating at 20 kV, after sputter-coating with gold-palladium.

2.4 X-ray scattering analysis

The samples were cut and pressed into a disk using a cylindrical steel mold (Φ=1.3 cm) with an applied pressure of about 7000kg/cm^{2}in a laboratory press. Ni-filtered CuKa radiation (l=0.1542 nm) was generated at 40 kV and 35 mA using a Bruker D8 X-RAYS. The X-ray diffractograms were recorded from 10 to 44.5^o, 2θ (Bragg angle) by a

goniometer equipped with scintillation counter at a scanning speed of 0.05[i]/s and a sampling rate of 2 data/s.

3. Results and discussion

3.1 Chemical composition

From the literature, the chemical composition of mulberry varies, according to the species, the area of production and the maturation of the plant. Tables 1 shows the mulberry bast contain mainly cellulose(44.3%), lignin (9.6%),pectin (22.7%), water soluble substance (18.8) and a smallamount of wax (1.7%) and others.

Table 1. The Chemical Ingredient of mulberry bast and the other kind bast fiber (%).

	Cellulose	Lignin	Pectin	Water Soluble substance	Wax	Ash
Mulberry	44.3	9.6	22.7	18.8	1.7	
hemp	78.1	6.2	6.7	2.1	1.4	0.8
Linen	80.5	5.2	3.7	3.4	2.7	1.1

3.2 Physical properties

The fabric properties of the durability, feeling, draping and comfortable are affected by the length, fineness and regain of the fiber. Therefore, we research the several properties of mulberry fiber. The result was in table 2.

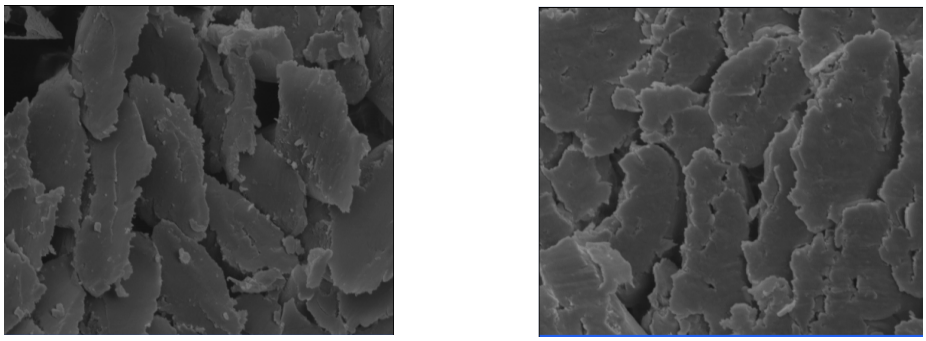
Table 2. The indexes of the mulberry fiber with the other natural fibers

	Mulberry fiber	Cotton	Linen
Length(mm)	23.0-35.0	23.0-31.0	60.0-250.0
Fineness (dT)	2.3-3.5	1.6-2.5	2.8-6.7
Breaking tenacity (cN/dT)	5.0-10.0	2.7-4.4	4.5-4.9
Breaking extension rate (%)	3.5-5.5	5-7	2-2.5
Moisture regain (%)	9-10	7-8	12.13

Table 2 shows that the length and the breaking extension rate of mulberry fiber are similar to cotton. The average fineness of mulberry fiber is thicker than cotton and it is similar to linen. The breaking tenacity of mulberry fiber is higher than any other fibers, and its moisture regain is lower than linen and higher than cotton, which indicates that the softness of mulberry fiber is acceptable.

3.3 Scanning electron microscopy

3.3.1Lateral-sectional structure



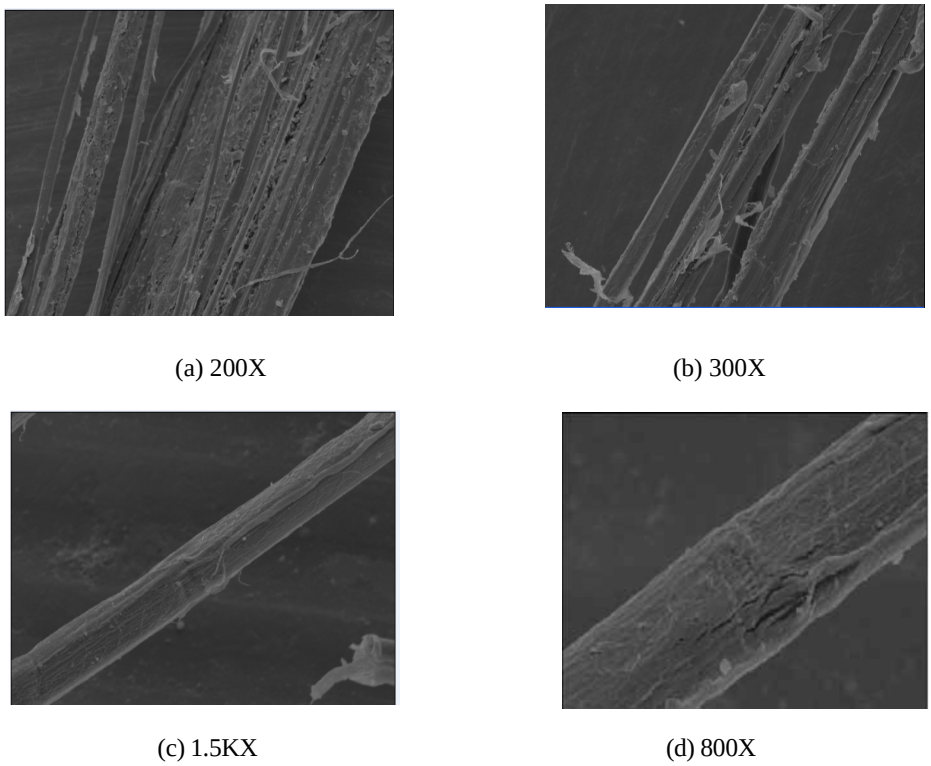
1.0KX 1.5KX

Figure 1. SEM of mulberry fiber

Figure 1 shows SEM photographs of the mulberry fiber lateral-sectional structure. The lateral-section structure of mulberry

fiber have some different shape, such as triangle, ellipse and polygons, in which the ellipse is majority. The lateral section center has the mesocoele.

3.3.2 The appearance of the mulberry fiber



(a) 200X (b) 300X

(c) 1.5KX (d) 800X

Figure 2. SEM images of (a) and (b) raw; (c) and (d) steam treated mulberry fiber.

Figure 2 shows SEM photographs of the original and steam treated mulberry fibers samples. It can be seen that most of the non-cellulosic components were removed after treatment. The fibers were separated into single. The surface covered with small lignin droplets and pectin is removed during the sodium hydroxide extraction, but the sodium hydroxide extraction resulted in some damage to the fibers. We can observe, the surface of the fiber is no longer smooth, but covered with grooves and ridges.

3.4 X-ray scattering results

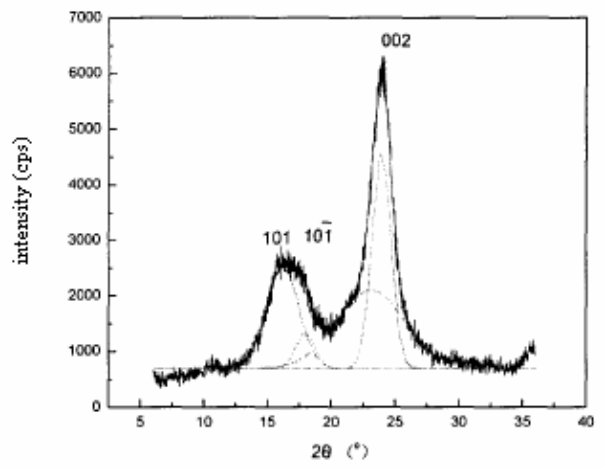


Figure 3. X-ray diffractogram of untreated and treated mulberry fiber

Figure 3 shows X-ray diffractograms of the untreated and steam extraction mulberry fibers. The major diffraction planes of cellulose namely 110, 11_0 and 020 are present at 15, 17, and 22.5º, 2èangle. Untreated fiber shows the characteristics of cellulose I. the alkaline treatment with NaOH caused no change to the cellulose structure. However, it caused an increase in intensity of the 020 plane. It is important to note that the crystallinity index was used to indicate the order of crystallinity

rather than the crystallinity of crystalline regions. This brought about the idea to measure the changing of each crystalline plane in cellulose separately. The crystalline order index was determined from the fraction of the ratio of the 020 to the sum of 110, 012 and 020 reflection areas. There was a variation of results in the solvent extracted sample. The crystallinity of fibers treated by NaOH was increased.

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The Measure and Control System in Parameters Testing Device of the Spindle Wings of Fly Frames

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Abstract

The programmable logic controller, touch panel and printer are applied in the parameters testing device of the spindle wings of fly frames, which realizes a new intelligentized control system. And then the hardware and software designs are introduced. The system has been used successfully in the parameters testing device of the spindle wings of fly frames, whose performance is reliable while the operation is very easy.

Keywords: PLC, Touch panel, The parameters testing device of the spindle wings of fly frames

1. Overview

Roving working procedure is one of the important procedures. The spindle wing is a crucial component which decides the roving machine' performance. During producing process, the cotton bar produced by the collateral bar procedure will be extended by the roving machine and twisted by the spindle wing and then winded on the canister pipe. To use the spindle wing press palm is to make the roving directing pipe coiled and to give pressure to the pipe cop so that they can be winded closely. The press palm of the spindle wing will produce centrifugal force to the roving pipe in high speed rotation so that it makes the roving wind asymmetry or too many breakers. It often arises quarrel between manufacture and the user. While the questions are main aroused by the unbalanced press palm strength. The distortion value arisen by the high revolving wing influences the roving machine's rotate speed and design structure. So press palm strength and distortion are two important parameters of the roving spindle wing. There aren't tests about it but only about the rigidity. For example, using the micrometer to measure the extended value and the corresponding speed. The disadvantage of above is: low measure precision, bad automatic testing method, and restrictive testing scope. It is of importance to develop high precision and high efficiency dynamic testing equipment in order to test whether the parameter is ok. The measure and control system in testing parameter's device of the spindle wings of fly frames will play an important role in measuring the dynamic press palm strength and distortion, investigating the structure of the spindle wing as well as improving the spindle wing quality. The characteristic of the device is: continuous measure of the dynamic press palm strength and distortion value, high precision, self-loading measure results, routine data statistic. It is a new design and has high technology content. The device can be used not only by the corporation and cotton factory that produce the spindle wing but the school referring to the textile and mechanism specialty.

2. System structure

The control system adopts Taida PLC: DVP-12SA.It supplies abundant instruction settings and has a 8K program memory including digital input/output (the max input/output points can reach 112)and analog module(A/D,D/A).It can communicate with PC through special cable. The program software is WPL soft. And the touch panel is HITCH PWS6600-S.With the touch panel we can set the parameters, choose the mode, regulate the rotate speed and direction, display the cause of the faults and the production's No., data, current speed, press palm strength, distortion value, radius display the press palm strength curve .The measured data can be recorded in graph. All data can be printed by the printer.

The system input is composed of several sensors and switches including two high pulse input photoelectricity sensor, two displacement sensor, one press sensor and two button switches and so on. The displacement sensor which tests the distortion value of the roving spindle wing's solid and hollow arm of force and the pressure sensor which tests the dynamic press palm strength both use the analog value .So DVP-04AD analog module of TaiDa is adopted .The system output is AC motor. The rotate speed and direction are written in the PLC register from the touch panel. The PLC can

control the converter to change the motor's rotate speed and direction. The system has two main working modes: testing the press palm strength mode and testing distortion value mode. The MCW-L (high prevision differential transforming DC displacement sensor) can test the pressure on the spindle wing. The PLC records the pressure when the radius increases and the velocity changes and the detailed data will be disposed and stored and then displayed on the touch panel in chart format. If needed, the history data will be printed. During the last mode, the MCW-L/D displacement sensor is chosen, which is a differential replacement transformer sensor and it changes the line moving mechanical variable into electricity one. Its nonlinearity is lower than 0.05(%F.S), the non-repetition rate is less than 0.05(%F.S), precision and high lag <0.05(%F.S).It can work reliably. Synchronously the instrument can test the shape variable of the sincere and hollow arm of force and dispose and store the detailed data. According to the data, the craftwork rules and equipment can be modified so that it can guarantee the reliability of the instrument. Among each part there are necessary mutual lock relations. When there is a fault all of the actions can be stopped immediately. During normal status, the rational reset can be required. When the reset button is pressed the hollow arm will stop at mechanism zero position.

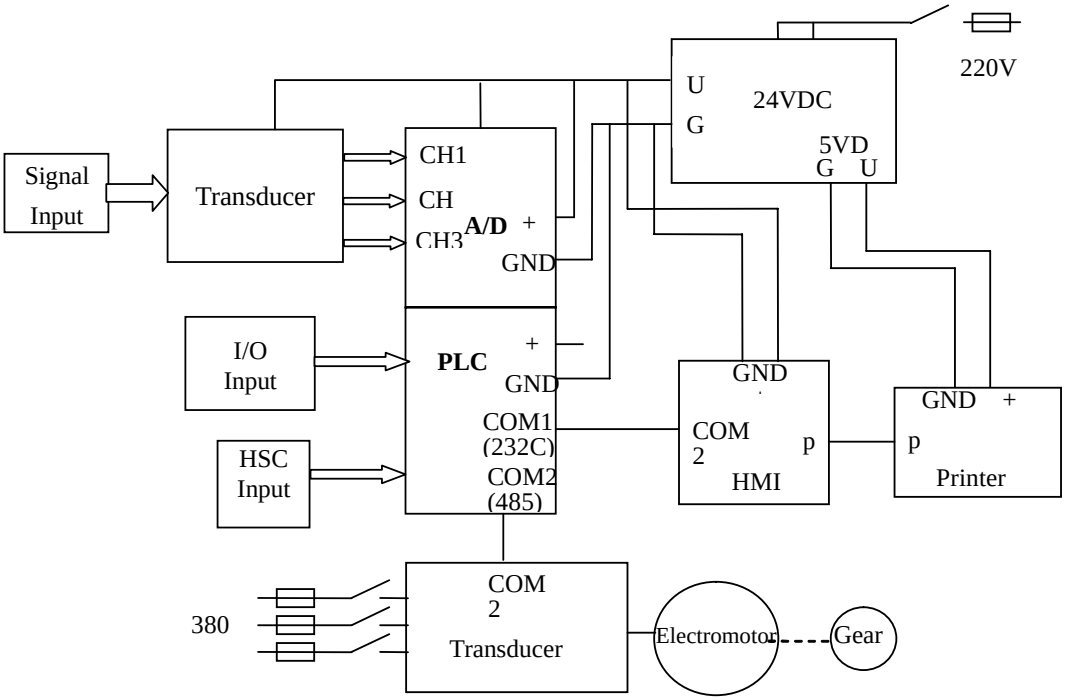

Figure 1. System circuit diagram

3. Software design

The program flow is shown as diagram2. When the machine starts to run, it will enter self check mode and the touch panel program will be executed and the work mode will be chosen. Firstly the equipment will enter self-test screen. The operator needs to input password before entering into the control screen and then chooses work mode, rotate speed, rotate direction and the production's batch number and spindle wing hatch width. If the width does not accord with the test requirements, the alarm will be brought and the equipment action will not be executed so that the reliability can be guaranteed. There are nine modules in the program design. I.initialized module: that is mainly to set the communication protocol, exceeding time, send requirement and read the data equipment's address and length. II. HMI design module. III. start-up and mode chosen module. IVtest and regulate rotate speed module: when the equipment is running, the program will test the wing's rotate speed and show on he HMI in real time. If the speed can not reach the requirement value, push the button to rectify the speed. V return to the initiative module: when the equipment shuts down, the hollow arm should be on the zero position (positioned by the photoelectricity sensor).VI. Abnormal status, urgency stop module: when the equipment goes wrong, all actions will be stopped, the program will jump END. VIItest the palm pressure module: firstly read the chosen rotate speed, direction and batch number on the HMI, test and store the palm pressure of the motor into D0 in low speed. Then calculate the spindle's max radium according to the import width so that the max displacement of the sensor can be known .The sensor can be protected by touching the arm wing. When the max displacement arrives, the motor will stop. As the palm pressure is monotonously changed with the increasing of roving pipe's radium .In order to make the test curve keep consistent with the real one, the program will set the pipe's radium. When it increases 2 mm, the press palm and the radium will be stored and recorded in the buffer. That can supply data for the palm pressure curve and can calculate the average palm pressure.

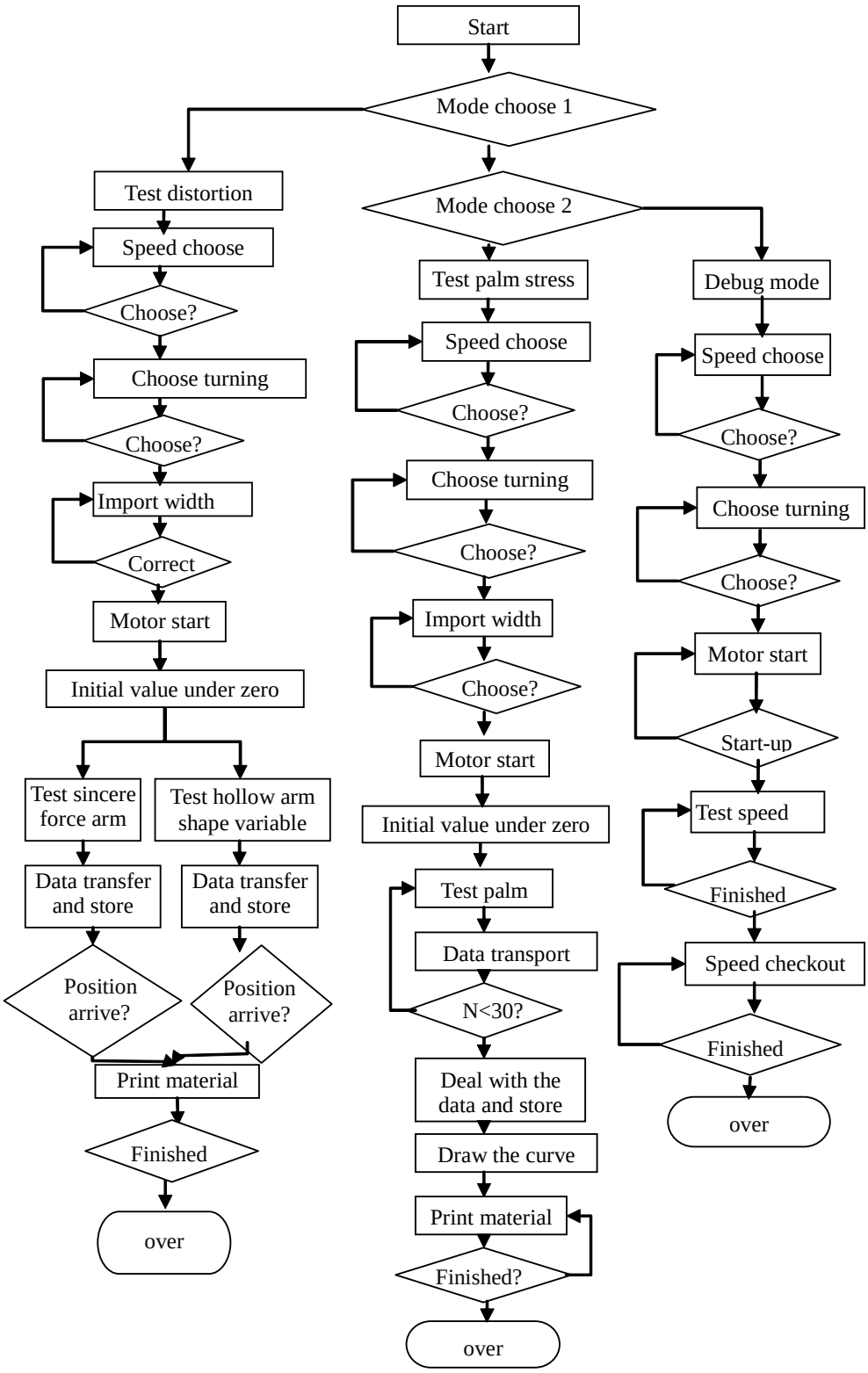

Figure 2. System flow

VIII.test the distortion module: firstly read the chosen rotate speed, direction and batch number on the HMI, test and store the initial value of the spindle wing's solid and hollow arm force and then store in D1, D2.In order to enhance the work efficiency, when the chosen speed of the motor arrives, 30 seconds will be countered. And then we think the distortion is steady and the value will be stored in D23, D24 and the buffer in order to supply data for the operators. IX.data store module: when the batch number is the same, 150 spindles' palm pressure values and 100 distortion values can be recorded while the batch number is changed, 200 batches palm pressure value and distortion can be recorded.

3.1Protract the palm pressure curve

Because we should test the palm pressure and protract the curve in dynamic mode, we design that the sensor move along the silk bar to simulate the spindle radium .In high rotate speed, the sensor will be distorted by the palm, the centripetal force of itself and the silk bar. The sensor mode decides that the A/D mode will collect the data in self test. That is $F_t=F_p-F_s$,, F_s is the composition force of sensor. The sensor contrail in the plane is near spire route and is very complex. During the testing, data is collected by equal space using the formula : $N_n(x) = f(x_0) + f[x_0, x_1](x - x_0) + \cdots + f[x_0, x_1, \ldots x_n](x - x_0)(x - x_1)\cdots(x - x_{n-1})$

For the test point (x_i, y_i), $x_i = x_0 + 2i$ (i=0,1,2,…, n)

$F_s = y_0 + \frac{1}{2}\Delta y_0(x - x_0) + \frac{1}{8}\Delta^2 y_0(x - x_0)(x - x_1)$. With this method, we can calculate different F_s and then add the test F_t, we can get the actual value. The result is better in this way.

3.2Hitech hmi

The HMI we use is ADP6.0, which is a Chinese and visual interface. It has strong real-time performance and good disposal capability and many rich, live multimedia screen so that it can deal with the real-time data. This ADP configuration soft has open structure and wide data adoption and data processing function. Meanwhile, it supplies good safety mechanism to provide different operating popedom. ADP supports much hardware equipment. It will not influence the whole system when there is a local change. The ADP configuration software is made up of two parts: ADP configuration environment and running environment which are isolated and related.

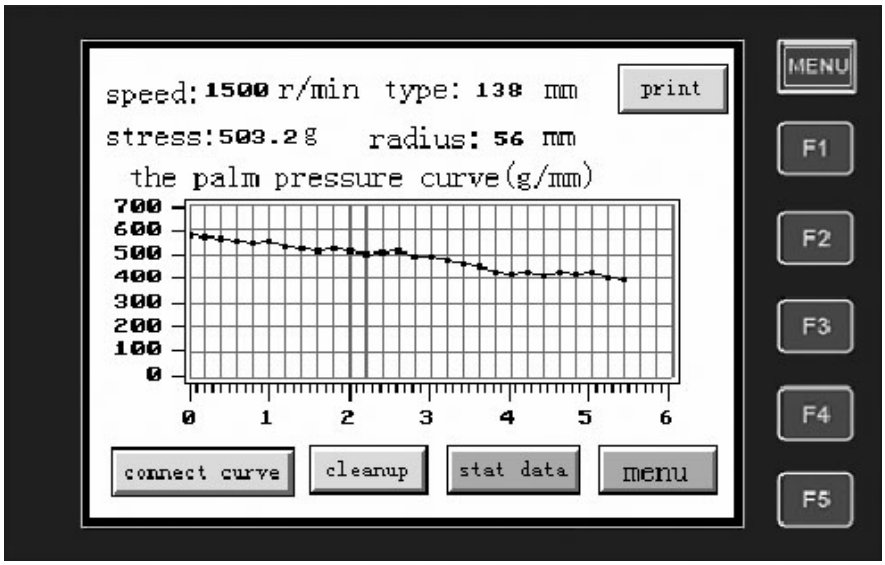

Figure 3. HMI drawing (curve of palm strength pressure)

According to the control process, the control interface of the roving spindle wing performance parameter testing instrument mainly has several parts: main screen, testing the distortion screen, testing press palm strength screen, regulating the speed screen and data screen and so on .The main screen helps the user operate the instrument correctly and give the responding clue with striking sign. Testing press palm strength screen and regulate the speed screen mainly help display the change trend of the press palm with the change of the radium, the parameter of the main working parts ,the history running trend picture and the printing message and so on.

4. The tag

Using the PLC and touch panel in the roving spindle system can improve the reliability and simplify the parameter setting and adjustment. It has intelligence so that the operators can work immediately without training. So the efficiency can be improved. The technique has been successfully used in spindle testing instrument in Tian jin textile factory.

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Independent Directorship and Corporate Performance: Some Further Testing from the China Case

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Abstract

This study attempts to re-examine several hypotheses suggested by the literature concerning the relationship between corporate governance and corporate performance using the data from China. The findings of the paper suggest that corporate performance in China is mostly influenced by other economic variables, not by corporate governance and the hypotheses that corporate governance will have positive on corporate performance is not valid. This poses a question for China as to whether the current top-down approach to corporate governance (which is largely based on duplicating the Anglo-American model) will be effective in linking the firm performance and independent directorship.

Keywords: Independent directorship, Corporate governance, Chinese economy.

1. Introduction

The relationship between corporate governance and corporate performance remains as one of the important topics in the literature of corporate governance. Corporate governance is expected to improve firm performance and efficiency and the use of independent directors is one important symbol of better corporate governance. However, one has been debating on whether there is an empirical relationship between them corporate performance and corporate governance/independent directors. There are two popular hypotheses concerning this empirical relationship: one is that companies with better corporate governance, usually represented by having independent directors, will lead to better firm performance and efficiency; another is that companies with higher percentage of independent directors on the board will improve corporate performance.

The empirical studies on the topic have been limited and inconclusive. In particular, one finds limited empirical studies on China in relation to the relationship between independent directorship and corporate performance. This paper attempts to apply the data from China to shed some light on this interesting topic.

2. Areview

Corporate governance has been an important topic for research, and the use of independent directorship, which is an important part of corporate governance, is the reflection of the change in modem business environment as shown by the more diversified corporate ownership, the separation between corporate ownership and management, and the increasing control of corporate management over the stake of the company. In order to avoid insider collusion or CEO's domination, more outside directors are preferred, especially those without any affiliation with the firm (see, eg., Fama, 1983 and Dalton et al., 1998). Therefore, it is suggested that independent directors will protect the interest of shareholders and improve corporate governance so as to achieve better corporate performance.

An independent director or "outside director" and/or "non-executive director", is defined as the director appointed by the company as a member of the board of directors who has no financial interest in the company and hence is independent of the management of the company (see, e.g. Jensen and Meckling, 1976 and Fama, 1980). Recently Jensen and Meckling (1976), Fama (1980), Fama and Jensen (1983), Word Bank (1999) has made more comprehensive discussions on the importance of independent directors. The similar arguments can be found in the studies by Kimber (1969) and Tricker (1978). As such, independent directorship have become a common practice for corporate governance in OECD countries, it is not uncommon that majority of board of directors are composed of independent directors in western companies (eg., a recent survey by Economist reveals that some 88% of American companies whose board of directors are largely represented by

external/independent directors).

The roles played by an independent director in improving corporate governance and corporate performance can be seen, as argued by in the literature, through his supervision and monitoring of the company management (ie., to solve the so called "agency cost"), his consultancy and advice to provide help in new technology, marketing and other expertise; his political role and connections, which will promote the marketing of the company; his "buffer' role to protect the interest of different groups between management, shareholders and the regulatory institutions; In particular, an independent director is expected to promote transparency and social morality of the company in complying reporting, accounting and disclosure requirements as set by the regulation. Thus, it will usually improve the image of the company in the eyes of public and hence promote reputation of the company, which will improve corporate performance.

However, the empirical studies on the relationship between independent directors and corporate performance have been inconclusive. On one hand, Rosenstein and Wyatt (1990) has found that there is significant and positive relationship between independent directors and share prices of the company, with a higher return on average. They also found that the percentage of independent directorship of the board of directors is positively correlated to the market value of the company. Friday and Sirmans (1998), base on a study on independent directorship and the wealth of shareholders from real estate investment trust, found that the wealth of shareholders will increase when independent directors have more seats of the board of directors. Further, Suchard, Singh and Barr (2001) have found that there is a relationship between CEO turnover and lagged performance rather than current performance, and further, non-executive directors and independent directors are more likely to monitor management. Block (1999) finds that the announcement of the appointment of an independent director is likely to produce positive abnormal returns. Ghosh and Sirmans (2003) argue that alternative monitoring mechanisms, including external directors must be in place to discourage deviant managerial behavior. Using a simultaneous equation system, they found that while independent directors enhance REIT performance, "Outside board members seems to enhance performance" (Ghosh and Sirmans, 2003, p.287). Similarly, Gomers, Ishii and Metrick (2003) found that firms subjected to effective corporate governance through stronger shareholder rights have higher market values, profit and sales growth and lower cost of capital. Lehman and Weigand, 2000) also indicated that corporate governance is associated with economic performance of firms.

On the other hand, Fosberg (1989) found in his empirical study that there is no relationship between independent directorship and corporate returns. In particular, he provided empirical evidence that a higher independent directorship percentage has no relationship with corporate performance. The similar finding can be found in William and Brown (1996), Hermalin and Weisbach (1988) and Bhagat and Black (1999). In particular, Ford (1988) has shown that a mixed board of directors where independent directors are included are doing much less satisfactory job than a board of directors, which only includes executive directors.

In particular, some scholars point out that incentives exist for collusion between independent directors and top management to the detriment of outside shareholders (Mangel and Singh, 1993). Some even argue that firm with a high percentage of independent directors may perform worse (Yermack, 1996). This is because inside directors have superior knowledge of the firm and its industry, who also work as diligent as outside directors, therefore, they can be more effective than those outsiders (Rosenstein and Wyatt, 1997). Further study from Bhagat and Black (1999) suggest there is no convincing evidence suggesting that greater independence results in better performance, but some evidence shows that firms with super-majority independent boards perform worse than others.

3. The Problem

Corporate governance and the use of independent directorship in China is a recent phenomenon as China has further reformed its financial market and corporate system. The use of independent director can be traced back to 1993, when TsingTao Beer H Share was listed in Hong Kong and was request to invite at least two independent directors into the board of directors. In 1997, 1999, 2000 and 2001, China has issued several regulations, which made provisions for the listed companies to include independent directors. As such, about 90% of the listed companies in China in 2003 have independent directors as opposed to some 60% in 2001.

Some typical problems frequently occur in the Chinese corporate world are the insider control issue, the unfair related party transitions and the highly concentrated state ownership in the corporate ownership. A number of corporate governance ranking surveys suggest that the practice of corporate governance in China is still lagging behind other Asian countries, such as Singapore, Korea, Malaysia, Thailand or the developing markets like Brazil, Romania, Czech Republic etc. (see., eg., Fremond and Capaul, 2002).

The state owns about 50% of all the shares of listed companies (Wu, 2003). According to a study by He (1998), there is highly concentrated ownership in Chinese company where the state as the so called "inside director" is the largest single shareholder. Figure 1 indicate that the state as a single shareholder owns about 1/3 of all shares in the listed companies, and the three major shareholders (and they are in most cases state-owned entities) account for most than ½ of all shares in the listed companies. It is found that about 50% of the listed companies where 70-80% of shares are controlled by these inside directors(Wu, 2003).

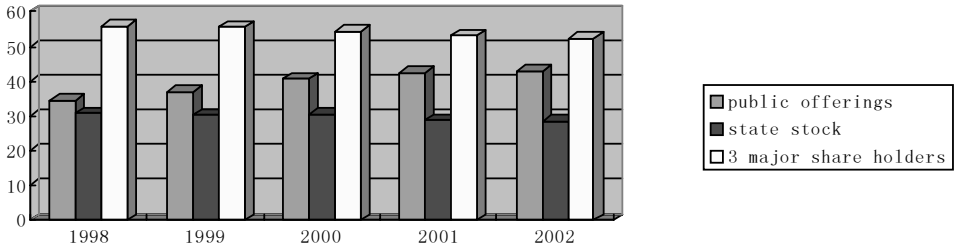

Figure 1. The Equity Composition (%)

The centralized ownership structure ultimately gives the leading shareholder the ultimate controlling power to determine firm's business movement and development. In order to protect the interests of nearly 60 million minority shareholders in China, CSRC has emphasized on strengthening board independence to improve corporate governance of the Chinese companies. And the "Guidelines for Introducing Independent Directors to the Board of Directors of Listed Companies" was released accordingly. Therefore, China has learned from the west and introduced independent directorship to improve corporate governance in China (Note 2) Lin (2001) argued that actual governance of corporatised Chinese firms are however seriously defective, characterized by excessive power of CEOs, insider control and collusion, lack of safeguards for minority shareholders and weak transparency, but above all, there is continued state dominance in ownership and control of the corporate sector and listed company. Therefore, independent directors will be one of the measures which improves corporate governance in China.

Chen (2001), based on cross-sectional relation between ownership structure and corporate performance of a sample of 434 manufacturing firms listed on the Chinese stock exchange, has found that there is a strong relation between ownership concentration and corporate performance. Xu and Wang (1999) investigated whether ownership structure and a mixed structure including independent director significantly affects the performance of publicly-listed companies in China. They found ownership is heavily concentrated: the five largest shareholders accounted for 8 percent of the outstanding shares in 1995, compare with 57.8 percent in Czech Republic, 79 percent in Germany and 33 percent in Japan. Their empirical analysis shows that the mix and concentration of stock ownership do indeed significantly affect a company's performance. Further, labor productivity tends to decline as the proportion of state shares increases. The results suggest the importance of large institutional shareholders in corporate governance, the inefficiency of state ownership, and potential problems in an overly dispersed ownership structure.

Fung and Leung (2001) argued that Chinese financial liberalization will have significant implications for corporate governance in China and independent directors will be vital for Chinese corporate performance. Mar and Young (2001) conducted a study which examined the extent to which listing of shares of Chinese state-owned enterprises on public stock exchanges – a key part of the on-going reforms – is associated with convergence of their corporate governance practices toward those accepted as global standards. Wei and Varela (2003) conducted a research, which examines the relation between state equity ownership ad firm market performance for China's newly privatized firms in 1994 (164 firms), 1995 (175 firms), and 1996 (252 firms). The overall results show that state ownership as a negative effect on firm value. One of the implications from their study is to improve corporate ownership by including independent directors.

Chen (2002) is among very few researchers who have done a preliminary empirical study on the relationship between independent directorship and corporate performance. Using the data from 53 companies, he has found that there is no relationship between the size of board of directors and corporate performance, and state stock has the most important impact on company performance. Most importantly, he found that there is a negative relationship between independent directors, measured as the percentage of independent directors in the board of directors, and corporate performance.

Current Chinese corporate governance model is largely a duplication of the Anglo-American model, and it has been pushed as a top-down framework in China. Tam (1999) argues that "[such an approach] is not effective and unlikely to serve its intended purposes unless complementary conditions can be created or developed," and further, there are "alternative functioning systems of corporate governance" (Tam, 1999, p.3).

It is thus obviously difficult for independent directors to achieve better corporate governance and firm performance due to its problem of "foreign seed being planted on the Chinese soil". The difficulty of making independent directors work in China lies in its cultural, political and economic roots arising from the old regime. Traditionally and culturally, an "outsider" to the company such as independent directors, if they have no CEO title, will not be respected for the opinions they wish to express. In come cases, the company executives are hostile to an outsider. The company will respond more to the CEO rather than to its independent directors. A survey conducted in 1999 by Tam (1999) shows an interesting finding concerning the attitude of company executives towards non-executive directors, or independent directors: about 64% of company executives (inside directors and mangers/supervisors) wants more company executives to join the board of directors and only some 30% of the surveyed believe there should have more outside independent directors. In such background, it is difficult

for independent directors to obtain the company information and to perform their job well.

The "independence" of independent directors is often questionable in China as independent directors are usually appointed through their old-time supervising ministries or current seemingly government-controlled shareholding company (a typical phenomenon in the transition phase in China as one of the "Chinese characteristics), or because he/she is the old mate of the CEO or the top executive. Therefore, independent directors in China are more or less "résumé independent directors". Scandals such as the collusion between independent directors and top management to the detriment of outside shareholder are frequently reported in the media since the incentives exist for such collusion in some listed Chinese companies (Wu, 2003).

Recent reports on the performances of independent directors in China are striking: one independent director was fired due to his reports on the accounting fraud of his company(Note 3); Leshan Electric Co. management had stopped an independent investigation, although it was supported the China government, conducted by its two independent directors; and one independent director had resigned from his company, Xinjiang Tunhe Co. after his long battle with the management concerning the release of the information from the management to him(Note 4). To reflect this concern about the "independence" of independent directors, a survey conducted by Shanghai Securities Daily in 2004 provide further worries in this regard: 33.3% of the surveyed independent directors said they had never vetoed any decisions made by the Board; 35% of them had never expressed a different opinion against the management; and 15% said they are one way or another cheated by the management in the information release and decision making process. Further, 35% of them believe that they do not share the same information and the decision process as other directors in the Board (Note 5).

Other reasons that independent directors do not work well include the corruption occurred in some of the Chinese listed companies and the lack of the supervision. Those who are seeking a huge profit through unfair related party transition would not want an outside director to sit on his board. Wu (2003) pointed out that unfair related party transition includes large shareholder and its affiliates misappropriate or transfer the capital, assets or other resources of the listed firm through various means. The legal institutional procedures and related code of corporate governance in China are also different from those of the west. For instance, shareholders' meetings in China were often not conducted in the same manner as in the west. Tam's survey in 1999 indicates that only 16% of the surveyed companies allowed shareholders to freely participate in shareholders' general meetings.

Ultimately, one would ask this question: is there a direct link, or an empirical relationship between corporate governance/ independent directorship and corporate performance? Therefore, to link directly the firm performance and corporate governance may over-estimate the role played by independent directors, as confirmed by the empirical analysis below.

4. The Model and Findings

We first undertake some descriptive analysis of the two samples we have selected: the listed companies which include independent directors and the listed companies which have not included independent directors. The findings are shown in Table 1 and Table 2.

It is interesting to note that the sample data shows that the companies which has an independent director does not show significant differences in its share price, net return and other performances measures, compared to those companies without independent directors. One cannot find significant differences in share price, and return per share according to a formal hypothesis test for two populations (Note 1) in the means. This suggests that whether there is an independent director or not in the board does not make the statistical difference in the firm financial performance.

Table 1. Companies with independent director

	average	Sd.	max	min	median
Company size	14.4327	1.0221	18.791	12.3113	14.2769
Growth of Company Size	24.6934	10486.63	1202.9988	-91.03	10.188
Stock price					
Return/share	0.1918	0.0952	2.09	-1.0127	0.161
Net asset/share	3.0448	1.8381	10.135	-3.69	2.94
net return	5.333	107.7229	41.62	-266.09	5.83

* All variables are expressed in Chinese currency, Yuan, except company size is in logarithm forms and annual growth of company size in %.

The data used in this paper is compiled from the FinDataLink, Guanghua School of Management, Peking University, China Stock Market Database -CSMAR2004,and China Securities Regulation Commission (www.csrc.gov.cn). There are 490 companies altogether with 92 percent of them including independent directors and the rest do not. The models were estimated using SPSS. Variables are transformed to logarithm form. Because the impact of independent directors on corpo-

rate performance by and large has a lagged effect, we have used the 2004 data for dependent variable and the 2003 data for independent variables.

Table 2. Companies without independent director

	average	Sd.	max	min	median
Company size	14.5363	5.2764	21.56	12.69	13.80
Growth of Company Size	39.9906	2505.223	152.66	-22.28	18.34
Stock price					
Return/share	0.2517	0.05087	0.874	-0.09	0.1822
Net asset/share	3.9106	2.2645	3.08	1.36	3.765
net return	6.2017	19.5114	16.27	-6.18	5.53

* All variables are expressed in Chinese currency, Yuan, except company size is in logarithm forms and annual growth of

To test the hypotheses raised earlier, we wish to examine (i) whether the companies with independent directors perform better than those without, and (ii) whether there is an empirical relationship between percentage of the independent directors on the board and the firm performance. The models will use cross-sectional data from 490 Chinese listed companies in 2003 and 2004.

The dependent variables (to measure the firm performance) used in the models are, respectively, MBt, which is Market-to-book Ratio (defined as the ratio of market share price to book value per share), and share price of the company (which is average share price of the company).

The independent variables used in the models are, accordingly, NRPSt (net return per share), MAJORt which is the percentage of shareholding controlled by three largest shareholders, POIND, which is the percentage of independent directors on the board; and finally, STATt and INDt are dummy variables, i.e.,

$$IND_t = \begin{cases} 1 & \text{if company includes independent directors} \\ 0 & \text{if not} \end{cases}$$

$$State_t = \begin{cases} 1 & \text{if company is largely state controlled} \\ 0 & \text{if not} \end{cases}$$

The regression models are as follows according to the two hypotheses raised earlier, independent directors and its percentage on the board improve corporate performance:

$$MB_t = \alpha + \beta_1 STAT_t + \beta_2^{+} IND_t + \beta_3^{+} NRPS_t + \beta_4^{+} POIND + \mu_t \quad \ldots\ldots \quad (1)$$

$$P_t = \alpha + \beta_1 MAJOR_t + \beta_2^{+} IND_t + \beta_3^{+} NRPS_t + \beta_4^{+} POIND \quad \mu_t \quad \ldots \quad (2)$$

The signs above each variable in the above models indicate the expected signs of the relationship between each dependent variable and its independent variables. In model 1, a higher return per share, NRPSt, will no doubt increase net return on asset of the company as postulated by the theory. While IND and POIND are the focus variables which we expect to be positive, as argued in the literature, the effect of STAT is not certain as some economists have argued that a heavy state controlled shareholding, particularly in the Chinese case, have a negative impact on the performance of Chinese listed companies, but others had stated the opposite.

In the model 2, we include MAJOR, which is the percentage of the first three largest shareholders of the company. It is established in the literature that the higher degree of the share ownership by few largest shareholders, the higher is the fluctuations in share price (Chen, 2001). The definitions and coverage of other variables are the same as in Model 1.

Given the research topic of this paper, we wish to test whether the dummy variable, IND, and another independent variable, POIND, are significant in these models. The use of dummy variables is to make distinctions between those companies who have included independent directors and those who do not. If the dummy variables are significant and positive, we then can establish the Hypothesis 1 that independent directors do improve corporate governance in terms of improving their corporate performance, such as its share price and market value. To test Hypothesis 2 (i.e., the percentage of independent directors on the Board will improve share price and market value of the company), we test the significance of POIND, if it is significant, we can conclude that the Hypothesis 2 is valid.

Table 3 reports the regression result for model 1. The model is generally satisfactory in terms of conventional statistical criteria and the expected signs. A graphic examination of the relationships amongst dependent variable and residuals

indicates no sign of heteroscedasticity and reveals that they are normally distributed. The Goldfeld-Quandt test statistic also confirms the same result (Note 6).

Table 3. The MB Model

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.246	.129	2.13	25.124	.000
STAT	-.115	.096	-.055	-1.197	.233
IND	.034	.094	.017	.367	.714
NRPS	.792	.044	.830	17.945	.000
POIND	0.114	.095	.326	1.188	0.243

Dependent Variable: MB

Adjusted R2= 0.678

ANOVA, F= 108.163, Sig. = .000

Table 4. The Share Price Model

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.342	.720	1.26	4.640	.000
IND	.006	.067	.007	.086	.931
MAJOR	.192	.179	.105	1.078	.103
NRPS	.131	.033	.327	3.978	.000
POIND	.005	.699	.007	.087	.923

Dependent Variable: P

Adjusted R2= 0.432

ANOVA, F= 4.045, Sig. = .004

We found that Market-to-book Ratio, MB, is influenced mostly by net return per share (7.9% of change in MB for 1% change in NRPS). It is interesting to note that the STAT variable (government-owned companies) has a negative impact on MB, and hence it confirms the hypothesis that the state-owned enterprise has much poorer performance in China. It poses the need for further reform in the state-owned companies.

However, both IND and POIND are not significant in the model, and hence indicate that there is no empirical relationship between corporate governance and firm performance. The results for model 2 are shown in Table 2. They suggest that the three largest shareholders in the company, as expected, influence the changes in the share price although it is marginally significant in the model. NRPS also has a significant impact on the movement of the share price. This is because good net return per share sends a strong signal to prospective investors that the company concerned is a potentially strong performer and hence attracts more investments, pushing up the share price.

However, as in the model 1, both IND and POIND are not significant in the model, and hence indicate it is not significant for the changes in share price whether there are any outside directors on the board, or there is a higher percentage of independent directors on the board. Thus, again, one cannot find an empirical relationship between corporate governance and corporate performance.

The insignificant roles played by the Chinese independent directors have confirmed the argument earlier in Section 2 that the use of independent directors in China is more or less “foreign seed being planted on the Chinese soil”, and will have a long way to go in improving corporate governance in China.

5. Concluding remarks

This paper has used the cross-sectional data of 650 listed companies from China to test the hypothesis that independent directors will improve corporate governance in improving company performance and efficiency. The study shows that corporate governance, as measured by the significance and the percentage of independent directors on the board, do not have a direct and significant relationship with firm performance (share price and market-to-book value). Therefore, the hypothesis that independent directors will improve corporate governance and performance is not supported by the empiri-

cal findings of this paper, at least not from the Chinese experience.

This finding poses an important question for China as to whether the current top-down approach to corporate performance, which is largely based on duplicating the Anglo-American model, will be effective in linking the firm performance and independent directorship when there is a wide debate on the topic in the west and alternative systems of corporate governance are available.

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Notes

Note 1 The hypothesis is: H0 : u1 = u2 and HA : u1≠u2 where u1 represents population men in the sample with independent directors and u2 represent population mean in the sample without independent directors.

Note 2 According to the Guideline, listed companies should have at least two independent directors of the board of directors by 30 June 2002, and at least one third of board members shall be independent directors by 30 June 2003.

Note 3 Yili Ltd. made the decision on the 16th June, 2004. Beijing Youth Daily, the 19th June, 2004.

Note 4 Beijing Youth Daily, the 19th June, 2004.

Note 5 Shanghai Securities Daily, May 30, 2004 and CAAC Journal, June 2, 2004.

Note 6 They are not reported here but available upon request.

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Some Properties of Relative Topological Space

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Abstract

In this paper, some topological properties were studied, especially including the Cartesian Product of relative T_1, Hausdorff and superregular and the property of 2-paracompact under the perfect mapping was also discussed.

Keywords: Y is T_1 in X, Y is Hausdorff in X, Y is superregular in X,Y is 2-paracompact in X.

1. Introduction

Relative topological properties are extension of classic topological invariants.In 1989,the relative topological properties were discussed by A.V.Archangel'skii and H.M.M.Genecli in(Arhangel'skii,1996,p.1-13), and A.V.Arhangel'skii gave the first systematic text on relative topological properties in 1996. In recent years, some further new results of the relative topology were obtained respective by A.V.Arhangel'skii, J.Tartir and W.Just, O.Pavlov and M.Matveer, I.Yaschenko, V.V.Tkachuk, M.G.Tkachenko and R.G.Wilson,etc.

In my paper, some relative topological properties were studied and four results were given.

2. The Cartesian Product of Relative Topological Space

X is a space, Y$\subset$X, the concept of Y is T_1,Hausdorff and superregular in X were introduced in(Arhangel'skii,1996,p.1-13). In this part, the Cartesian Product of them were discussed, and I gave there results.

Definition 2.1 Y is T_1 in X: If for each y$\in$ Y ,the set {y} is closed in X.

Definition 2.2 Y is Hausdorff in X: If for every two distinct points x and y of Y ,there are disjoint open subsets u and v of X, such that: x$\in$ u and y $\in$ v .

Definition 2.3 Y is superregular in X :If for each y of Y and each closed subset p of X ,such that y$\notin$ p, there are disjoint open subsets u and v of X, such that: y$\in$ u and p$\subset$v.

Lemma 2.4 Let $\{X_a\}_{a\in A}$ is a family of topological space. Then for each $a \in A$,the projection $P_a : \times\{X_a : a \in A\} \to X_a$ is an onto and open continuous mapping.

Lemma2.5 Y is superregular in X if and only if for each y and arbitrary open subset u of X which contains y, there exists an open subset v of X , such that: $y \in v \subset \bar{v} \subset u$

Proof. "$\Rightarrow$" Let y is an arbitrary point of Y, and u is an open subset of X which contains y. Then, u' is closed in X and such that: y$\notin u'$. Since Y is superregular in X, so there exist two disjoint open subsets u_1 and v, such that: y$\in$ v and $u' \subset u_1$. Obviously, v$\subset u_1'$.So, $\bar{v} \subset u_1' = u_1' \subset$ u. That is: $v \subset u$.

"$\Leftarrow$" Let y is an arbitrary point of Y and p is a closed subset of X which doesn't contains y. Obviously, X\p is an open subset of X and such that: x$\in$X\p. So, there exists an open subset v of X, such that: y$\in$ v$\subset \bar{v} \subset$ X\p. Let u= $X \setminus \bar{v}$, it is obvious that u is a neighborhood of p and such that: u$\bigcap$ v=$\varnothing$.So, Y is superregular in X.

Theory 2.6 If Y_S is T_1 in X_s for each s$\in$ S. Then, the Cartesian Product $\times\{Y_s : s \in S\}$ is T_1 in $\times\{X_s : s \in S\}$.

Proof.Let y is an arbitrary point of $\times\{Y_s : s \in S\}$.For each $y_s \in Y_s$,since Y_S is T_1 in X_s ,so $\{y_s\}$ is T_1 in X_s,so $\{y_s$ is closed in X_s.By the TH2.3.4(Arhangel'skii & Nogura,1998,p.49-58),then, y=$\times\{y_s : s \in S\}$ is closed in $\times\{X_s : s \in S\}$.That

is the Cartesian Product $\times\{Y_s : s \in S\}$ is T_1 in $\times\{X_s : s \in S\}$.

Theory 2.7 If Y_s is Hausdorff in X_s For each s ∈ S. Then, the Cartesian Product $\times\{Y_s : s \in S\}$ is Hausdorff in $\times\{X_s : s \in S\}$.

Proof.Let x and y are two distinct points of $\times\{Y_s : s \in S\}$. Then, there exists a s ∈ S, such that $x_s \neq y_s$ .Obviously $x_s \in X_s, y_s \in X_s$,.Since Y_s is Hausdorff in X_s, so there exist two open subsets u and v of X_s, Such that : $x_s \in u_s$, and $y_s \in Y_s$ and $u \cap v = \varnothing$.Let $u = p_s^{-1}(u_s)$ $v = p_s^{-1}(v_s)$,by the lemma2.4 ,u and v are open in $\times\{X_s : s \in S\}$.It is obvious that : $x \in u$ and $y \in v$ and $u \cap v = \varnothing$.That is , $\times\{Y_s : s \in S\}$ is Hausdorff in $\times\{X_s : s \in S\}$.

Theory 2.8 If Y_S is superregular in X_s for each s ∈ S. Then, the Cartesian Product $\times\{Y_s : s \in S\}$ is superregular in $\times\{X_s : s \in S\}$.

Proof. For each y ∈ $\times\{Y_s : s \in S\}$ and arbitrary open subset u of $\times\{X_s : s \in S\}$, such that: y ∈ u.There exists a member v= $\{v_{\alpha_s} : s \in S\}$ of the some fixed base of $\times\{X_s : s \in S\}$,such that:y ∈ v ⊂ u. For each y_s and V_{α_s}, since Y_s is superregular in X_s, so there exists an open subset v_{α_s}', such that: $y \in v_{a_s}' \subset v_{a_s}' \subset v_{a_s}$. Let $v' = \{v_{\alpha_s} : s \in S\}$. Obviously, $y \in v' \subset \overline{v}' \subset u$. By the lemma2.5, $\times\{Y_s : s \in S\}$ is superregular in $\times\{X_s : s \in S\}$.

3. The Property of Relative Compactness under the Perfect Mapping.

The definition of 2-paracompact was introduced in (Arhangrl'skii, 2002, p.153-201). Some properties of topological spaces under the perfect mapping were given in (Engelking, 1997). In this part, I studied the property of 2-paracompact under the perfect mapping, and gave a result about it.

Definition 3.1 Y is 2-paracompact in X: If for each open covering A of X, there exists an open family covering $\Re$ of X, such that: $\Re$ refines A , $Y \subset \cup\Re$ and $\Re$ is locally finite at each y of Y.

Theorem 3.2 Let f: X? Y is a perfect mapping. If Y_1 is 2-paracompact in Y. Then, $f^{-1}(Y_1)$ is 2-paracompact in X.

Proof. Let A= $\{u_s : s \in S\}$ is an open covering of X. Since f is a perfect mapping, so for each y ∈ Y, the fiber $f^{-1}(y)$ is a compact subset of X. Thus, there exists a finite subset $s(y)$ of S, such that: $f^{-1}(y) \subset \bigcup_{s \in S(y)} u_s = u_{y(s)}$. Since f is a perfect mapping, by the TH1.4.13 in (Engelking, 1997), there exists an open neighborhood $w_{y(s)}$ of y, such that: $f^{-1}(y) \subset f^{-1}(w_{y(s)}) \subset u_{y(s)}$. We may also assume that: $f^{-1}(w_{y(s)})$ is $v_{y(s)}$.That is $v_{y(s)} = f^{-1}(w_{y(s)})$. Then, it is obvious that: $v_{y(s)}$ is open in X and such that: $f^{-1}(y) \subset v_{y(s)} = f^{-1}(f(v_{y(s)})) \subset u_{y(s)}$ and $f(v_{y(s)})$ is an open subset of Y. Obviously, $\Re_1 = \{f(v_{y(s)}) : y \in Y\}$ is an open covering of Y. Since Y_1 is 2-paracompact in Y, so there exists an open family $\Re_2 = \{v_a : a \in A\}$ of Y by open subsets of Y_1, such that: $\Re_2$ refines $\Re_1, Y_1 \subset \cup\Re_2$ and $\Re_2$ is locally finite at each y ∈ Y. We may also assume that $f(v_{y(s)})$ which contains v_a is $f(y_a(s))$. Since f is perfect mapping , thus, $\Re_3 = \{f^{-1}(v_a); a \in A\}$ is an open family of X and locally Finite each $x \in f^{-1}(Y_1)$ and $f^{-1}(Y_1) \subset \cup\Re_3$ .Obviously $f^{-1}(v_a) \subset f^{-1}(f(v_{y(s)})) = v_{y_a(s)} = u_{y_a(s)}$ .Let $\Re = \{f^{-1}(v_a) \cap u_s : a \in A, s \in S_a(y)\}$ .Then , $\Re$ is an open family of X and such that $\Re$ refines A, $f^{-1}(Y_1) \subset \cup\Re$ and $\Re$ is locally finite at each x ∈ $f^{-1}(Y_1)$. That is $f^{-1}(Y_S)$ is 2-paracompact in X.

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Study on the System of Technical Innovation in Our Country's Textile Industry

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Abstract

After our entering WTO, the insufficient ability of new technical creating and the lags of the facilities and craftwork have become the main problems that restrict the confineable progress of our country's textile industry. In the base of having collected a great deal of data, this essay analyses the main facts that can influence technical innovation of our country's textile industry, and creating the estimating system of technical innovation of our country's textile companies which is fit for our country's textile industry.

Keywords: Textile industry, Technical innovation, The estimating system

The textile industry is traditional and indispensable industry of our country. It is the third biggest export industry which is only inferior to electronically machine and tourism. With the quota of some restricted goods from many main export markets, such as America, UN, being cancelled, the free trade in textile globally will help the textile industry of our country make best of the foreign and domestic resources and expand not only domestic market, but also domestic one.

But now, the insufficient ability of new technical creating and the lags of the facilities and craftwork have become the main problems that restrict the continual progress of our country's textile industry. If we want to exert more competitive advantages of our country's textile industry, and confirm correctly the position that our country's textile industry stands in the Asian and even the international textile industry, and collocate all kinds of resources reasonably to generate main competitive power, then promote the continual progress of our country's textile industry, we should change the actuality of concerning on quantity, and focus on the technical innovation of our textile industry, especially the technical innovation system's creating and efficient running.

In the course of running the system of technical innovation in textile industry, all the innovational resources get together in the company, and get the new combination which is based on the textile company, and then achieve the purpose of improving company's main competitive capabilities and economical benefits. Whether the technical of innovation in textile industry are high or not is the gist that could judge the running status of the whole technical innovation system of textile industry. In this condition, creating the judging system of technical innovation capability in textile industry externally and scientifically makes significant effort in a textile company's realizing its advantages and disadvantages, and making suitable innovation strategies, then improve the running efficiency of the whole industry system.

1. Picking up the index that can judge the technic innovation capability of textile industry

The technical innovation capability of a textile company is an integer which is formed by many facts. According to the process of technical innovation and the features of textile industry, and in the base of the comprehensive principle, the systemic principle and the feasible principle, we can divide the technical innovation capability of a textile company into many facts, such as policies, innovation resources, market surroundings, information surroundings, people resources, and technical serves agency. After surveying more than one hundred companies, we had created the judging system of technical innovation capability in textile industry.

Table 1. the index that can judge the technical innovation capability of a textile company

The System of Technical Innovation	index
Policy (C1)	Industrial Policy (P1)
	Technical Policy (P2)
	Financial Policy (P3)

	Resource & Surroundings (P4)
	Social Development (P5)
	Employment (P6)
	Other Policy (P7)
Innovation Resource (C2)	R&D Devotion (P8)
	R&D Personnel Devotion (P9)
	None R&D (P10)
	Innovation Risks (P11)
Market(C3)	Market Concept (P12)
	Organization Structure (P13)
	Industry Structure (P14)
	Innovation Efficiency (P15)
	Technical Import(P16)
Information(C4)	Technical Information (P17)
	Flat Of Industrial Technique (P18)
	Information Management (P19)
Human Resource(C5)	Capability Of Enterpriser (P20)
	Ability Of Innovation Personnel (P21)
Broker Serves System (C6)	Broker Serves System (P22)
	Broker Serves Manager System (P23)
	Broker Serves Organization (P24)
	Brokers (P25)

2. Confirming the model of the judging system of technic innovation capability in textile industry

First, according to the certain subject function relationship, calculate the results of every index. In the process of constructing certain subject, we use the method of model comparing, as to the positive index, its function is

$$A_{it} = \frac{X_{it} - X_{i\min}}{X_{i\max} - X_{i\min}}$$

In the function, X_{it} is the real value of X_i, which is the $no._t$ company's $no._i$ index; X_{imin} is the min value of Xi, which the $no._i$ index of the sample textile company. X_{imax} is the max value of Xi, which the no i index of the sample textile company. A_{it} is the value of xi, which is the $no._i$ index of $no._t$ Textile Company.

Second, confirm index's average.

Third, calculate the sample textile company's average score.

To be convenient, we can use the method of linearity average to calculate the scores of every sample textile companies. When index judging system are X_1, X_2, —X_{P-1}, X_P, and there are P textile companies judging, in this condition, the formula is

$$Z_i = \sum_{i=1}^{t} w_i A_{it}$$

In this formula, W_i is the average of the $no._i$ index; Z_i is the average scores that $no._i$ Textile Company gets.

Forth, compare in accordance to scores that every company gets, and judge

3. Assessing the relative average of system of technic innovation capability in textile industry

We use the analytic hierarchy process, AHP for short, to confirm the average. Our country's textile industry should optimize the effect of technical innovation to the largest extent. To achieve this goal, we should consider policy, system surroundings, market surroundings, resource supporting surroundings, people resource surroundings and information supporting surroundings. However, those facts are related to some subsidiary facts. So, the judging levels are divided into two parts in

this essay, the first is $c_{i,}$ and the second is $_{pi}$.

Based on a large number of researches towards all kinds of textile companies, we collect the survey results. According to the analytic hierarchy process, we form matrix to the facts of all levels to confirm the average fact in the system. Then, we compare every fact's relative importance degree with each other, and we can get the matrixes, A—Ci,C1—Pi ,C2—Pi,C3—Pi,C4—Pi,C5—Pi,C6—Pi

Table 2. Matrixes A—Ci

A	c1	c2	c3	C4	c5	c6	wi	
c1	1	1/2	2	4	3	5	0.266171	
c2	2	1	3	5	4	6	0.360618	
c3	1/2	1/3	1	3	2	3	0.168871	λmax=6.25146
c4	1/4	1/5	1/3	1	1/2	3	0.056386	
c5	1/3	1/4	1/2	2	1	2	0.104471	
c6	1/5	1/6	1/3	1/3	1/2	1	0.043506	

Table 3. Matrixes C1—Pi

c1	p1	p2	p3	p4	p5	p6	p7	wi	
p1	1	4	2	3	5	5	6	0.295959	
p2	1/4	1	1/3	1/2	2	3	4	0.126162	
p3	1/2	3	1	2	4	5	6	0.244735	
p4	1/3	2	1/2	1	3	4	4	0.168848	λmax=7.3373
p5	1/5	1/2	1/4	1/3	1	2	3	0.082906	
p6	1/5	1/3	1/5	1/4	1/2	1	2	0.051034	
p7	1/6	1/4	1/6	1/4	1/3	1/2	1	0.030355	

Table 4. Matrixes C2—Pi

c2	p8	p9	p10	p11	wi	
p8	1	3	6	3	0.4756678	
p9	1/3	1	4	1	0.2317356	
p10	1/6	1/4	1	1/4	0.060983	λ_{max}=4.091498
p11	1/3	1	4	1	0.2317356	

Table 5. Matrixes C3—Pi

C3	p12	p13	p14	p15	p16	wi	
p12	1	1	1/3	1/4	1/4	0.067412	
p13	1	1	1/2	1/4	1/5	0.070188	
p14	3	2	1	1/2	1/2	0.166548	λmax =5.028566
p15	4	4	2	1	1	0.28551	
p16	4	5	2	1	1	0.309303	

Table 6. Matrixes C4—Pi

C4	p17	p18	p19	wi	
p17	1	1/4	3	0.270701	
p18	4	1	5	0.636943	λmax=3.049611
p19	1/4	1/5	1	0.092357	

Table 7. Matrixes C5—Pi

c5	p20	p21	wi	
p20	1	2	0.666667	λmax=2
p21	1/2	1	0.333333	

Table 8. Matrixes C6—Pi

c6	p22	p23	p24	p25	wi	
p22	1	3	1	4	0.3731343	
p23	1/3	1	1/5	1	0.1050304	λmax=4.04518
p24	1	5	1	3	0.4145937	
p25	1/4	1	1/3	1	0.1071034	

$\lambda_{\max}$ —— the Max Character value CR —— the index of accordance

$$AW = \lambda_{\max} W \qquad \lambda_{\max} = \sum_{i=1}^{n} \frac{(AW)_i}{nW_i} \qquad CR = \frac{\lambda_{\max} - n}{n-1}$$

	CR_A	CR_{C1}	CR_{C2}	CR_{C3}	CR_{C4}	CR_{C5}	CR_{C6}
	0.00091	0.041338255	0.034269	0.006376	0.047703	0	0.016922

CR<0.1,it means all the consequence is satisfied.

index	c1	c2	c3	c4	c5	c6	the average of the index	compositor
	0.266171	0.360618	0.168871	0.056386	0.104471	0.043505		
p1	0.295959						0.078776	4
p2	0.126162						0.033581	12
p3	0.244735						0.065141	6
p4	0.168848						0.044943	9
p5	0.082906						0.022067	14
p6	0.051034						0.013584	19
p7	0.030355						0.00808	22
p8		0.475667					0.171534	1
p9		0.231735					0.083568	2
p10		0.060983					0.021992	15
p11		0.231735					0.083568	3
p12			0.067412				0.011384	21
p13			0.070188				0.011853	20
p14			0.166548				0.028125	13
p15			0.28551				0.048214	8
p16			0.309303				0.052232	7
p17				0.270701			0.015264	18
p18				0.636943			0.035914	10
p19				0.092357			0.005208	23
p20					0.666667		0.069647	5
p21					0.333333		0.034824	11

p22						0.373134	0.016233	17
p23						0.105030	0.004569	25
p24						0.414593	0.018037	16
p25						0.107103	0.00466	24

We can find from the total compositor, those facts can be made in order from high influence made to the technical innovation of textile industry to low influence: R&D devotion, R&D personnel devotion, innovation risks, industrial policy, capability of enterpriser, financial policy, technical import, innovation efficiency, resource surroundings, flat of industrial technical, ability of innovation personnel, technical information, people obtaining employment, system structure, market concept, other policies, information management, brokers, and broker serves manager system. All these facts react and are related with each other, and influence the technical innovation abilities of our country's textile industry. Through the judge of textile companies, we can judge of a certain company's ability of technical innovation better, and give the gist to the companies for them further development.

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The Value of a Network

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Abstract

This paper presents a simple mechanism for quantifying the value which a network creates based upon the way in which it is connected. The mechanism is grounded in a process of information sharing by nodes and is, in a sense, an extension of Bonacich's (1972) centrality measure.

Keywords: Networks, Value, Super-additivity

1. Introduction

When parties join together in a network, they are able to create a whole greater than the sum of their parts, a superadditivity of synergies. This paper examines a means of calculating superadditivity based upon the connection pattern of a network and the quasi-static results of an information transfer game. Section Two outlines the literature on network attributes in social networks and game theory. Section Three outlines the measure of value, some of its characteristics and some extensions to the model. Section Four concludes.

2. Network Structural Analysis

Wasserman and Faust (1994) suggest five levels of network analysis:

The individual level.

The dyadic or tiered level.

The triadic level.

The subgroup level.

The global level.

The individual level examines the relationships between nodes relative to one another. A common individual-level analytic methods is that of centrality. Centrality measures the relative importance of a node in a network, compared to all other nodes in that network. Freeman (1979) discusses a number of centrality measures including:

Degree Centrality: The number of edges incident upon a node, with more edges indicating greater importance, and the node being more 'embedded' in a network.

Closeness Centrality: The minimum geodesic distance from each node to each other node in the network, which is useful when the concern is the speed of transfer across a network. The centre of a star is the central node by this measure.

Betweeness Centrality: The extent to which a node lies between other nodes, and is hence a conduit for information, or to which a node can control the flow of information.

Importance might also be judged not only on how many nodes a node is joined to, but how important those nodes are. Bonacich (1972) calculates this by considering a centrality measure based upon the largest eigenvalue of the adjacency matrix. This measure is related to our own, as is discussed below.

Stephenson & Zelen (1989) suggest that information between nodes might follow many paths at the same time. They propose a measure of centrality based upon information theory in statistics, by maximising the 'information' contained in a weighted sum of all paths between each node (where the weighting depends on the variance in the path distances between nodes).

Burt (1992) suggests that what is important in networks is the strategic location of 'holes' within a network. Linkages are costly to form, and hence nodes should only link to other nodes when they provide access to new information and, moreover, when the links allow them to become arbitrageurs between two densely connected local networks. Burt suggests that, in strongly connected networks, information flows rapidly between all members, soon becoming common knowledge, and hence providing little opportunity for strategic behaviour. This contrasts with the view of Coleman (1988), who suggests that highly interconnected networks are beneficial, because they provide strong linkages and stability to their members. Benassi & Gargiulo (2000), in a study of the Italian computer industry, suggest that each type of network has a role in certain circumstances, with strong linkages important where stability is valuable, and sparse networks important where flexibility is necessary.

Dyadic-level analysis focuses on ties between two nodes and the paths between them. Milgrom's (1967) small worlds hypothesis is one example of this. Monge & Contractor (2003) suggest two key concepts in relation to dyadic analysis; reachability and redundancy. Reachability refers to the shortest path between two points, whilst redundancy refers to the number of paths between two points. One extension of our model (see below) falls loosely within the ambit of reachability, considering the way in which information generated in one part of the network reaches the remainder of the network.

Triadic-level analysis examines nodes three at a time. Where ties are directional, Monge and Contractor (2003) note the importance of transitivity; A linked to B, B linked to C and A linked to C implies transitivity. Where links are non-directional, transitivity is the same as cyclicality. Cycles in graphs and their effects on the value of nodes in a network are examined in a game theoretic framework by Gomez, Gonzalez-Aranguena, Manuel, Owen, del Pozo & Tejada (2003) and their concept of a connected hull. Triads are also the first point of stability in a growing network in a dynamic extension of our measure (see below).

A more general form than triadic-level analysis is analysis of sub-groups, where collections of nodes strongly connected to each other but weakly connected to the rest of the network for the focus of analysis. Granovetter's (1973) analysis of strong and weak ties social networks and their importance in finding a job are an early example of sub-group analysis. Clique or sub-group structures are widely observed in real-world networks and this has lead to a large literature on dynamic evolutionary algorithms which replicate such networks. Goh, Eom, Kanhg & Kim (2006), and Moriera, Paula, Costa-Filho & Andrade (2006) are two recent examples of this approach, from the physics literature where much of it has developed. Cliques and sub-groups are also an area of significant interest in game theory. Conley & Smith (2005) survey the literature in the public goods field, where it has been widely applied to the study of Tiebout equilibria (Note 1). Bloch (2005) examines application in industrial economics, where it has been used to study cartels, as well as more benign forms of industrial networks, such as research and development collaborations. Adler & Smilowitz (2006) examine an application in airline mergers.

The final level of analysis is the global level, which considers the network as a whole. Our measure operates at this level. Monge & Contractor (2003) suggest two global measures; network density and network centralisation. The first measures the number of ties in a network compared to the total possible number of ties, whilst the second measures the dispersion in centrality scores. In the game theory literature, the global value of a network is considered as a product of the analysis of the dynamic growth of the network. Jackson (2005) presents a recent review of this literature. Jackson & Wolinsky (1996) suggest that network growth is a function of each pair of nodes in the network examining the benefits and costs of forming a link and forming the link if each experiences and increase in utility from doing so. By summing the extra utility created by each link formed in a round of a network growth game, one might ascertain the overall value of the network to its participants.

The notion that the value of a network is related to the value it creates for each individual node seems intuitive. Indeed, there are parallels between Jackson & Wolinski's (1996) model and our own, at the conceptual level. However, it is also very intensive in information; in order to calculate network value, one needs to know the utility functions of all nodes and the gains and losses which would be made by each party when a link is formed. This paper suggests a simpler approach, based on the pattern of connectivity and the quasi-static results of an information transfer game.

3. The Measure

We motivate our measure by considering, like Stephenson & Zelen (1989), that networks represent patterns of information flow between the individuals. Each node joins the network with a stock of private information, which may be complementary to the private information stocks of others in the network creating synergies through information-sharing. This process of creating synergies allows those in the network to create a value which is greater than the sum of the values each is able to create independently, using their private stocks of information. Knowledge of where such synergies lie underpins decisions about whom each node will choose to connect to. If one considers information as underpinning utility, then our approach is roughly analogous to that of Jackson & Wolinsky (1996). We suggest that nodes aiming to join or expand a

network examine their private information stocks and what they know about the private information stocks of others and make decisions about with whom to connect directly. Once these decisions are made, the network is formed, its members communicate and it produces its output. We suggest that the network is able to produce this output precisely because of the way in which it was connected, and the synergies thus created. The synergies represent the amount of network superadditivity which is created through information sharing.

The measure is perhaps best understood by considering it as the end product of a dynamic information transfer process between the nodes of a network which transfer private information stocks between each other through a series of rounds of interaction. The dynamic representation of the 'information transfer game' has, at time *k*, the vector of information x^k, which can be described thus:

$$x^k = x^0 + Ax^{k-1} \tag{1}$$

Where x^0 describes the initial information vector, and *A*, the adjacency matrix, describes the way information is updated each 'round' of the process. Over a period of infinite updating the final (or quasi-static) information state is described thus:

$$x^\infty \cong (I - A)^{-1} x^0 \tag{2}$$

If one considers the information stocks held by each node of the network through the process, the eigenvectors can be taken to represent some measure of the amount of each type of information held by each node in the new quasi-static equilibrium after the private information stocks held at the outset have been augmented by the information sharing process. The eigenvectors are described thus:

$$e_i = (1 - \alpha_i)^{-1} e_i \tag{3}$$

where α_i represents the eigenvalues of the adjacency matrix *A* and e_i appears on both the left-hand side and right-side of the equation because the eigenvectors are the same for *A* and $(I\text{-}A)^{-1}$. If λ_i represents the eigenvalues of the matrix $(I\text{-}A)^{-1}$ then this may be expressed:

$$e_i = \lambda_i e_i \tag{4}$$

Each eigenvalue λ_i is summarising how far the eigenvector e_i has been 'stretched' along the i^{th} dimension of the underlying information space through the augmentation process of information-sharing. If all eigenvalue-eigenvector pairs are considered, we have a measure of the amount of 'stretch' in each dimension in the information-space which has resulted from the communication activities along the paths laid out by the network pattern. Each of the $\lambda_i e_i$'s are orthogonal. If they are multiplied together, they will provide an indication of the volume of the underlying space. If the eigenvectors are normalised such that their length is unity, the eigenvalues provide an indication of the length of the underlying information space in the given dimension indexed by that particular eigenvalue. With e_i normalised to one, the result becomes the product of the λ_is, or the determinant of the matrix $(I\text{-}A)^{-1}$.

This is true if and only if the eigenvalues of the adjacency matrix are less than one, otherwise the dynamic state oscillates, rather than converging. In an adjacency matrix of zeroes and ones, the largest eigenvalue will often be larger than one. The matrix must thus be normalised to prevent oscillation. We do so by choosing a scalar factor ε with $0 < \varepsilon < 1$, which, when multiplied by the adjacency matrix A, produces a new matrix A' which does not have any eigenvalues greater than one and which hence produces dynamic convergence. The use of ε implies that not all information held by a node is passed on in one round of communication. For ε we choose the reciprocal of the Frobenius Norm of the adjacency matrix. We could have chosen any matrix norm, but the Frobenius Norm in a zero-one matrix is simply the square root of the sum of the non-zero entries, making it easy to calculate.

One might also consider our measure as an extension of Bonacich's (1972) measure of centrality. Bonacich's measure can be developed as follows: if the adjacency matrix is multiplied by itself, the result, rather than describing which nodes are connected to which, describes how many two step connections exist between the ij^{th} node. If the adjacency matrix is multiplied by itself again, it describes how many three step connections exist and so on. The series of such connections is $I+A^2+A^3+\ldots\ldots+A^n$ which can be summed as follows:

$$\sum_{i=0} A^i = (I - A)^{-1} \tag{5}$$

This relationship is true where the eigenvalues of the adjacency matrix are all less than one. If they are not, oscillation, rather than convergence occurs, and the adjacency matrix must be normalised.

Bonacich suggests that his measure, which endeavours to obtain the closest measure of the actual 'bond' between two nodes by minimising the sum of the squared differences between the estimated and actual (but unknown) matrices representing bonds, is akin to principal components analysis in statistics, in that the use of a (suitably standardised) eigenvector as the centrality measure preserves as much as is possible, the maximum variance in the original. Mathematically (following Bonacich, 1987), if *R* is the matrix of relationships, and *e* the measure of 'centrality', the centrality of unit *i* is given by:

where λ is constant, chosen so the equations have a non-zero solution. This can be expressed as:

$$\lambda e = Re \quad (7)$$

where λ represents the eigenvalue and *e* its associated eigenvector. Bonacich considers the largest eigenvalue/eigenvector pair as these preserve the most variation from the original data in *R* but (Note 2), as he notes,

any eigenvector/eigenvalue pair can be used as a centrality measure, although other pairs will not preserve as much variation as the largest pair. However, as noted by Hadi & Ling (1998), despite containing the largest amount of variation present in the original data, the first principal component (or indeed, the first *p* of them) may not in fact be 'closest' to the underlying data. This means it may be appropriate to use difference eigenvalues, or even combinations of eigenvalue/ eigenvector pairs. Our measure effectively uses all principal components. This would not be useful from a statistical perspective, but the focus here is on the value of a network not statistical estimation.

3.1Characteristics of the Measure

For an empty network of size *n*, the score is always one, which accords with the intuitive notion that a network with no connections would not be able to produce any more than is possible for its members acting alone, as there is no scope for synergy. As nodes are added to the network, the scores rise, although not in a manner strictly monotonic with link addition. A commonly studied network shape is the star, which is often used as a test for the validity of a measure of network centrality. For our measure, however, stars score relatively lowly, and the score increases as nodes are added to the star. This is shown in Table One.

Note in Table One that all stars score two. In the general case of an *n* node network with an *(n-s)* node star, all stars score two. This is a characteristic of stars and is not a general result for network shapes in expanding networks. For example, the score of an *(n-s)* node box or circle (where each node is connected only to its immediate neighbours) in an *n* node network decreases in size as the number of nodes in the box increases. Some shapes appear less scaleable than others as networks grow.

Table One here

The results of Table One seem intuitive; when considering the network as a whole, it may not be particularly efficient to have all nodes transferring information through a central node. Few real-world networks are stars (see Barabasi, 2002) and, as Jackson & Wolinski (1996) suggest, if the apportionment of network value is somehow related to one's position in a network, then peripheral nodes have a strong incentive to link directly with each other rather than communicate through the central node. Our measure reflects this. However, Table One raises an issue; in every case the highest score is attained by the fully-connected network. This raises the question of whether a fully-connected network will necessarily be what one might expect to occur in each case. As Barabassi (2002) notes, empirically, most networks exhibit a power-curve relationship, whereby some nodes are densely connected and many are sparsely connected. Something prevents a network from evolving to the fully-connected state and that something, missing from Table One, is the cost of link formation. For our measure to be useful in the analysis of network growth, it needs to be incorporated into a model which includes notions of the cost of link formation.

The main aim of this paper is to introduce and discuss our measure and not to discuss network evolution (Note 3). However, it is worthwhile considering the utility of the measure in a simple model of network evolution. A very simple notion of cost is that of the veto, whereby network participants can allow or disallow a link to form depending upon the impact of that link upon themselves. This establishes a tension between the desires of the group to maximise what it can produce and the desires of individuals within the group to maximise their share of production. The tension seems an intuitively useful notion; if a group relied upon some relative measure of prestige to apportion gains (like the centrality of each of its members) and the formation of a link resulted in a net gain for the group, but one which diverted gains away from an actor who currently had high status in the group, then it does not seem unreasonable to suspect that that actor would endeavour to prevent the new link from forming. One could model this formally by considering veto power to be a function of the centrality of each node in the network, and considering an exercise of veto power between two extremes:

Strong veto: a given node will allow no linkages to be made anywhere in the network which reduces its centrality.

Weak veto: a given node will allow no connections to itself which would reduce its centrality.

Network formation thus proceeds along a path whereby connections form which increase the value of the network as a whole but which are not subject to veto due to the effects on the centrality of members of the network. Using Bonacich centrality as the centrality score underpinning the exercise of veto, it becomes apparent that the notion of strong veto may be too strong; experimentation with some small networks suggests that there are very few cases where the addition of a link does not violate strong veto rules. On the other hand, it would appear that weak veto rules may be too weak; experimentation with small networks suggests that the weak veto almost always allows a given network to move to a fully connected state. The exception to this is when a sub-network becomes full connected, at which point the weak veto stops all further

network growth.

In reality veto within a given network is likely to be more complex; some nodes might have a strong veto, some a weak veto and some none at all. Alternatively, the amount of veto power a node has might be dependent upon its place in the network, with more central nodes being able to exercise greater veto than less central nodes. There could be an overarching hierarchy of decision-making, such as that suggested by Palamara & Shapley (2000) which determines veto power. The precise nature of the veto wielded by different nodes in a given network may depend upon context, but as a basic notion, the idea of a tension between group and individual desires seems useful.

3.2Extensions

There are a number of relatively simple extensions which could be made to the measure to take into account a greater richness of knowledge about a given network. For example, if something were known about the relative resistances to information flow between each of the pairs of nodes (for example, if two nodes are joined, but joined by email, they might be less able to communicate than if they were located physically adjacent to one another), then it may be possible to replace the ones and zeroes with numbers between one and zero. Similarly, one could account for asymmetric flows of information between two nodes.

A more fundamental extension, however, is to change the learning model. The above description of information flow, is essentially a 'no-learning' model (Note 4); each node takes into the model the information it possesses and, whilst it transfers information from other nodes as part of the process of being in the network, it never adds to its own stock of knowledge during the course of the game. This is realistic in a quasi-static world, but less so in one where one wishes to trace the path of knowledge acquisition, rather than simply plot the end point of resultant value. In particular, whilst it shows the equilibrium at which a network will eventually arrive, it does not show whether the journey there involves oscillation, nor how long it might take. Both of these are possible, and would add richness to the analysis. In general, the process is as follows: rather than the adaptations process above of:

$$x^k = x^0 + Ax^{k-1} \tag{8}$$

consider the other extreme of the 'perfect learning' case:

$$x^k = x^{k-1} + Ax^{k-1} \tag{9}$$

which can also be written:

$$x^k = (I + A)x^{k-1} \tag{10}$$

and gives rise to a $\lambda_i=(1+\alpha_i)^{-1}$. If the adjacency matrix is composed of zeroes and ε, where $0< \varepsilon<1$, rather than zeroes and ones, the perfect learning and no learning cases converge as ε approaches zero. ε could represent the proportion of one's knowledge that is passed on in a single iteration. Another alternative is to express:

$$x^k = f(x^0) + Ax^{k-1} \tag{11}$$

which captures the fact that information is passed on imperfectly in a more realistic way than the use of the Froebenius Norm of the adjacency matrix.

In this dynamic setting, the determinant is not longer a particularly useful measure, because it is too crude to capture the pattern of adaptation which occurs as iterations progress. However, examination of the individual eigenvalues and their associated eigenvectors provides a wealth of information about evolving networks.

4. Conclusions

The measure developed in this paper endeavours to quantify, in a relatively simple fashion, the value of a network, connecting it to the pattern of the network and basing the measure in a theoretical framework of information transfer.

The simplicity of the measure suggests it may be attractive to network analysts, particularly in comparing networks and examining the evolution of networks over time, as part of a broader model. Further work establishing the empirical validity of the measure by comparing the score of a series of networks with their actual output, would be useful if the analysis is to be cardinal rather than ordinal, but the brief analysis of the characteristics of the measure discussed here suggests it represents a potentially useful addition to the suite of analysis tools used in the examination of network attributes.

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Notes

Note 1. The local provision of public goods and the formation of a society into jurisdictions based upon preferences for collections of such locally provided (and funded) public goods.

Note 2. Bonacich, by basing his centrality scores on the largest eigenvector/eigenvalue pair, is effectively taking the amount of 'stretch' in the dimension where the most stretch has occurred, and then apportioning that across nodes according to the elements of the eigenvector to measure centrality.

Note 3. Jackson (2005) and Monge & Contractor (2003) contain two surveys of models of network evolution.

Note 4. Bonacich's (1972) measure is similarly 'non-learning', as it has the same basis as ours.

Table 1. Network Scores from Stars to Full Connection

Network Size	Scores										
	Star	+1arc	+2arcs	+3arcs	+4arcs	+5arcs	+6arcs	+7arcs	+8arcs	+9arcs	+10arcs
3 node	2	2.74788									
4 node	2	2.34062	2.67731	3.48776							
5 node	2	2.18936	2.39427	2.58431	2.92571	3.35392	4.22552				
6 node	2	2.11541	2.25201	2.39252	2.53009	2.69853	2.91907	3.18196	3.54051	4.03791	4.96244

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Performance Analysis on Equivalent Elasticity of 3D 4-directional Braided Composites

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Abstract

Based on the small parameter asymptotic homogenization theory, this article adopts the technology of digitized cell-based finite element method (DCB-FEM) to establish the digital cell-based mechanics analysis model of three-dimensional 4-directional braided composite material, analyzes and calculates the equivalent elasticity performance of 3D braided composite material using homogenization method, and the results show a good agreement with the experimental data.

Keywords: Three-dimensional braided composite material, Homogenization, Microstructure, Digital model, Finite element method

Three-dimensional braided composite material are the engineering structure composite material which are developing very fast for recent years. These materials have many advantages such as good integrated performance, reasonable mechanical structure and good abilities to resist damage limits and crackle extension, which offer wider prospects of applications on main load-bearing structure for 3D braided composite material (Yang, 1992, p.87-91). The mechanical performances of 3D braided composite material depend on not only performances of various part materials, but also their microstructures. The yarn spaces in 3D braided structure present multi-directional distribution and form seasonal yarn structure by complecting each other, and just because of the complexity of this microstructure, it becomes very difficult to make the mechanical performance analysis for 3D braided composite material. Based on the finite element method of the digital cell-based model, this article establishes the numerical computation method of homogenization for 3D 4-directional braided composite material, analyzes and calculates the equivalent elasticity constants of these materials, and makes the comparative research with the test results.

1. Cell-based model of 3D 4-directional braided composite material

3D 4-directional braided composite material are superposed by single seasonal microstructure unit cells (Chen, 1999, p.391-404). The interior unit cell model is seen in Figure 1. The interior unit cell model of 3D 4-directional braided composite material presents cube shape. If taking braid direction as axis x, so width direction of unit cell is axis y and thickness direction is axis z. The included angle between braid yarn and braid axis direction x is the interior braid angle γ, and the included angle between projection of braid yarn on workpiece cross section (y-z section) and thickness direction (axis z) is θ which is the interior tropism angle of interior yarn.

Supposed that the cross section of braid yarn is ellipse which long axis and short axis respectively are 2a and 2b, the section shape along axis direction of braid yarn is not changeable, the braiding process is stable and even to ensure the equality and consistency of braid structure, all braid yarns have same geometry characters, braid yarns have enough tensions to make braid yarns produce bends only on the surface of the preforms, we can describe the relations between geometry structure of unit cell and geometry shape of braid yarn as follows.

Width of interior unit cell: $$W_i = \frac{4b}{\cos\varphi} \quad (1)$$

Thickness of interior unit cell: $$T_i = \frac{4b}{\sin\theta} \quad (2)$$

Relation between interior braid angle γ and braid angle α: $tg\gamma = \frac{1}{\sin\theta} tg\alpha$ (3)

Braided pitch length of interior unit cell h: $h = \frac{8b}{tg\gamma \sin 2\theta}$ (4)

1.1 Fiber volume content

The fiber volume content is one of main performance indexes for 3D braid composite material, which is higher and the performances of composite material are better. The fiber volume content lies on two aspects, one aspect is the interspace among interior braid yarns of 3D braid composite material, the other one is the interspace among interior fibers of braid yarns, that is the yarn filling factor. The fiber volume content V_f can be calculated by the following formula.

V_f = volume of fibers / volume of unit cell = $\frac{8A\sec\gamma}{h^2 tg^2\gamma \sin 2\theta}\varepsilon$ (5)

Where, A is the cross section acreage of yarn, h is the braided pitch length, θ = 45° and ε is the yarn filling factor.

1.2 Tightening status

In the braid shaping process, because of the function of yarn tension and "tightening" working procedure after every machine cycle, conterminous braided yarns in preform contact each other and are in tightening estate. The complecting estate of interior yarns of 3D 4-directional braid composite material is seen in Figure 2. Define the shape change factor of yarns cross section k=a/b, according to the tightening estate of yarns, the relation between shape change factor of yarns cross section and various tropism angle of yarns can be described as follows.

When $\theta \geq 45^\circ$, $k = \cos\gamma\sqrt{(3\csc 2\theta + ctg2\theta)(\csc 2\theta - ctg2\theta)}$ (6)

When $\theta < 45^\circ$, $k = \cos\gamma\sqrt{(3\csc 2\theta - ctg2\theta)(\csc 2\theta + ctg2\theta)}$ (7)

1.3 Yarn surface equation

Supposed the position of one braided yarn in 3D 4-directional composite material in the whole coordinate system (x, y, z) is seen in Figure 3, define the local coordinate system of yarns as (x'', y'', z''), axis y'' and axis z'' as the cross section of braided yarn.

Through the transform from the local coordinates to the whole coordinates, considering the origin of local coordinates is located at the point (x_0, y_0 , z_0) in the whole coordinate system, the yarn surface equation can be obtained as follows.

$$\frac{(((y-y_0)\sin\theta + (z-z_0)\cos\theta)\cos\gamma - (x-x_0)\sin\gamma)^2}{a^2} + \frac{((z-z_0)\sin\theta - (y-y_0)\cos\theta)^2}{b^2} = 1 \quad (8)$$

The interior of 3D 4-directional braid composite material has 4 directional braid yarns, and the tropism angles respectively are (γ, θ), ($-\gamma, \theta$), ($\gamma, -\theta$), and ($-\gamma, -\theta$). Taking these angles in the equation (8), four surface equations of tropism braid yarn can be obtained. Levelly move various yarns to the corresponding positions of unit cell, we can obtain the interior unit cell entity model of 3D 4-directional braid composite material, which is seen in Figure 4.

2. Cell-based digitalization of 3D braided composite material

Based on the interior unit cell entity model of 3D 4-directional braid composite material, this article adopts 3D rasterizing technology to digitalize the unit cell entity model (Wang, 2001), that is to say, when the resolution ratio is 30 × 30 ×30, the unit cell of 3D 4-directional braid composite material is dispersed as the form of space element. Four kinds of glue braid yarns and one kind of substrate material are represented as 0 to 4, where, 0 represents the substrate material and 1 to 4 respectively represent four kinds of tropism glue braid yarn. In the scanning process, first the attribute values of all space elements are endowed as 0, that is 0 represents the space element material, then according to the relations between the position of space element point and the braid yarn surface equation, the attribute value of every space element is quantified, and if the space element point is located in the interior of one yarn surface equation, so this space element point is activated and endowed the corresponding material attribute. When the digitalization of unit cell of 3D 4-directional braid composite material is completed, the corresponding data collection of space element is formed, and the distribution of component material in unit cell is detailedly recorded, and the digital unit cell model obtained is seen in Figure 5.

3. Numerical computation of equivalent performance

Based on the finite element method of the digital cell-based model (Guedes, 1990, p.143-198 & Chen, 1999, p.2383-2391 & Peng, 2002, P.45-56 & Wang, 2003 & Ma, 2006 & Chen, 2007, p.1-5), this article analyzes the

equivalent elasticity modulus, and compares it with the test results. And the workpiece is made by the 3D 4-directional braid technology and pitch transfer mould technics (RTM), where, the strengthened fiber is fiberglass of 1440Tex, the substrate material adopts the epoxy resin of TDE-86#, the braid technical parameters are seen in Table 1, and the component material performances are presented in Table 2.

3.1 Glue braid yarn

When braid yarns in the 3D composite material infiltrate the substrate material, it can be considered as the unilateralism fiber strengthened composite material, which fiber volume content is the filling factor of yarn and is called glue braid yarn. The stress-change relation of glue braid yarn in the material principle axis direction can be represented as the following equation.

$$\begin{Bmatrix}\sigma_1\\ \sigma_2\\ \sigma_3\\ \sigma_4\\ \sigma_5\\ \sigma_6\end{Bmatrix}=\begin{bmatrix}C_{11} & C_{12} & C_{13} & 0 & 0 & 0\\ & C_{22} & C_{23} & 0 & 0 & 0\\ & & C_{33} & 0 & 0 & 0\\ & & & C_{44} & 0 & 0\\ & \text{symmetry} & & & C_{55} & 0\\ & & & & & C_{66}\end{bmatrix}\begin{Bmatrix}\varepsilon_1\\ \varepsilon_2\\ \varepsilon_3\\ \varepsilon_4\\ \varepsilon_5\\ \varepsilon_6\end{Bmatrix} \tag{9}$$

Where, $\sigma_1=\sigma_{xx},\sigma_2=\sigma_{yy},\sigma_3=\sigma_{zz},\sigma_4=\gamma_{yz},\sigma_5=\gamma_{xz},\sigma_6=\gamma_{xy}$

$\varepsilon_1=\varepsilon_{xx},\varepsilon_2=\varepsilon_{yy},\varepsilon_3=\varepsilon_{zz},\varepsilon_4=\tau_{yz},\varepsilon_5=\tau_{xz},\varepsilon_6=\tau_{xy}$

, and [C] = rigidity matrix of unilateralism fiber strengthened material.

For the glue braid yarn with four kinds of tropism in 3D 4-directional composite material, the material principle axis direction is not consistent with the whole coordinate of the composite material, which needs be uniformed into the whole coordinate system. Rotating axis formula of material rigidity is

$$[C(\gamma,\theta)]=[T(\gamma,\theta)][C][T(\gamma,\theta)]^T \tag{10}$$

Where, $[C(\gamma,\theta)]$ is the rigidity matrix in the material principle axis, $[T(\gamma,\theta)]$ is the stress conversation matrix, and the superscript T represents the transpose of the matrix.

And $[T(\gamma,\theta)]$ has the following form.

$$[T(\gamma,\theta)]=\begin{bmatrix}l_1^2 & m_1^2 & n_1^2 & 2m_1n_1 & 2n_1l_1 & 2l_1m_1\\ l_2^2 & m_2^2 & n_2^2 & 2m_2n_2 & 2n_2l_2 & 2l_2m_2\\ l_3^2 & m_3^2 & n_3^2 & 2m_3n_3 & 2n_3l_3 & 2l_3m_3\\ l_2l_3 & m_2m_3 & n_2n_3 & m_2n_3+m_3n_2 & n_2l_3+n_3l_2 & l_2m_3+l_3m_2\\ l_3l_1 & m_3m_1 & n_3n_1 & m_3n_1+m_1n_3 & n_3l_1+n_1l_3 & l_3m_1+l_1m_3\\ l_1l_2 & m_1m_2 & n_1n_2 & m_1n_2+m_2n_1 & n_1l_2+n_2l_1 & l_1m_2+l_2m_1\end{bmatrix} \tag{11}$$

Where, $l_1=\cos\gamma,l_2=\sin\gamma\sin\theta,l_3=\sin\gamma\cos\theta$

$m_1=-\sin\gamma,m_2=\cos\gamma\sin\theta,m_3=\cos\gamma\sin\theta$

, and $n_1=0,n_2=-\cos\theta,n_3=\sin\theta$.

3.2 Numerical computation

This article adopts the development software of Visual C++ to implement the numerical computation. First taking the fiber filling factor obtained by computation as the fiber volume content, the homogenization equivalent elasticity modulus is calculated, then input the above results as the material performances, calculate the homogenization equivalent modulus of 3D 4-directional braid composite material. The input parameters include elasticity constants of substrate material and glue braid yarn, diameter and braiding angle of braid yarn, fiber volume content and cavalcade line yarn coefficients. The comparative results between the theory values and test values of portrait elasticity modulus E11 are seen in Figure 6, and the computation results show a good agreement with the test data, which indicates that this method is feasible.

4. Influences of braid technical parameters

4.1 Braiding angle

The factors which influence the mechanical performances of braid structure composite materials mainly include the interior braiding angle γ and fiber volume content V_f. Keeping the performances of component material and supposed

Figure 7, we can see that with the increase of the interior braiding angle γ, the extension modulus E11 sharply decrease, E22 and E33 gradually increase, and the transverse extension modulus E22 and E33 are much smaller than the portrait extension modulus E11 and the changing current is reverse with the portrait, and with the increase of the interior braiding angle γ, the clipping modulus G32 gradually increase, the increasing current of G12 and G13 is from fast to slow, and when γ = 40°, the portrait clipping modulus G12 and G13 achieve maximal, and the Poisson's ratio v12 and v13 is from increase to decrease with the increase of the interior braiding angle, and when γ < 25°, v12 and v13 increase with the increase of γ, then decrease with the increase of γ, and the Poisson's ratio v32 is from decrease to increase with the increase of γ, and when γ < 30°, v23 decreases with the increase of γ and achieves minimal when γ = 30°, and when γ > 30°, v23 increases with the increase of γ. In a word, the interior braiding angle γ observably influences the extension modulus E11.

4.2 Fiber volume content

Keeping the performances of component material and supposed the interior braiding angle γ is 20%, if the fiber volume content V_f changes, we will obtain Figure 8 which presents the values of effective elasticity performance forecast composite material change with the fiber volume content V_f.

Form Figure 8, we can see that all extension modulus and clipping modulus increase with the increase of the fiber volume content V_f, but the change of Poisson's ratio is relative complicated, with the increase of the fiber volume content V_f, Poisson's ratio v23 gradually decrease, but v12 and v13 is from the increase to decrease, when the fiber volume content V_f achieves about 45%, they get the maximal values, and when V_f < 45%, v12 and v13 increase with the increase of V_f, and when V_f > 45%, v12 and v13 decrease with the increase of V_f. Anyway, the Poisson's ratio v12 and v13 are mainly controlled by the interior braiding angle γ and the fiber volume content V_f has few influences to them.

5. Conclusions

Based on the small parameter asymptotic homogenization theory, this article adopts the technology of 3D graph digital processing to establish the digital cell-based mechanics analysis model of 3D 4-directional braided composite material, analyzes and calculates the equivalent elasticity performance of 3D braided composite material using homogenization method, and the results show a good agreement with the experimental data. Therefore the forecast method of the elasticity performance of 3D 4-directional braided composite material is established, and this article offers an effective analysis method for the technical parameter choosing, performance design and structure optimizing of this type of material in the developing process, promotes the further application of 3D composite material in the area of aviation and spaceflight, and establishes the bases for further analyzing the damage, intension and non-linearity activity of this type of material.

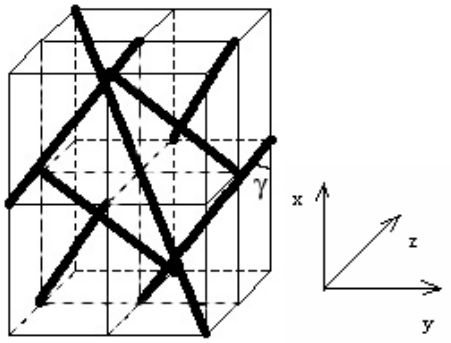

Figure 1. Schematic Illustration of the Spatial Traces of Interior Yarns

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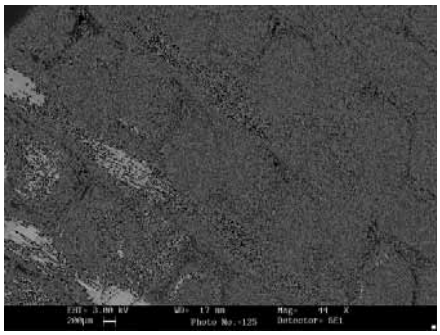

Figure 2. The Cross Section Photograph of Preform

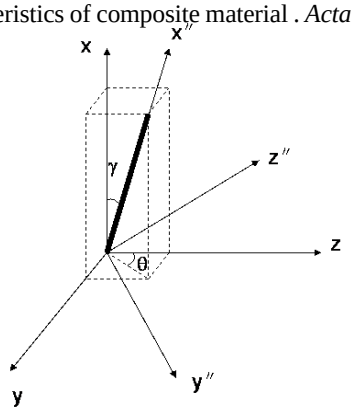

Figure 3. The Directions of Braided Yarn

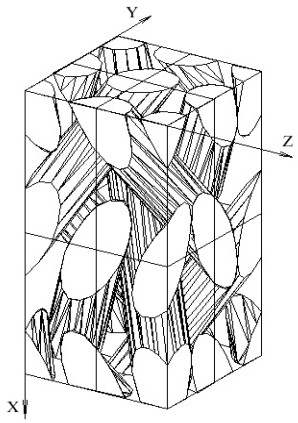

Figure 4. Interior Unit Cell Model of 3D 4-directional Braided Composites

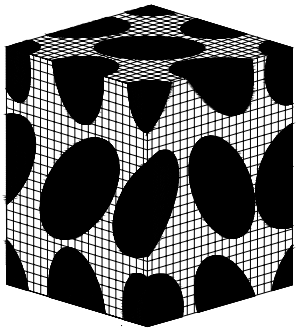

Figure 5. The Digitized Cell Model of 3D Four-directional Composites

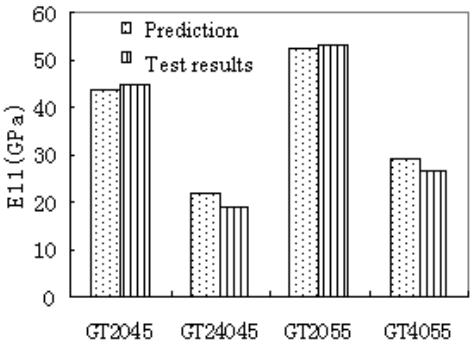

Figure 6. Prediction and Test Results of E11

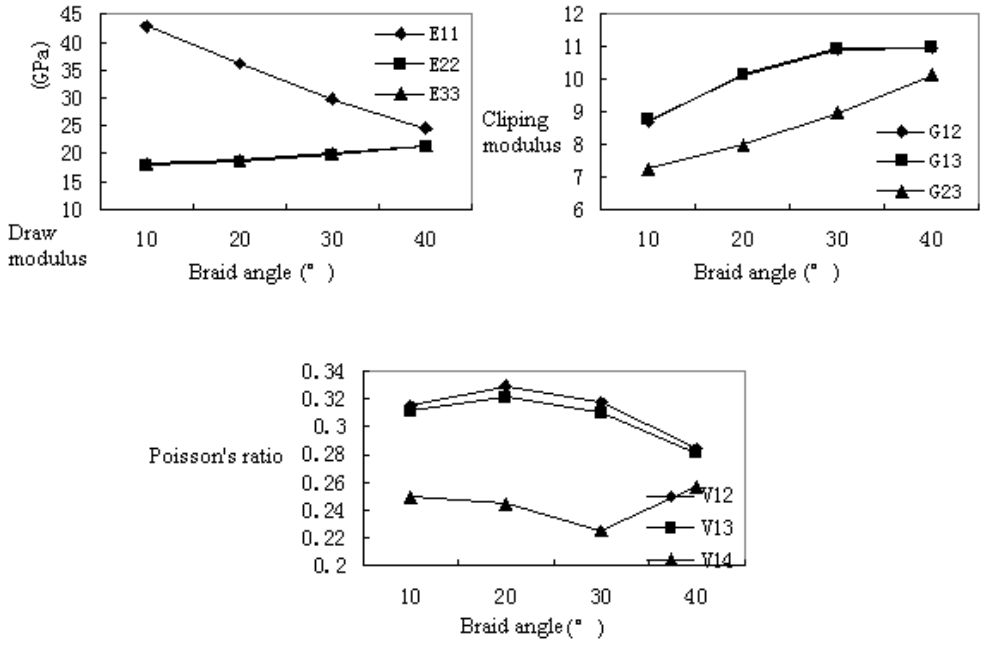

Figure 7. Elastic Constants Variation with Braiding Angle

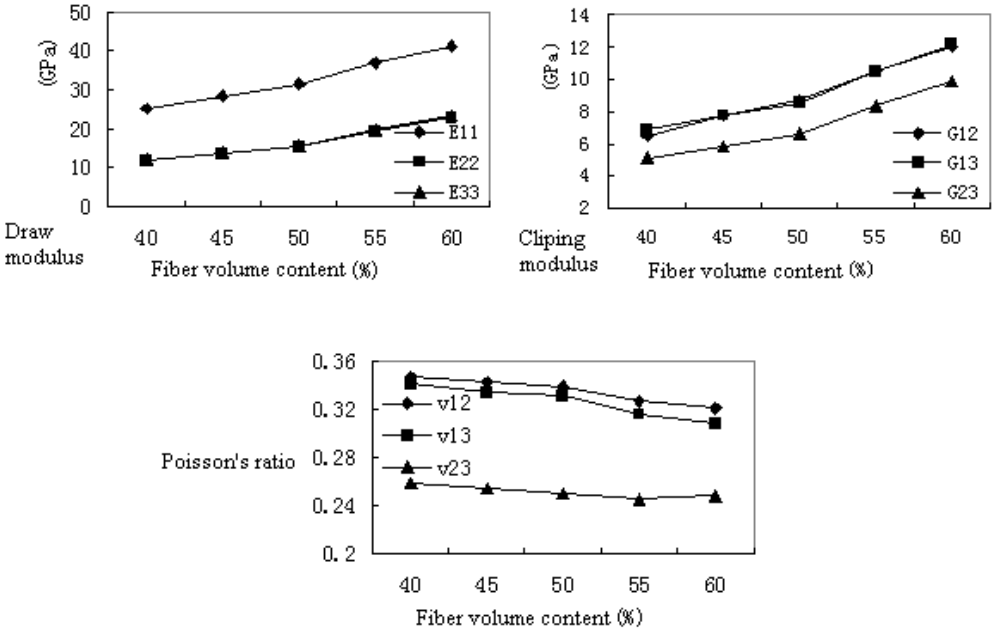

Figure 8. Elastic Constants Variation with Fiber Volume Content

Table 1. Technical parameters of the specimens

No.	Materials	Fiber	Size (mm×mm×mm)	Main body yarn	Braid angle (Deg.)	Fiber volume content (%)
GT2045	Glass	1440Tex	5×25×250	4×23	9.18	52.84
GT4045	Glass	1440Tex	5×25×250	3×22	33.21	48.77
GT2055	Glass	1440Tex	5×25×250	5×25	9.57	63.44
GT4055	Glass	1440Tex	5×25×250	4×23	31.19	60.61

Table 2. Mechanical property parameters of components properties

	Extension modulus (GPa)	Poisson's ratio	Density (g/cm^3)
Glass fiber	82.9	0.30	2.54
Epoxy resin	3.5	0.35	1.17

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Discussion and Application of WPKI Technology

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Abstract

With the developments of wireless communication and wireless network technology, the wireless data service will be more widely used in commerce. In order to realize safe electronic commerce, the security of wireless network should be assured. As a rising technology to implement wireless network safety, WPKI (Wireless Public Key Infrastructure) becomes more and more important. This article will discuss structure, implementing principle, security infrastructure, application model and application in wireless network environment of WPKI, analyze the functions of WPKI in WAP security, and probe into the application prospect of WPKI.

Keywords: WPKI, WAP, WTLS, PKI, Network safety

1. Introduction

With the developments of mobile communication technology and Internet, the application wireless communication technology gradually becomes mature, and its security becomes more and more important. In cable network, one important security guarantee is PKI (Public Key Infrastructure). Keeping to the standards, PKI is the key management platform to pellucidly provide key and certificate management needed by cryptogram services such as encrypting and digital signature for all cable network applications. In wireless network, WPKI (Wireless Public Key Infrastructure) properly complements, optimizes and improves PKI to fulfill the requests including secrecy, integrality, authenticity and undeniable character of wireless network security. WPKI also adopts some management mechanism being differ from PKI to fulfill the needs of wireless network environment.

2. Structure of WPKI

For WPKI, the key management system is composed of EE (Entity End), PKI portal, CA (Certification Authority), PKI directory and other parts. In the application mode of WPKI, it also involves data server, WAP gateway and other service equipments. The basic structure and data flow of WPKI are seen in Figure 1.

In Figure 1 these following parts are involved.

(1) EE (wireless user)

EE in WPKI depends on WMLSCrypt API to realize key management and optimization of encrypt computation. Its main functions include producing, storing and allowing visiting user key pair or public key pair, application of original certification, updating request of certification, recalling request of certification, inquiring, recovering and recalling certification information, validating certification, reading certification, producing and validating digital signature.

(2) PKI Portal (RA Registration Authority)

Like WAP gateway, PKI Portal is also the server operating on the cable network. Its function seems to RA in cable PKI, and it is usually used as the joint bridge between cell-phone terminal and present PKI, taking charge of transforming the requests to RA and CA in PKI for WAP users.

(3) CA (Certificate Authority)

It takes charge of signing certification, Authorizing certification, managing authorized organization, constituting policies and concrete approaches to validate and identify users' identities, and signing user certification to insure certification owners' identities and properties to public key.

(4) PKI Directory

The certification sending server such as LDAP (Lightweight Directory Access Protocol) directory server takes charge of sending certification information to CA and content server.

(5) Content Server

It provides content service to users. Taking WEB server as an example, it mainly takes charge of providing service information needed through content server after successful authority.

(6) WAP Gateway/Proxy

In WAP 1.X, a WAP gateway is needed to deal with protocol conversions between users and source server. WAP gateway uses WAP protocol to communicate with users and uses standard Internet protocol to communicate with source server. But in WAP 2.0, users and source server can directly use HTTP 1.1 to communicate, which also involves WAP 1.0.

3. Implementing principle

In wireless network, the method of security mainly is WPKI. The concept of WPKI is developed from cable PKI, that is to say, in wireless environment WPKI offers security service system similar with cable PKI. WPKI is the proper complement and reasonable optimization of cable PKI in its present mechanism to adapt the characteristics of wireless communication service. The characteristics of wireless communication service are that the calculating ability, frequency width and EMS ability of wireless communication terminal such as cell-phone and PDA are much lower than the computer in cable network. Therefore, WPKI needs adopting some management mechanisms other than cable PKI to adapt these characteristics and offer safe guarantee for applications in wireless network. But for users they can enjoy security service like PKI, just the terminal equipments are different and carriers are wireless. As viewed from this opinion, WPKI is a sort of extension of PKI security service in wireless network.

WPKI adopts optimized ECC encryption and constringent X.509 digital certification. It also adopts certification management public key, validates users' identities through the third party's credible organization, CA (Certificate Authority) to realize safe transport of information. The wireless terminal applies for digital certificate to CA through registration authority, then CA sends digital certificate for users through auditing users' identities, users store certificate and key in UIM card, and the wireless terminal utilizes digital certificate to ensure the security from port to port when implementing electronic business on wireless network. ISP internet confirms users' identities through validating user certificate and offers users corresponding services to realize safe running of wireless network application.

4. Security infrastructure

WAP is a collection with language, communication protocol and tools, which aim is to fulfill the requests that people link internet in move and pass contents and super data operations on internet to wireless mobile users. WAP security infrastructure includes WIM (WAP Identity Module), WMLSCrypt (WML Script Crypto API), WTLS (Wireless Transport Layer Security) and WPKI.

(1) WIM (WAP Identity Module)

WIM is an embedded chip preventing juggle in WAP equipments (such as cell-phone and PDA) to store key information such as WPKI public key and user key and other relative certificate information. At present, SIM card is usually used to implement the security module. Because WAP terminal equipments such as cell-phone and PDA have limited processing abilities and limited resources, so the SIM card realizing WIM module also can have its own processor, integration code arithmetic assistance unit, RAM and EEPROM, and can realize encrypting arithmetic and other functions.

(2) WTLS (Wireless Transport Layer Security)

WTLS evolves from TLS (Transport Layer Security), adapts to be used in narrowband communication channel to validate communication users, encrypted WML data and check their integralities. Based on encrypting technology, WTLS offers services including data integrality, confidentiality, identification and forbidden service protection, and provides safe guarantee for using mobile data communication to implement business operation.

(3) WMLSCrypt (WML Script Crypto API)

WMLSCrypt API is an application program interface (API) and it offers WMLSC lib for WML (Wireless Markup Language). This lib gives basic security functions which include producing key pair, storing key, accessing control to stored key and data, producing and validating digital signature, encrypting or encoding data and so on. WML script lib utilizes WIM module to offer supports for bottom code operation.

(4) WPKI

Aiming at wireless communication environment, WPKI performs optimized development on the base of cable PKI. It usually uses BER (Basic Encoding Rules) and DER (Distinguished Encoding Rules) to deal with PKI service requests, but the operations of BER/DER request more system resources, so it is not fit for WAP equipments. However, WPKI protocol adopts WML and WMLSCrypt to deal with PKI service request. Comparing with traditional methods, function of Sign-Text in WML and WMLSCrypt can save much system resources when coding and putting in PKI service request.

The above parts have different functions for realizing security of wireless network application, where, as basic establishment platform of security, WPKI is the base to effectively implement security protocol and any applications based on identity validation need supports of WPKI. It can combine with WTLS, TCP/IP and WML Script Sign to implement functions such as identity validation, key signature and so on.

5. Application model

According to different situations of linking among wireless terminal, WAP gateway and content server, WPKI can offer three security models.

(1) Model WTLS Class2. Its terminal needs validating server.

(2) Model Sign Text. Both the terminal and server need validating each other and use the mode of application layer signature.

(3) Model WTLS Class3. Both the terminal and server need validating each other and use the mode of "challenging password".

5.1 Model WTLS Class2

The security layer in WAP system is called wireless security transport layer that is WTLS, which main aim is to offer secrecy and integrality of validation and data for two communication applications. The functions of WTLS are similar to TLS1.0, but it involves some new characters such as data report support, optimizing handshake negotiation, dynamically updating key, and optimizing longer time-lapse narrow bandwidth network. WTLS Class2 can make users validate identities of commutation gateways with it. Figure 2 is the summarization of necessary steps to start WTLS Class2. As Figure 2 shows, the terminal equipments preinstall some CA root certification information.

WAP gateway produces key pair, the public key and key, and implements the following steps.

(1) The gateway sends validation request to PKI portal.

(2) The portal confirms the identity and transfer the request to CA.

(3) CA sends gateway public key certificate (maybe through portal) to the gateway.

(4) The mobile terminal and gateway establish WTLS conversation.

(5) The gateway and server establish SSL/TLS conversation.

(6) The server sends certificate request to PKI portal, the portal confirms ID and transfers the request to CA.

(7) CA sends server public key certificate (WTLS certificate) to the server.

(8) The mobile terminal and server establish WTLS conversation.

5.2 Model Sign Text

The terminal equipments and server in model Sign Text must preinstall (or load) CA root certificate.

The steps to establish security communication are seen in Figure 3. The operation process of model Sign Text includes following steps.

(1) The mobile terminal applies for certificate to PKI portal.

(2) The portal confirms the identity and transfer the request to CA.

(3) CA produces user's certificate and sends URL of the certificate to user (the other method is that CA sends the whole user's certificate to the equipment, for example, CA can store it in WIM).

(4) CA put user's public key certificate in the database (if necessary).

(5) User signs affair on client post (Sign Text offers a sort of mechanism which sets up digital signature by the mode of WML Script for user equipments), and sends affair, signature and certificate URL (or certificate) to the server.

(6) The server takes user's certificate from the database by certificate URL.

(7) The certificate database of CA sends user's certificate to the server.

5.3 Model WTLS Class3

As viewed from PKI, WTLS Class3 (see Figure 4) validation and model Sign Text are almost same, and the difference is in step 5. In this step, model Sign Text uses the mode of application layer signature to complement validation, that is to say, user must confirm the readable message from the server and attach its own digital signature, then sends it to the server for validation, where the using key pair must be the key specially used for digital signature and the message from the server must be readable, however, the model WTLS Class3 validates "challenging password" from WTLS server through user key, which "challenging password" means that the server sends some random numbers to the user and these numbers may not be readable information and need user's signature to validate user's identity.

The operation process of model WTLS Class3 includes following steps.

(1) WAP sends a certificate request to PKI portal through the gateway.

(2) The PKI portal confirms the identity and transfer the request to CA.

(3) After CA signs the certificate, it sends the certificate to the WAP terminal through WAP gateway, and at one time, CA

stores the WAP certificate into the certificate database.

(4) The WAP terminal signs in the dealing affair data, and sends dealing data, signature and certificate to the source server.

(5) The source server validates the signature, and if the certificate keeps to the URL mode, the following two steps are needed.

(6) The source server lookups in the certificate database according to the position appointed by URL.

(7) The certificate database returns the certificate to the source server.

6. Application example

The example model is to utilize WPKI technology to simulate cell-phone terminal to offer charging and inquiring services for one card through campus.

The flow of application model is seen in Figure 5. Students input some authorized information such as sequence number or code and bank accounts or code using short message through cell-phone terminal, the cell-phone terminal transports encrypted message to the WAP gateway, when the WAP gateway receives a request, it sends a certificate request to PKI portal for confirming identity and then transfer CA to complete certification signing, where, one certificate is sent to the cell-phone terminal, the other one is sent to the application server, and the WAP gateway also needs send the executive order information to the server of short message, the short message server transports it to the application server through SSL, the application server validates the received information utilizing received digital certificate, then completes needed charging or inquiring services, finally it will send the executive results after encrypting to the cell-phone terminal through the short message server, if the validation is not successful, it will directly return the encrypted wrong information to the cell-phone terminal through WAP gateway.

7. Application prospect

The network security is a complicate research domain with application values. With the popularization of computer application, the network security becomes more and more important. And WPKI just adapts these requests for the applications of wireless network security. The network security needs consider many aspects which mainly include security strategy and security technology. With the development of wireless network security, the future development of WPKI technology must be possess more characters including standardization, internationalization, commerce and centralization to fulfill various requests from the developing applications of wireless network.

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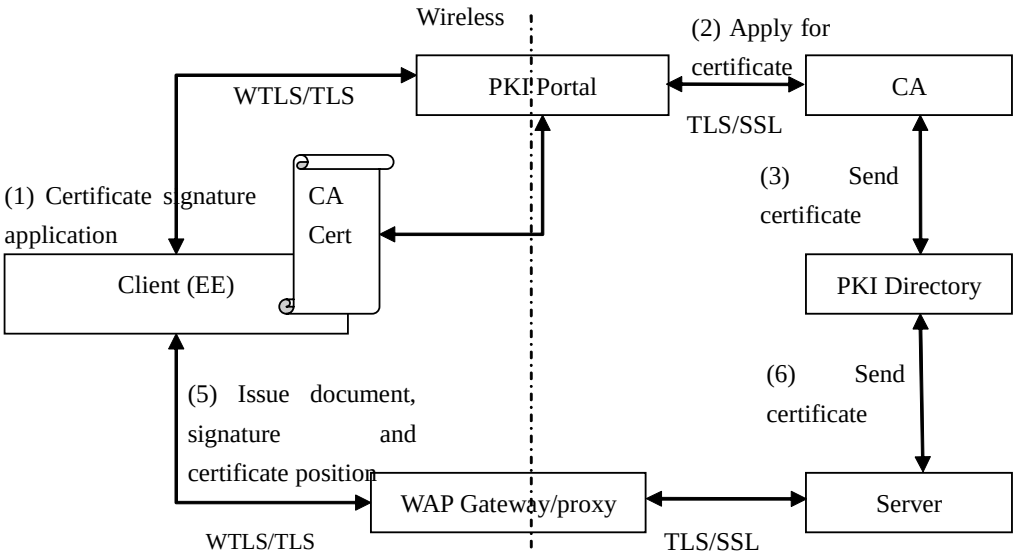

Figure 1. Structure of WPKI

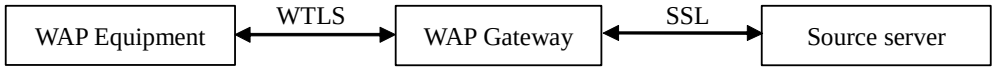

Figure 2. Model WTLS Class2

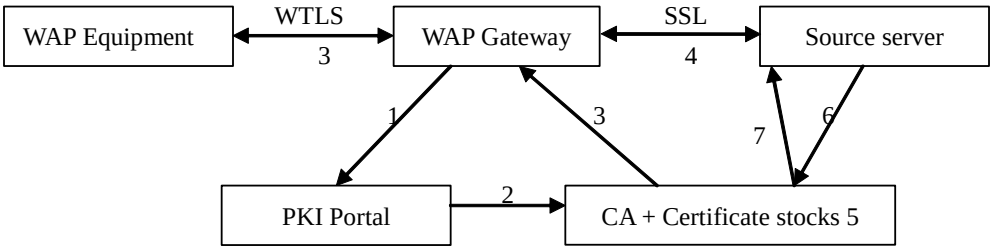

Figure 3. Model Sign Text

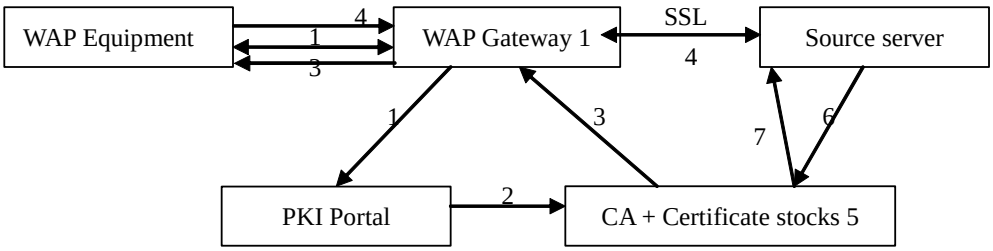

Figure 4. Model WTLS Class3

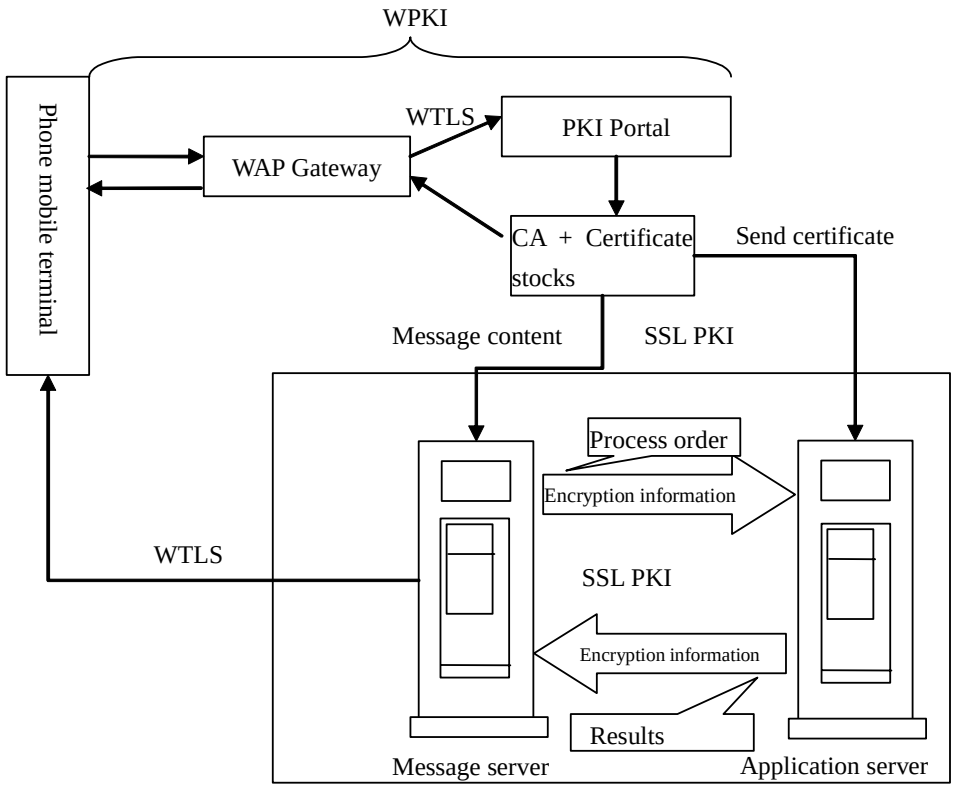

Figure 5. Flow of Application Model

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Reliability Analysis of an n-unit Standby Repairable System with K Repair Facilities

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Abstract

Redundancy or standby is a technique that has been widely applied to improving system reliability and availability in system design. In general, standby repairable system contains cold standby repairable system, hot standby repairable system and warm standby repairable system. In this paper, we shall deal with cold standby repairable system and warm standby repairable system with repair facilities. Under the assumptions that the failure time of unit and the repair time of failed unit are assumed to follow exponential distribution, we present a reliability analysis of an n-unit standby repairable system with $k\ \{k \in (1,2,\cdots,n)\}$ repair facilities.

Keywords: Standby repairable system, Reliability, Markov process theory, Steady-state quantities.

1. Introduction

Standby repairable system contains cold standby repairable system, hot Standby repairable system and warm standby repairable system. (Jinhua Cao,1986).has discussed the cold standby repairable system and the warm standby repairable system with only one repair facility, moreover, (Jianxiong Gu,2006) has discussed the cold standby repairable system with two repair facilities. In this paper, we shall deal with an n-unit standby repairable system with k repair facilities. Under the assumptions that the failure time of unit and the repair time of failed unit are assumed to follow exponential distribution, we obtain the steady-state quantities and average quantities by using the Markov process theory.

2. Cold standby repairable system

2.1 The assumptions of the model

2.1.1 The system consists of n identical units and k repair facilities. At the beginning $(t=0)$, all units are good, and one unit is working and others are under cold standby. The repair facility will repair the working one as soon as it fails. At the same time, the standby one begins to work .When the failed one has been repaired, it either begins to work again or becomes under cold standby. If the rest units fail while k units are still under repair, they must wait for repair. The switch is perfect, instantaneous.

2.1.2 Assume that each unit after repair is 'as good as new'.

2.1.3 The failure time of unit and the repair time of failed unit are all exponentially distributed with parameter λ and μ respectively. The failure time distribution and the repair time distribution are denoted which, respectively, by

$$X \sim F(t) = 1-e^{-\lambda t},(\lambda>0),t\geq 0;Y \sim G(t) = 1-e^{-\mu t},(\mu>0),t\geq 0,$$

The random variables are mutually independent.

2.2 The steady-state quantities and average quantities of the system.

Theorem 1: The system consists of n+ 1 no-identical state. Let $x(t)=j$, $\{j=1,2,\cdots,n\}$ denote the state that there are j

failed units (which contains the units that they are under repair) in the system at time t. So, the steady-state availability of the system is $A=1-\pi_n$; the steady-state failure frequency of the system is $M=\lambda\pi_{n-1}$; the mean up-time of the system is $MUT=\frac{A}{M}$; the mean down-time of the system is $MDT=\frac{1-A}{M}$; the mean cycle time of the system is $MCT=\frac{1}{M}$.

Where,

$$\pi_0=\left\{1+\sum_{j=1}^{k}\frac{\lambda^j}{j!\mu^j}+\frac{\lambda^k}{k!\mu^k}\sum_{j=k+1}^{n}\left(\frac{\lambda}{k\mu}\right)^{j-k}\right\}^{-1} \tag{1}$$

$$\pi_j=\frac{\lambda^j}{j!\mu^j}\pi_0 \qquad j=1,2,\cdots,k. \tag{2}$$

$$\pi_j=\frac{\lambda^k}{k!\mu^k}\left(\frac{\lambda}{k\mu}\right)^{j-k}\pi_0 \qquad j=k+1\cdots,n. \tag{3}$$

The mean time to the first failure of the system is

$$\begin{aligned}MTTFF&=\sum_{i=0}^{n-1}x_i\\&=\frac{1}{\lambda}+f\left(\frac{1}{\lambda}\right)+f\left(f\left(\frac{1}{\lambda}\right)\right)+\cdots+\underbrace{f\left(f\left(\cdots f\left(\frac{1}{\lambda}\right)\right)\right)}_{n-k}+g_{k-1}\left(\underbrace{f\left(f\left(\cdots f\left(\frac{1}{\lambda}\right)\right)\right)}_{n-k}\right)\\&\quad+g_{k-2}\left(g_{k-1}\left(\underbrace{f\left(f\left(\cdots f\left(\frac{1}{\lambda}\right)\right)\right)}_{n-k}\right)\right)+\cdots+g_1\left(g_2\left(\cdots g_{k-1}\left(\underbrace{f\left(f\left(\cdots f\left(\frac{1}{\lambda}\right)\right)\right)}_{n-k}\right)\right)\right)\end{aligned} \tag{4}$$

Where,

$$f(x)=\frac{1+k\mu x}{\lambda},$$

$$g_i(x)=\frac{1+i\mu x}{\lambda},$$

$i=k-1,k-2,\cdots,1$.

Proof: By the definition of the cold standby repairable system, we can know that

$x(t)=j$, $\{j=1,2,\cdots,n\}$, The state n denotes that the system is down, and the rest states denote that the system is up.

Therefore $E=\{0,1,\cdots,n\}$, $W=\{0,1,\cdots,n-1\}$, $F=\{n\}$, so, the stochastic process $\{x(t),t\geq 0\}$ is Markov process with state space E.

The transition probability form different states in the time Δt is equation (5).

$$\begin{cases}P_{j,j+1}(\Delta t)=\lambda\Delta t+o(\Delta t) & j=0,1,\cdots,n-1\\ P_{j,j-1}(\Delta t)=\begin{cases}j\mu\Delta t+o(\Delta t)\\ k\mu\Delta t+o(\Delta t)\end{cases} & \begin{matrix}j=1,2,\cdots,k-1\\ j=k,k+1,\cdots,n\end{matrix}\\ P_{j,j}(\Delta t)=\begin{cases}1-[\lambda+j\mu]\Delta t+o(\Delta t)\\ 1-[\lambda+k\mu]\Delta t+o(\Delta t)\\ 1-k\mu\Delta t+o(\Delta t)\end{cases} & \begin{matrix}j=0,1,\cdots,k-1\\ j=k,k+1,\cdots,n-1\\ j=n\end{matrix}\\ P_{j,l}(\Delta t)=o(\Delta t) & otherwise\quad j\neq l\end{cases} \tag{5}$$

Where, $l\in(1,2,\cdots n)$.

And we get the matrix of transition probability that is matrix (6).

$$P=\begin{pmatrix} -\lambda & \lambda & & & & & & \\ \mu & -(\lambda+\mu) & \lambda & & & & & \\ & 2\mu & -(\lambda+2\mu) & \lambda & & & & \\ & \ddots & \ddots & \ddots & & & & \\ & & (k-1)\mu & -[\lambda+(k-1)\mu] & \lambda & & & \\ & & & k\mu & -(\lambda+k\mu) & \lambda & & \\ & & & \ddots & \ddots & \ddots & & \\ & & & & k\mu & -(\lambda+k\mu) & \lambda & \\ & & & & & k\mu & -k\mu & \end{pmatrix}_{(n+1)\times(n+1)} \tag{6}$$

From the below equations (7), equation (4) can be obtained.

$$\left(x_0, x_1, \cdots, x_{n-1}\right)\begin{pmatrix} -\lambda & \lambda & & & & & \\ \mu & -(\lambda+\mu) & \lambda & & & & \\ & 2\mu & -(\lambda+2\mu) & \lambda & & & \\ & \ddots & \ddots & \ddots & & & \\ & & (k-1)\mu & -[\lambda+(k-1)\mu] & \lambda & & \\ & & & k\mu & -(\lambda+k\mu) & \lambda & \\ & & & \ddots & \ddots & \ddots & \\ & & & & k\mu & -(\lambda+k\mu) & \end{pmatrix} = (-1, 0, \cdots, 0) \tag{7}$$

3. Warm standby repairable system

3.1The assumptions of the model

3.1.1 The system consists of n identical units and k repair facilities. At the beginning $(t=0)$, all units are good, and one unit is working and others are under warm standby. The repair facility will repair the working one as soon as it fails. At the same time, the warm standby one begins to work .When the failed one has been repaired, it either begins to work again or becomes under warm standby. If the rest units fail while k units are still under repair, they must wait for repair The switch is perfect, instantaneous.

3.1.2 Assume that each unit after repair is 'as good as new'.

3.1.3 The lifetime distribution of all units is $F(t)=1-e^{-\lambda t}, t\geq 0, (\lambda>0)$,The lifetime distribution of standby units is $H(t)=1-e^{-\nu t}$, $t\geq 0$, $(\nu>0)$,the failure time distribution and the repair time distribution are $G(t)=1-e^{-\mu t}$, $t\geq 0, (\mu>0)$,The all random variables are mutually independent.

3.2 The steady-state quantities and average quantities of the system.

Theorem 2: The system consists of n+ 1 no-identical state. Let $x(t)=j, \{j=1,2,\cdots,n\}$ denote the state that there are j failed units (which contains the units that they are under repair) in the system at time t. So, the steady-state availability of the system is $A=1-\pi_n$; is the steady-state failure frequency of the system is $M=\lambda\pi_{n-1}$; the mean up-time of the system is $MUT=\frac{A}{M}$; the mean down-time of the system is $MDT=\frac{1-A}{M}$; the mean cycle time of the system is $MCT=\frac{1}{M}$.

Where,

$$\pi_0=\left\{1+\sum_{j=1}^{k}\frac{\prod_{i=1}^{j}[\lambda+(n-i)\nu]}{j!\mu^j}+\frac{\prod_{i=1}^{k}[\lambda+(n-i)\nu]}{k!\mu^k}\sum_{j=k+1}^{n}\frac{\prod_{l=1}^{j-k}[\lambda+(n-k-l)\nu]}{(k\mu)^{j-k}}\right\}^{-1} \tag{8}$$

$$\pi_j=\frac{\prod_{i=1}^{j}[\lambda+(n-i)\nu]}{j!\mu^j}\pi_0 \qquad j=1,2,\cdots,k; \tag{9}$$

$$\pi_j = \frac{\prod_{i=1}^{k}\left[\lambda+(n-i)\nu\right]\prod_{l=1}^{j-k}\left[\lambda+(n-k-l)\nu\right]}{k!\mu^k}\frac{}{(k\mu)^{j-k}}\pi_0 \qquad j=k+1,k+2,\cdots,n; \tag{10}$$

The mean time to first failure of the system is

$$\begin{aligned} MTTFF &= \sum_{i=0}^{n-1} x_i \\ &= \frac{1}{\lambda} + f_1\left(\frac{1}{\lambda}\right) + f_2\left(f_1\left(\frac{1}{\lambda}\right)\right) + \cdots + f_{n-k}\left(f_{n-k+1}\left(\cdots f_1\left(\frac{1}{\lambda}\right)\right)\right) + g_{k-1}\left(f_{n-k}\left(f_{n-k+1}\left(\cdots f_1\left(\frac{1}{\lambda}\right)\right)\right)\right) \\ &\quad + g_1\left(\cdots + g_{k-1}\left(f_{n-k}\left(f_{n-k+1}\left(\cdots f_1\left(\frac{1}{\lambda}\right)\right)\right)\right)\right) \end{aligned}$$

Where,

$$f_i(x) = \frac{1+k\mu x}{\lambda+i\nu}, \quad i=1,2,\cdots,n-k;$$

$$g_j(x) = \frac{1+j\mu x}{\lambda+(n-j)\nu}, \quad j=1,\cdots,k-1 \tag{11}$$

Proof: By the definition of the warm standby repairable system, we can know that $x(t)=j, \{j=1,2,\cdots,n\}$,

The state n denotes the system is down, and the rest states denote the system is up.

Therefore $E=\{0,1,\cdots,n\}, W=\{0,1,\cdots,n-1\}, F=\{n\}$, so, the stochastic process $\{x(t), t\geq 0\}$ is Markov process with state space E.

The transition probability form different states during the time Δt is equation (12).

$$\begin{cases} P_{j,j+1}(\Delta t) = [\lambda+(n-j-1)\nu]\Delta t + o(\Delta t) & j=0,1,\cdots,n-1 \\ P_{j,j-1}(\Delta t) = \begin{cases} j\mu\Delta t + o(\Delta t) \\ k\mu\Delta t + o(\Delta t) \end{cases} & \begin{matrix} . \\ j=1,2,\cdots,k-1 \\ j=k,k+1,\cdots,n \end{matrix} \\ P_{j,j}(\Delta t) = \begin{cases} 1-[\lambda+(n-j-1)\nu+j\mu]\Delta t + o(\Delta t) \\ 1-[\lambda+(n-j-1)\nu+k\mu]\Delta t + o(\Delta t) \\ 1-k\mu\Delta t + o(\Delta t) \end{cases} & \begin{matrix} j=0,1,\cdots,k-1 \\ j=k,k+1,\cdots,n-1 \\ j=n \end{matrix} \\ P_{j,l}(\Delta t) = o(\Delta t) & otherwise\ j\neq l \end{cases} \tag{12}$$

Where, $l\in(1,2,\cdots n)$.

And we get the matrix of transition probability that is matrix (13).

$$P = \begin{pmatrix} -\lambda-(n-1)\nu & \lambda+(n-1)\nu & & & & & & \\ \mu & -\lambda-(n-2)\nu-\mu & \lambda+(n-2)\nu & & & & & \\ & 2\mu & -\lambda-(n-3)\nu-2\mu & \lambda+(n-3)\nu & & & & \\ & & 3\mu & -\lambda-(n-4)\nu-3\mu & \lambda+(n-4)\nu & & & \\ & & \ddots & \ddots & \ddots & & & \\ & & & k\mu & -\lambda-(n-k-1)\nu-k\mu & \lambda+(n-k-1)\nu & \\ & & & \ddots & \ddots & \ddots & & \\ & & & & k\mu & -\lambda-k\mu & \lambda & \\ & & & & & k\mu & -k\mu & \end{pmatrix}_{(n+1)\times(n+1)} \tag{13}$$

By calculating equations

$$\begin{cases} (\pi_0,\pi_1,\cdots,\pi_n)P = (0,0,\cdots,0) \\ \pi_0+\pi_1+\cdots+\pi_n = 1 \end{cases}$$

and using matrix (13), we can get equations(8),(9)and(10).

From the above equations(14), equation (11) can be obtained.

$$\left(x_{0,}x_1,\cdots,x_{n-1}\right)\begin{pmatrix} -\lambda-(n-1)\nu & \lambda+(n-1)\nu & & & & & \\ \mu & -\lambda-(n-2)\nu-\mu & \lambda+(n-2)\nu & & & & \\ & 2\mu & -\lambda-(n-3)\nu-2\mu & \lambda+(n-3)\nu & & & \\ & & 3\mu & -\lambda-(n-4)\nu-3\mu & \lambda+(n-4)\nu & & \\ & & \ddots & \ddots & \ddots & & \\ & & & k\mu & -\lambda-(n-k-1)\nu-k\mu & \lambda+(n-k-1)\nu & \\ & & & \ddots & \ddots & \ddots & \\ & & & & k\mu & -\lambda-k\mu & \end{pmatrix}$$

$$=\left(-1,0,\cdots,0\right) \tag{14}$$

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Design and Implementation of Sales Management Information System

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Abstract

The sales works is one key stage in the whole enterprise operation, which importance is more and more obvious in the tide of market economy. “Market surrounded by enterprises” fully shows the sales center position in the enterprise activities. At present, the enterprise sales management level and marketing system directly influence the sales situation of products and the benefits of productive operation. In this article, more than one year’s operation of Jinan Refinery Sales Management System indicates that this sales management system is successful in the aspects of the reform of sales mode, the application of IC card and the join with MIS system of the factory.

Keywords: Sales management system, IC card, Network

1. Introduction

The sales works is one key stage in the whole enterprise operation, which importance is more and more obvious in the tide of market economy. “Market surrounded by enterprises” fully shows the sales center position in the enterprise activities. At present, the enterprise sales management level and marketing system directly influence the sales situation of products and the benefits of productive operation. The traditional sales flow and management mode still have time colors of planned economy and many disadvantages which are mainly represented as follows.

Traditional sales flow and management mode have too many stages and low efficiency and are easy to make mistakes, which brings many inconveniences to clients.

The business management can not be standardized, and management function and operation function have blurry borderlines, so it is difficult to balance strengthening management and servicing clients.

Business personnel are immersed in the business works and can not bind up to market development.

The capital return and sales operation situation have bad diaphaneity and real-time character, which is not convenient to supervise and control, and is easy to produce leaks and unnecessary capital occupation.

The statistical report forms have large quantities and different sources and formats, which often induces mutual conflicts because of different provenances.

The applied level of computer is low, which only limits to bill prints and material management, and the sharing degree of information is very low, and the diaphaneity and real-time character are bad, so the leaders lack reliable references to make decisions.

To make the selling of our factory closely follow the developments of the market economy, the factory director puts forward reforming present mode, strengthening management, emphasizing market development, improving services and servicing clients. Therefore, combining characters and practices of our sales works, we should face the developments of market economy, use foreign advanced experiences as references, firstly establish sales management system and actualize the modernization of sales process and management when preparing to construct Jinan Refinery electronic information technology application project. Our main missions and aims are the following four aspects.

(1) Establishing a set of safe, reliable and perfect sales management system, reasonably adjusting the functional borderlines between management and operation, realizing microcomputer, systematization, network and scientific sales management works, combining with factory information system and fully enhancing the modernization level of enterprise management.

(2) Strengthening management, unifying provenances, ensuring normative and perfect data management, detailed and uniform report forms, exactly reflecting the sales and capital situation of the enterprise, enhancing the objectivity, real-time character and diaphaneity of information feedback, building up leaks and reducing losses.

(3) Establishing IC card applied management system, realizing picking up the goods by cards, and offering convenient and

fast services for clients.

(4) Providing corresponding sales analysis, establishing corresponding leader inquiry system, and offering references for enterprise forward decision-making.

2. Total project

2.1 System mode

The system mode is the most pivotal factor to decide whether the system can be successful. According to the aim that Jinan Refinery sales management information system construction wants to realize, combining with the requirements of market economy and the direction of enterprise restructuring, through almost half year's argumentation, we establish the system mode which takes market as the center to realize the separation of sales business management and operation and strengthen market developments, which takes clients as the center to reasonably adjust the distributions of sales spots, and establish sales and financial central business center, which takes capital as the center to connect sales system and financial system and strengthen finance supervision.

According to this mode, aiming at the situation that our factory has three transport means including railway, auto and pipe transportations at the same time, we decide to adopt two operation and management modes. To railway transport (pipe transport) means, the factory will transact consignment procedures, and because this work is mainly represented as management, so the trade process is completely managed by network, and the operation flow is that when the planner sets down sales plan, the bill of goods needing railway transport will be downloaded to the transport department management system, and the transport department carries out the railway transport plan according this bill and returns the results to the planner system to adjust, and if the plan has been carried out, the bill will be as implementing plan and be downloaded to the railway control or railway shipping or railway measure system, and when the vehicles arrives, the shipping plant will implement shipping and inform quality supervision department to inspect, measure and weigh up and the control department allows departure. After this, business personnel transacts user's carriages or insurances and goods invoices according to the implementing plan and the shipping situations of vehicles, and charges account in the finance department after client returns funds, and the business personnel and planner can manage the capital returns at any moment. The pipe transport is easier than this, so we don't describe it again. To auto transport means, considering the characters of dispersive spots, too many batches, procedure transacted by the client himself, to convenient for client, we adopt management combining card with network in the trade process. Aiming at those unreasonable aspects in the former mode such as business personnel's two functions of making out invoices and contacting business mixing, distribution of sales operation according to product kinds, decentralization of trade work in the finance department, sales business office, various picking spots and weighing spots, we adopt the mode which separates the business personnel's double functions of making out invoices and contacting business and reserves his right of invoice control, and centralizes the function of financial balance and the function of making out invoice to sell and pick up goods at the locale.

2.2 Network project

As one important subsystem of factory CMIS, sales management system independently forms a network, which adopts 100M fast internet, ATM exchange technology (fiber trunk/ twisted-pair/ special MODE line together) and client computer/ server mode, introduces IC card technology, combines shipping spot terminal by the card and network, and connects with factory integrated information management system CIPROS through special port.

2.3 Software and hardware environment

The main hardware facilities of this system include two sets of servers (double computer hot backup), nineteen sets of client computers (IBM PC), ten sets of POS (S900/i), ten sets of IC card read-write machine (ICT800) which IC cards are CPU cards with perfect information encrypting system and firm and high security, and other relative supporting equipments such as printer and modem.

The basic composing of the system includes that servers use Windows NT4.0 Operation system and ORACLE Enterprise 7.3 Server, client computers use Windows95 Operation System and ORACLE Enterprise 7.3 Client, and the communications between servers and client computers are realized by TCP/IP agreements.

2.4 Development tool

The main development tool uses PowerBuilder6.0/ C++ (PowerBuilder is the development tool specially designed for enterprise client/ server mode application programs by Sybase Corporation, and it supports manifold platforms and possesses the abilities to develop application programs among different platforms).

3. System design

3.1 Design principles of system

Facing market, strengthening management, and actualizing science, standardization and network.

Centralizing to work, unifying servicing, simplifying procedures, servicing clients and improving services.

Holding reasonable factors in the former sales flow and management mode, daring to reform, properly adjusting, separating the business personnel's double functions of making out invoices and contacting businesses, reserving invoices control right of business personnel, centralizing functions of financial balance and selling, picking up goods and making up invoices, realizing the separation of management and operation, and emphasizing market development.

Putting the trade and management information on the network timely, and ensuring the real-time character, diaphaneity and security of the trade process and data.

As one subsystem of factory information management system, sales management system must insure the connection with the whole network system of the factory, avoid repeat constructions, and consider the expansibility of the system. Under the premise of ensuring technology and advanced facilities, we should insist on the practicality principle and reduce the investments of the system.

3.2 Function and structure design of system

According to the new demonstrated sales system mode, combining the practical situations of Jinan Refinery, the whole sales management system possesses four functions including sales plan management, sale/ balance management, picking/ consignment management and finance/ statistic/ inquiry decision-making management (see Figure 1).

(1) As the chief and control center of the whole sales management system, the sales plan management system mainly takes charge of the following aspects.

Making and adjusting sales plans according to the production plan established by the factory plan department.

Adjusting and implementing sales plans according to the implementation and production repertory of railway plans.

Signing, modifying and implementing self product sales contracts.

Managing control information of sales trade operation according to clients' reputations and market situations.

Managing prices and relative preferential policies.

Making and issuing IC cards and managing their uses.

Managing clients' files.

(2) The sale/ balance management system mainly takes charge of the following aspects.

Drawing in or refunding users' capitals and filling money into the user cards and drawing money.

Managing sales picking and consignment procedures.

Balancing and managing invoices.

Managing users' inquiry.

(3) The picking/ consignment management system mainly takes charge of the following aspects.

Collecting data of consignment quantities and managing network.

Realizing distribution/ consignment operations according to the information of user cards.

Managing the inquiries of user card information.

Making statistic of entering/ consignments in own spot.

Railway control and shipping management.

Other management systems such as quality inspection system.(4) The finance/ statistic/ inquiry decision-making management system mainly takes charge of the following aspects.

Sales accounts credence and statistic management.

Supervision of sales operation data and collection statistic and sales situation analysis.

Inquiry of sales information for relative departments.

Factory director inquiry system which can be references to make decisions for factory leaders.

3.3 Module design diagram of system

The module design diagram of the system is seen in Figure 2.

3.4 Module functional design of applied software

(1) Design of database application and maintenance management system

Dictionary maintenance, which includes net spot management, operator management, product coding management, business personnel management, purview management, plan coding management, provincial coding management, invoice index management, product variety purview management of business net spots.

System initialization management.

Data settlement and data codes management.

Daily balance/ monthly balance/ yearly balance management.

Products daily repertory management.

Daily output and self using quantities management.

Data copying and recovering management.

(2) Design of IC card initialization system

Accepting empty card according to its transport password and the content of batch card.

Creating keys.

Establishing file structure.

Creating card number.

Dispersing keys.

Explanation: All cards need to be initialized before they are sent to users, and the initialization includes establishing data files and writing card password and other relative keys into the card.

(3) Design of sale and statistic NAC management system

Signing in/ out communication flow management.

Blacklist management.

POS picking varieties maintenance management.

Picking flow management.

Dial-up management.

Loading and installing of POS application system.

Explanation: As one part of POS system, NAC is used for data transmission between front POS machine and back database.

(4) Design of sales planner management system

Making sales plans which include heavy oil scheme, liquefied petroleum gas scheme, schemes of gasoline, kerosene and diesel oil, self monthly scheme.

Making railway transport plans which include monthly plan of products of gasoline, kerosene and diesel oil, added plan of products of gasoline, kerosene and diesel oil, monthly plan of heavy oil and asphalt, added plan of heavy oil and asphalt.

Plan statistic managements which include consignment of national plan products, consignment of self products, accomplishment of kerosene resources, implementation of kerosene supply plan, sales season report of finished oil, heavy oil and liquefied petroleum gas, comprehensive report forms of material supply statistics.

Code maintenance managements which include users list of kerosene supply implementation table, products list of material supply statistic comprehensive report table, users list of heavy oil plan, users list of liquefied gas plan, provincial list of scheme plan of gasoline, kerosene and diesel oil, users list of various railway transport plan.

Price managements which include present planned price management of auto transport products, present self selling price management of auto transport products, present price management of railway transport products, and present price management of pipe transport products.

Users' files maintenance and management.

Explanation: The sales plan management is one manageable function of sales management system.

(5) Design of sales contract management system

Contract catalog inquiry management.

Signing contract management.

Performing contract management.

Purchase and sale agreement catalog inquiry management.

Purchase and sale agreement management.

(6) Design of sales business personnel management system

Client files maintenance management.

Business managements which include picking plan management, sales purview management, and overdraft allowance management.

Railway transport invoice managements which include product invoice management, railway carriage invoice management, railway transport goods invoice register, invoice inquiry, value-added tax invoice collection, copying and declaring tax management, and leaving factory bills maintenance of shipping products.

Code table maintenances which include self user setting, product variety bill of picking plan.

Statistic inquiry managements which includes sales plan inquiry, product price inquiry, daily consignment statistic, railway transport consignment statistic, invoice statistic, product repertory statistic, comparison between auto transport consignment and invoices.

System maintenances which include month end disposal, unlocking golden tax card, locking golden tax card, setting parameters of golden tax card.

(7) Design of pipe transport management system

Pipe transport plan management.

Pipe transport leaving factory bills management.

Pipe transport balance management.

Statistic management.

Maintenance managements which include unlocking golden tax card, locking golden tax card, setting parameters of golden tax card.

Tax control invoices management (printing/ canceling/ balancing).

Value-added tax collection.

(8) Design of transport and sale section transport department management system

Monthly vehicle demand plan management.

Daily vehicle use plan management.

Daily vehicle admission informing management.

Goods transport bills management.

Transport daily report/ monthly report management.

User maintenance.

Spots/ bureaus arrival maintenance.

Products maintenance.

Self-provided autos management (auto renting management, auto renting fees management, servicing management, servicing fees management and so on)

(9) Design of transport and sale section chief management system

Comprehensive inquiry managements which include day/ month/ year sales inquiry, sales plan inquiry, contract inquiry, agreement inquiry, invoice statistic, railway transport consignments statistic, price inquiry, user inquiry, funds return statistic inquiry, comparison between auto transport consignments and invoices, product repertory.

Selling supervision.

Special favors management.

(10) Design of factory director inquiry management system

Sales plan inquiry.

Sales statistic inquiry.

Sales financial income and expenses inquiry.

Sales analysis inquiry.

Quality inspection statistic inquiry.

(11) Design of business window sales management system

Cards managements which include user card issuance, picking card issuance, card password management, loss reporting and canceling, card logout, card identification, user card withdrawing, card operation inquiry.

Batch bill managements which include batch bill editing, batch bill printing, batch bill inquiry, batch bill canceling, batch bill balancing, batch bill withdrawing, batch bill price adjusting, editing batch bill picking card, transacting new batch bill picking card.

Invoices managements which include invoice selection and printing, invoice inquiry, invoice canceling, invoice balancing, invoice statistic, tax report of golden tax card.

Picking card balance.

Business statistic inquiry managements which include capital uses, user account checking, product sales statistic, products month/ year sales analysis.

Statistic report forms managements which include sales day/ month report, user purchase day/ month report, consignment report forms, unprinted invoices and report forms.

System maintenance and abnormal operation treatments which include communication port setting, abnormal operation record, unlocking golden tax card, locking golden tax card, ports management of accounting system.

Sales window management system of agency shipping (subsystem), which includes client files maintenance and user card issuance, picking editing (car number, variety, price, quantity, and money), balance, tax control invoices management, ports management of accounting system, value-added invoice collection.

Sales window management system of gas products (subsystem), which includes client files maintenance management, picking editing (car number, variety, price, quantity, and money), batch bill management, invoice management, operation inquiry, statistic report forms management, system maintenance management, tax control application management, ports management of accounting system, value-added invoice collection.

Explanation: The business window management system is the main stage of the sales system, where two subsystems of sales window management system of agency shipping and sales window management system of gas products are designed according to actual situations of our factory.

(12) Design of business window finance management system

Deposit management.

Balance management.

Offset account management.

Period balance management.

Check-out management.

Cash refundment management.

Check clearance account management.

Finance inquiry management.

Accounting system ports.

(13) Design of auto transport weighing management system

Taring management.

Gross weighing management.

Balance and out certificates management.

Weighing statistic inquiry management.

Consignment statistic management.

System maintenance management.

Card inquiry management.

(14) Design of auto transport consignment management POS application system

Signing in/ out managements which include equipment signing in, equipment signing out, blacklist obtaining, operator signing in/ out.

Operator management.

Facility initialization (telephone setting, spot number setting, and time setting) and operation parameters setting (light oil ton/ liter parameters setting, operator increase or deleting management).

Inquiry managements which include card inquiry, picking record inquiry, operator inquiry, picking variety inquiry and blacklist inquiry.

Consignment managements which include read-write operation, consignment trade and consignment trade canceling.

(15) Design of railway control management system

Vehicle entering factory management.

Daily vehicle admission management.

Actual leaving factory vehicles management.

Vehicles distribution management.

Task bills management.

Simulation management.

Shipping plan management.

Handing over and taking over management.

Daily report management.

Dictionary maintenance.

(16) Design of railway shipping measure management system

Current leaving factory bill management.

Daily vehicle admission informing management.

Shipping management.

Empty measure bill management.

Manual measure input management.

Leaving factory bill management.

Manual measure leaving factory bill management.

(17) Design of dynamic orbit weighing management system

Actual shipping management.

Daily vehicle admission informing management.

Empty measure bill management.

Measure bill management.

Dynamic weighing measure.

Oil products leaving factory bills.

(18) Design of static orbit weighing management system

Actual shipping management.

Daily vehicle admission informing management.

Empty measure bill management.

Measure bill management.

Single vehicle taring.

Single vehicle gross weighing.

Patches weighing.

Oil products leaving factory bills.

(19) Design of sales section sales statistic management system

Product sale statistic day/ month account management.

Report forms for General Corporation which include sales month table of enterprise oil finished products, direction month table of enterprise oil finished products, transport and storage month table of enterprise oil finished products.

Market marketing statistic month report.

4. Applied effects of system

Since Jinan Refinery sales management information system was used, it obtains obvious economical benefits and social benefits and wins extensive recognitions, which can be summarized in the following aspects.

The management level has been enhanced.

The work efficiency has been enhanced.

The labor intension has been reduced.

The mistake ratio has been reduced.

The clients have felt conveniences.

The labor costs have been reduced.

Before the sales management system was used, clients needed half day at least to transport oils form entering factory to go out factory, and needed to arrive several places and make out several invoices, and they complained “they almost need to arrive every place of the factory to transport oils one time”. But after the sales management system is used, the relative personnel of transport and sale section, finance section and other sections are centralized together, and the sales balance center was established, which works at the locale, and the IC card technology was introduced, and it is very convenient, fast and safe to trade using cards. At the consignment spot, weighing, invoices printing and go-off certificate are completed in one time, and it only needs half hour from entering factory to leaving factory, and the clients’ waiting time is reduced obviously, which makes clients obtain many conveniences. Furthermore, the balance center also real-timely displays the product price from the net through big screen to convenient for uses to know.

Before the sales management system was used, various sales stages were independent, and the responsibilities were blurry, the statistic, inquiry, account checking, report forms depended on handworks, which wasted energy and times very seriously. The sales situation, repertory situation and capital returns could not be grasped timely, which produced many difficulties to reasonably arrange, exactly make decisions and control real-timely. When the sales management system was applied, various sales stages had been connected through computers, and all data were “running” on the net, and the data and information can be sharing, which overcomes the above various advantages. For example, it usually needed transport and sale section transport department a few days to complete one work before the sales management system was used, but now this work only needs a few hours. The statistic and inquiry which often made personnel headache ago can be printed by pushing button, which fully reduces labor intensions and enhances work efficiencies. For example again, one operation personnel in transport and sale section transport department ago took charge of not only product salesmanship but also invoices. When he did sale promotion, there were no personnel to make out invoices for clients, but when he made out invoices at “home”, he couldn’t to do sale promotion. After the sales management system was applied, the mode is changed, and the operation personnel only needs do sale promotion and develop market intently. There are special personnel to take charge of sales invoices, and the product prices are transferred from the net, which has transparent and clear responsibilities and avoids human factors. The sales management system specially designs factory director and section chief inquiries, and the leaders can inquiry sales plans, sales statistics, sales financial income and expenses and product repertory at any time, and can do sales analysis according to appointed conditions, which fully supports leaders to manage, control and make decisions as viewed form the macro-standpoints.

Before the sales management system was used, at auto transport shipping spot, it needed eight personnel to manage oils distribution, make out lading bill and go-off certificate. Now clients use IC card to pick up the goods, which only needs brush card on the POS machine, and doesn’t need make out invoices by hand, and this work only need two personnel, accordingly the labor costs are reduced for the enterprise and the economical benefits are increased.

One year’s operation indicates that this sales management system is successful in the aspects of the reform of sales mode, the application of IC card and the join with MIS system of the factory. The system operation is table and reliable, and achieves the design requirements. This system is one successful exploration of the enterprise in the information-based construction, and exerts active influences for the enterprise to improve service, strengthen management, development market and increase benefits.

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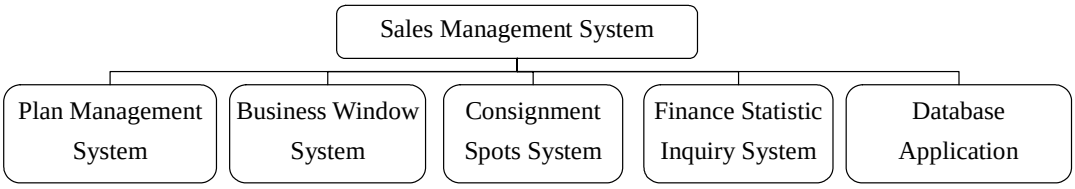

Figure 1. Function and Structure Diagram of Jinan Refinery Sales Management System

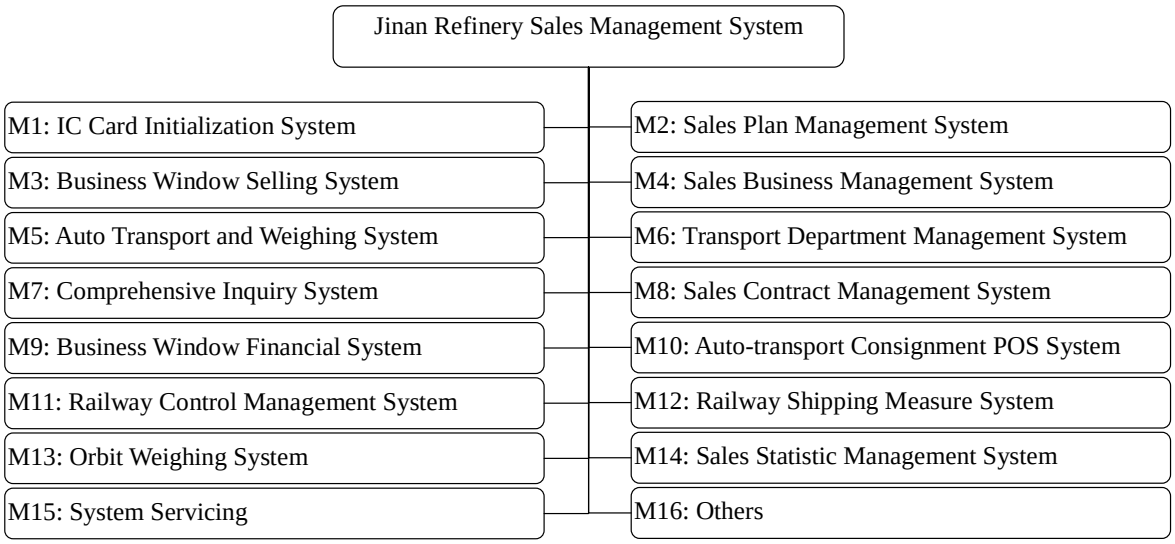

Figure 2. System Module Design Diagram

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Design of Alternating Impact Machine with High Temperature and Pressure Resistance

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Abstract

The alternating impact machine with high temperature and pressure resistance is a kind of equipment to make the fatigue experiment for rubber pipe in the auto industry. This article mainly introduces the work principle and the design of hydraulic pressure system and temperature control system of the alternating impact machine. This system uses Siemens S7-200 Programmable Logic Controller (PLC) control the temperature, impact of water or oil pulse and the impact control of test-bed. The master machine is monitored by the King View. The combination of PLC with the soft of King View is propitious to design and examine the PLC control system and possesses good practical value.

Keywords: System design, Hydraulic pressure system, Temperature control, PLC, King View

1. Introduction

The alternating impact machine with multi-mediums high temperature and pressure resistance is a kind of machine to add the temperature and pressure to the rubber pipe of auto industry and fulfill the situation of pressure alternating and simulation impact. In fact, this machine performs a kind of fatigue experiment, produces impacts to the interior of the rubber pipe which usually also produces vibration according to the purpose itself through the hydraulic pressure pulse of recurrent changes, finally examine whether the rubber pipe is eligible according to the time of fatigue experiment and the breach of the rubber pipe. This article systematically designs the vibration of the rubber pipe itself, the hydraulic pressure pulse of the interior of the rubber pipe and the interior and exterior temperatures of the rubber pipe, especially designs the hydraulic pressure system, really realizes the pulse change in the interior of the rubber pipe, and solves one of big problems for the examination of the rubber pipe.

2. Structure and work principle of alternating impact machine

The structure of the alternating impact machine with multi-mediums high temperature and pressure resistance mainly includes the test room, vibration part and the hydraulic pressure part. The sketch of the structure is seen in Figure 1.

In the design of the test room, we equip the temperature control and monitor system in the interior to credibly ensure the test temperature range of ±2°C in the test room and fully simulate the actual temperature of the exterior environment for the auto rubber pipe. In order to simulate the vibration of the rubber pipe, we adopt the frequency conversion mode to drive the mechanical vibration part, which can not only adjust the vibration frequency through changing the motor revolution, but can adjust the swing through adjusting the eccentricity of the mandrel of the vibration machine to fulfill the request of the work conditions of the tested rubber pipe, and this is the innovation of this design. To the design of the hydraulic pressure part, we adopt the double mediums of water and oil test system, where the test pressure of oil medium and water medium can be enacted on the master machine according to the needed parameters which can fully adapt the interior environmental change of the auto rubber pipe and simulate the impact to the rubber pipe.

The work principle can be described as follows. Equip the tested rubber pipe on the interface of water or oil according to the request, close the door of the test room after completing the equipment and the test room begins to be heated. Start the system, the vibration motor drive the tested piece to shake according to the input frequency, simultaneously the liquid in the rubber pipe begins to be heated and the heating process is completed in the box filling with liquid. When the heating temperature achieves the appointed value, the heating is stopped and this temperature is require to be maintained. When the heating begins, the hydraulic pressure system begins to work at the same time which produces pulses with a certain pressure and temperature in the rubber pipe. Circulate like this until the rubber pipe is broken, the protective program is started to close the system safely. All this test process is recorded in the master machine in order to analyze the rubber pipe after the test.

3. Design of control system

This control system uses PLC, collects the operation estate and actual data which are displayed on the monitor computer through the pressure and temperature sensors equipped on the machine, at the same time receives the operation orders and test enacted parameters from the monitor computer, controls the motors, heaters and magnetic valve on the machine according to the orders and test parameters to complete the test steps. Simultaneously the monitor computer can perform the save and printout of the test situations. And the master machine uses the configuration soft to complete the live display of the industrial flow and control parameters and realizes such functions as production monitor and management. This monitor system fully utilizes the respective characters of microcomputer and PLC and realizes the complements of their advantages. According to the actual situation of the test equipment, this article designs the computer monitor system which takes the Advantech Industrial Computer and Siemens S7-224CPU transmitter as the hardware core and adopts the King View6.50 as the soft platform, which can fully enhance the automatization level for the control and monitor. The control principle is seen in Figure 2.

The characteristic of this article rests with the hydraulic pressure and temperature control system, so we make the detailed research on these two aspects.

3.1 Hydraulic pressure part

The hydraulic pressure system of this machine is very important, and it is the key of this design, so we explain it detailed in this article. According to the actual situation of the auto rubber pipe, there are strict requests on the aspect of the choice of hydraulic pressure test equipment. All hydraulic pressure components providing for the pressure test system adopt the oil hydraulic pressure components which are refitted by temperature resistance and can work on the 150°C. And the overflow valve adjusting the pressure adopts the overflow valve with low noise which can ensure the noise is smaller than 60 dB in the process of the continuous test.

The main function of this system is realized by the switches of two magnetic valves to complete the simulation of the alternating pressure in the rubber pipe. After the test begins, the entrance valve is opened and the exit valve is closed, so the pipe interior is in the stage of pressure ascending, when the ascending pressure achieves the enacted value, two valves are closed at the same time, and the pipe interior is in the stage keeping pressure, finally, the entrance valve is closed and the exit valve is opened, and the pipe interior is in the stage releasing pressure.

The hydraulic pressure system control unit is composed by the motor controller and magnetic valve controller. The intermediate relay and AC contactor make up of the motor controller. The start or open orders of the motor made by PLC switches on or cuts the control turn of the AC contactor, control the connection or disconnection of the motor main loop power, and control the operation of the motor. The control part of the magnetic valve is composed by the rapid solid estate relays, and it can switch on or cut the control circuit of the magnetic valve according to the opening and shutting orders of the magnetic valve made by PLC in 5ms, and realize the rapid control of the magnetic valve.

The oil box and water box of the test system equip the sensors of heating and temperature control which can control the temperature of the liquid changes in the range of the test request. In the loop of the test system, there are sensors on the entrances of oil, water and unload, and the whole alternating process of the pressure ascending and unloading tests can be displayed on the computer, and the pulses can be clearly expressed in the Figure 3 of the wave ladder diagram. When the rubber pipe breaches, the low pressure time is very long, so the program design can ensure the safe stop.

3.2 Temperature control

This article adopts S7-200 PLC to design the temperature control system, and the advantages are: this PLC can compose proportion control, integral control and differential coefficient control according to different requests, the parameters can be adjusted conveniently, the program design is simple and easy to realize fussy mathematics operation, and the math model of the controlled objects is not needed. The composed PID adjustor bases on the continuous and systematic PID control laws, then digitizes and gets the control equation with the form of function. The principle of PID temperature control is seen in Figure 4.

Except for the restorations of all PID values in the initialization part we definite the control cycle T_c of PID controller. For the numerical value problems appeared in the process of computing PID and calculation of T_c, we complete them through replacement method and don't transfer the special division subprograms because of the limitation of scan time. To the calculation of differential coefficient and integral, we adopt the following formulas (the feedback input variables are from simulation in the processing process).

Differential coefficient operation = (old difference value $E_{(n-1)}$ + new difference value $E_{(n)}$) ÷ T_c

Integral operation = (old difference value $E_{(n-1)}$ + new difference value $E_{(n)}$) ÷ 2 ×T_c

The S7-200 PLC has the thermocouple modules, the input points of simulation are A+ and A-, the input voltage is 0-24V DC which is transformed as numerical values 0-1023 through A/D and the maximal error ? 0.2%. There is each amplifier in the interior of the input points. The output can be 220V AC or 24V DC. We adopt the magnetic valve with

24V DC, which has special cold junction compensation circuit, and the thermocouple and the thermocouple modular are connected. This circuit measures the temperatures of oil and water on the modular junction, and makes necessary correct to the measure values to compensate the temperature differences between benchmark temperature and modular temperature, which basically realizes the control without error and overcomes such disadvantages as temperature excursion, big error, bad quality of axes and so on.

3.3 Design of King View

The communication between the industrial computer and PLC can be performed by the PC/PPI cable which connects the program junction of S7-200 with RS232 junction of computer, and it is completed in the equipment window of program environment and view soft in the slave computer. The communication between the industrial computer and digital display instrument adopts the universal RS232/RS485 transmitter, and it is completed in the equipment window of instrument and view soft.

This operation system mainly designs three interfaces which include data monitor interface, oil pipe data display interface, water pipe data display interface and relative warning interfaces. The data monitor interface (see in Figure 5) lively displays the whole work estate of the machine. Various indexes including the figuration of the machine, the position of each data sampling point, valve and motor, the present value, the present running estate and the flowing direction of the liquid. The system exactly reflects all data of the present machine and test process. And in this interface, we can observe and adjust the test conditions in real time.

4. Conclusions

The practice proves that the control system has perfect function, reliable performance, convenient servicing and realizes the automatic control of the vibration control. The adoption of the hydraulic pressure system and PID temperature control ensures the test conditions and test process. The configuration control of the master computer enhances the automatization level of the vibration system, decreases the labor intensity and avoids the accidents produced by the artificial operation. Therefore, this design possesses comparative advancements.

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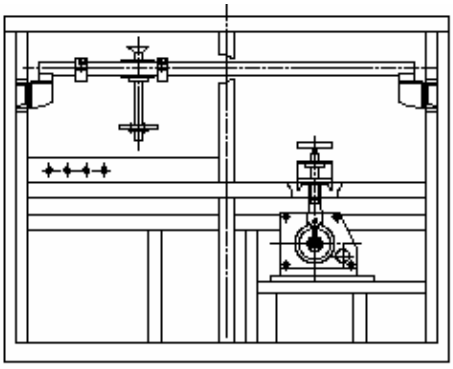

Figure 1. Sketch of Structure

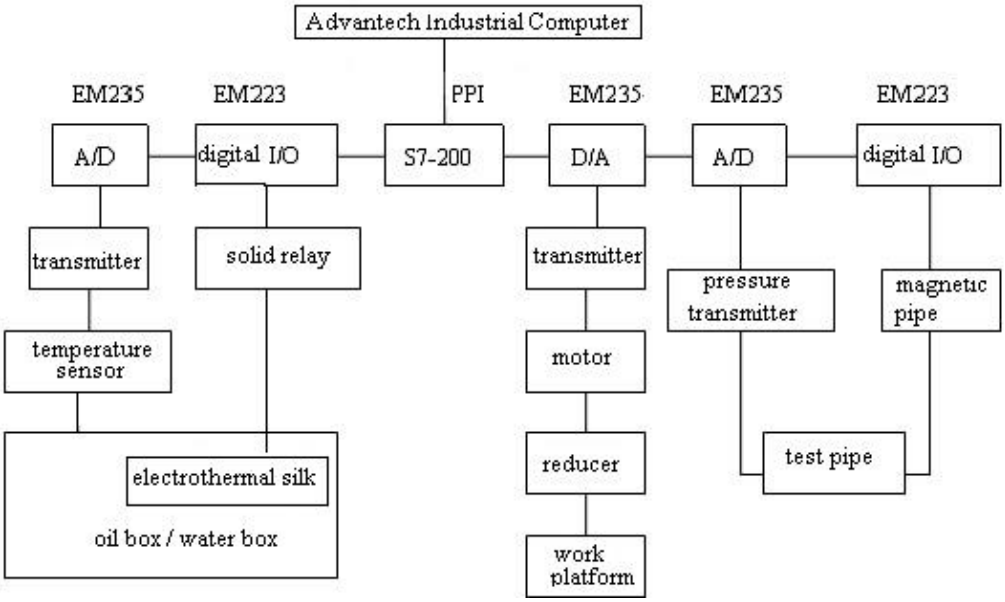

Figure 2. Control Principle of the System

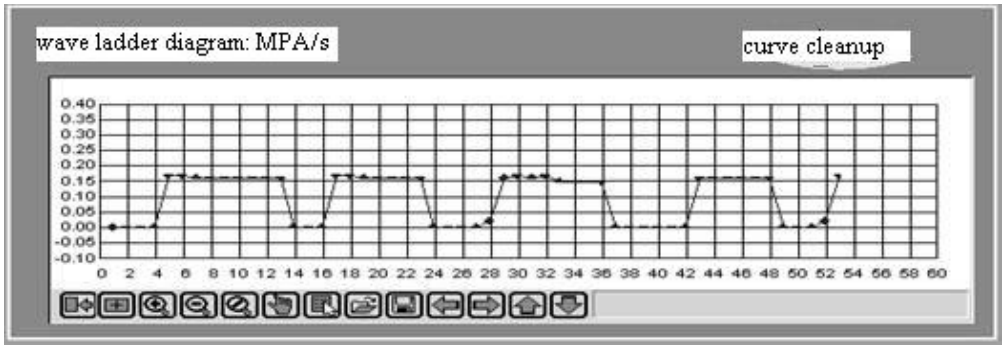

Figure 3. Pulse Curve

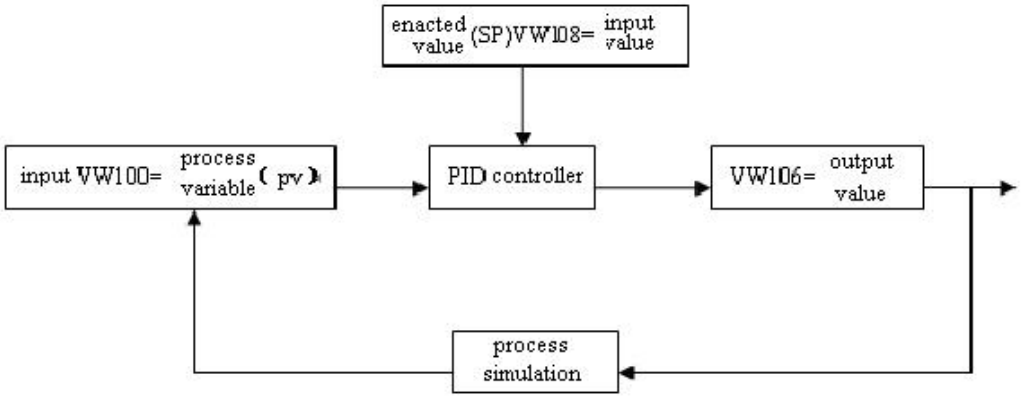

Figure 4. Control Principle of PID

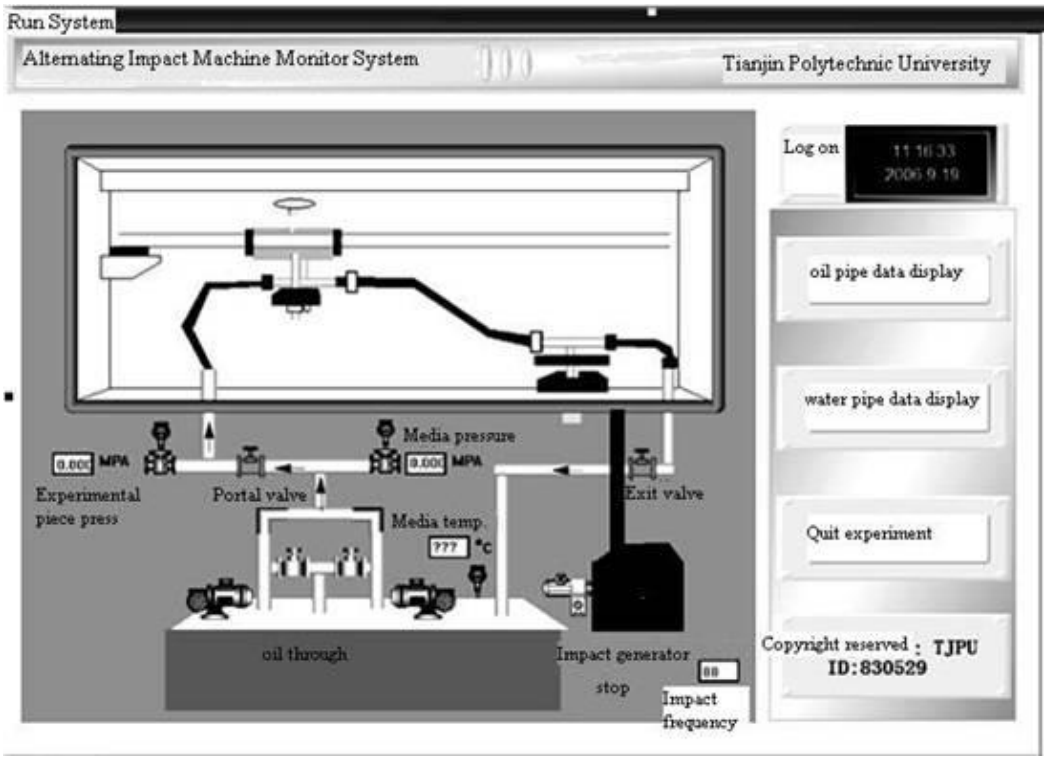

Figure 5. Data Monitor Interface

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A Study on the Relationship between the Thickness Of Nonwoven and Its Sound Absorption Capability

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Abstract

Nonwoven has got fast developed and widely used in the range of the world, while it is mainly used is as the auxiliary materials of perforated plate for its sound absorption capability in our country. In this paper, we summarized the relationship between the property parameters of the non-woven materials and their sound absorption capability. Experiments and theory analysis proved that the thickness of non-woven materials was the most influencing factor on their sound absorption capability.

Keywords: Nonwoven, Thickness, Sound absorption capability

1. Introduction

Sound absorbing materials have attracted much attention as the ambient noise impact people's lives greatly. The development of sound absorbing material has experienced natural fiber, such as cotton and ramie, and chemical fiber, such as mineralwool and glasswool, perforated resonance plate, micro perforated plate and membrane resonance structures. Applications of current sound absorbing materials have still some disadvantages, such as poor environmental adaptability, dust pollution caused by the brittleness, the inconvenience of construction caused by large volume (Zhou & Fan, 2004, p. 27). A new sound absorbing material is needed with the strengthening of people's environment protection consciousness. For its excellent properties, research on the sound absorption capability of nonwoven is of particularly importance.

Nonwoven is a kind of fabric material formed by fibers with orientation or random arrangement that compose into schistous matters, fiber web or wadding pad through friction, cohesion and bonding. It may need to be mentioned that paper, woven fabric, knitgoods, rufting goods, braided fabric with yam and felted texture made by wet method and milling are not nonwoven.¡¡The structure of nonwoven is three-dimensional netted and multiporous, which is very suitable for the application of sound absorption for its porosity, plasticity and elasticity. Besides, nonwoven has the advantages of wide raw material source, many varieties, simple production technology, high labor productivity, multiple process technology and wide field of applications. In this work, we studied mainly the relationship between the thickness of the needled nonwoven and its sound absorption capability.

2. Experimental Details

2.1 Material Preparation

Polyester needle-punched nonwoven was chosen to be our sample to avoid the influence of different fiber and different non-woven technology on the sound absorption capability. In our work, the thicknesses of the samples were 2.67 mm, 3.50 mm, 5.43 mm and 9.03 mm respectively.

2.2 Material Characterization

The thicknesses of the samples were measured by YG141 Fabric Thickness Gauge. The sound absorption capability of the samples is characterized by Digital Sound Lever Meter (TES-1350/ TES-1350A).

3. Results and Discussion

The sound absorbing capacity of a material is expressed by the absorption coefficient. In our present work, the absorption coefficients for the nonwoven with various thicknesses were measured in the frequency range from 125 Hz to 4000 Hz (Table 1 and Figure 1). Usually, materials with the sound absorption coefficient bigger than 0.2 can be named sound absorbing materials (Zhong, 2005, p. 46). According to the criterion, the nonwoven used in our experiment is of sound absorption property, which is associated with the porous structures. The surface morphology of nonwoven fibers is showed in Figure 2. Nonwoven is composed of orientated or randomly arranged fibers through friction, cohesion and bonding which might

include natural or chemical fibers, staple, filament, fibers formed on the spot (Guo, 2000, p. 16). The fiber components can be in parallel or in random distribution in two-dimension or three-dimension. The disordered structures introduce a lot of open pores into nonwoven that can absorb some incidental acoustic wave and scatter the others. The acoustic wave that enters into the open pores spreads in the fibers and thin space of the pores. The friction of this motion between the acoustic wave and the fibers dissipates a portion of acoustic energy by the viscosity and the thermal conduction.

Figure 1 shows the sound absorption coefficients of the four samples measured at different frequencies in a visualized way. The nonwoven thickness has a great impact on its sound absorbing qualities. It can be seen that the turning point of sample 1 and sample 2 is lower than 0.2. According to the criterion of sound absorbing material, if the thickness of nonwoven is less than 3.5 mm (sample 2), they have little sound absorption property. More thickness of the nonwoven means more loss of sound energy by the friction and vibration of the internal fibers. Sample 4, the thickness of which is 9.03 mm, has the best sound absorption performance in our experiment. The mechanism of nonwoven to "absorb" sound is considered to be the change of absorption acoustic energy into thermal energy. This results from the actions of friction between the vibration air that penetrated into the nonwoven and the inwalls of the pores. The viscosity resistance of air in pores makes the sound energy transformed into thermal energy. The process is repeated several times and result into the attenuation of acoustic wave. If the nonwoven is too thin, the times of the process repeat reduces and sound absorbed decreases. Situation on the contrary is that the thicker of the nonwoven, the more of the times of the process repeat and the more acoustic energy loss.

4. Conclusions

Nonwoven is used mainly as the auxiliary materials of perforated plate in sound absorbing materials. Carl Freudenberg (Germany) has developed a new inorfil sound absorbing material named SoundTex, which is made of perforated aluminium panel bonded with nonwoven. Laite Board produced by Wujiang Terelong Building Material Co., Ltd. is made of natural vegetable fibers and cement. Till now, nonwoven has not been used as a sound absorbing material alone. There is great importance and perspective of research on the sound absorption property of nonwoven, the thickness of which has the greatest impact on its sound absorbing qualities. Through the experiment and analysis above, the following results can be concluded:

(1)Nonwoven is of sound absorption property as the sound absorption coefficient of which can be bigger than 0.2.

(2)The thickness has a great effect on low-frequency sound absorption.

(3)The turning point of sample 1 and sample 2 is lower than 0.2. It can be concluded that if the thickness of nonwoven is less than 3.5 mm (sample 2), they have little sound absorption property. Sample 4, the thickness of which is 9.03 mm, has the best sound absorption performance in our experiment.

Table 1. The sound absorption coefficients for the four samples with various thicknesses at different frequencies.

samples	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
1# (2.664mm)	0.18	0.12	0.14	0.11	0.22	0.23
2# (3.501mm)	0.17	0.25	0.11	0.03	0.12	0.06
3# (5.435mm)	0.23	0.28	0.12	0.25	0.26	0.31
4# (9.032mm)	0.27	0.52	0.32	0.24	0.39	0.52

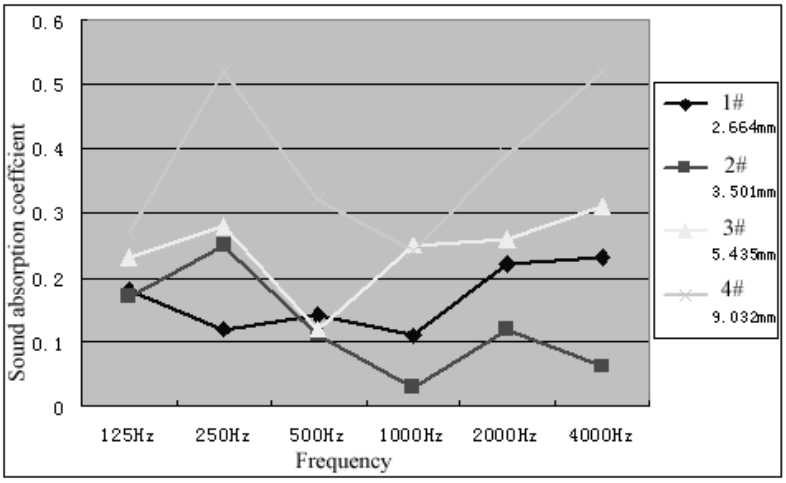

Figure 1. The sound absorption coefficients of the four samples at different frequencies

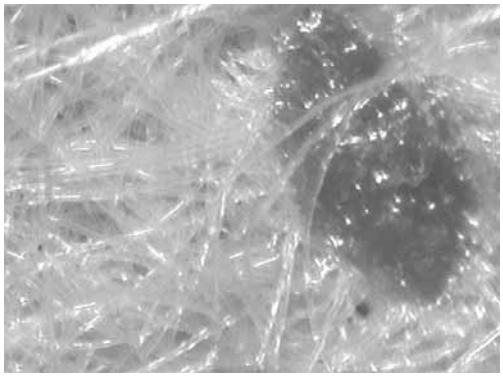

Figure 2. The surface morphology of nonwoven fibers

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Discussion on the Development Problems of Travel Agencies

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Abstract

Travel agency is the leading part of travel industry, and plays the role of promotion. However, the development of travel agency in china at present is incompatible with the developed travel industry today very much, This article elaborates the challenge which faced by travel agencies and pur forward many development countermeasures.

Keywords: Travel agency, Development, Countermeasures

As one of three pillars of tourism industry, the travel agent has many functions, such as production, marketing, organization and coordination, distribution of economic benefits, and providing information. It is the foundation for the development of tourism and the main organizer of tourist source for tourism destinations and resort hotels. As the agents of tourism products, travel agents should become a big tourism receipts department. But what happened to travel agents in China?

Based on economics management ideas and methods, this paper analyzes the development of travel agencies and countermeasures in China.

First, China's travel agency market is monopolistic competition market because of the following Features.

(1)The trade volume of enterprises is big

China's market has not only travel agencies which has also established a solid position earlier and got the high reputation, such as "China Travel", "The Youth Travel", and "veteran Chinese Travel Agency", but also many new established ones like "Gardens Travel Agent".

(2)Be free in or out of the industry

Travel agents can enter the market because of the higher average returns on capital to, or withdraw from competition because of the individually insufficient reason at any time without artificial barriers.

(3)The business of the products are differences between the

Because of the tour operators, the management model is not the same, and travel agents in the pure products of services and products, is the natural difference at all there.

(4)As China Travel Service in the case of, where possible, from travel agents to the scale, power is cut off from each other by the wall screen market.

As the financial gap among different scales of agents is big in Chinese market, larger travel agencies operate profits of larger businesses, small travel agencies can only operating profits of smaller businesses. Thus large groups and small groups exist between the larger conflict, having targeted competition. Therefore, various travel agencies have price competition only in the same scale of business, that is, the formation of fixed within the scope of free market competition.

Second, the product difference competition should be the mainstream of China Travel Service market competition , certainly not the pure price competition.

In the monopoly competition, the bigger THE product difference, the more loyal of different customers to their preferred products. Therefore if enhancing the price, the enterprise cannot lose the complete customers; or if reducing the price, the enterprise cannot attract the complete customers. In other words, the bigger of product difference, the smaller between product vicariousness, and also smaller of the product demand price elasticity.

We have four main approaches to differentiate our products.

(1) Advancing the total quantity of products

(2) Improving capabilities and structures of products

(3) Increasing purposes of products

(4) Providing more circumspect service for the customers

Shielded-market is a perfect competitive market. In the perfect competitive market, it only has the price competition because all products only have the perfect elasticity in this market, and as long as slightly raising the price, products can not be able to be sold. That's the reason why this is the low level price competition in China's travel agency market.

Third, the fixed price mechanism has the erroneous zone

There are two methods regarding the product fixed price:

(1) Cost addition fixed price law

(2) Goal investment income rate fixed price law

But the present travel agency all mostly uses the following quoted price methods:

At the first step:

They alculate round-trip fare which this service entire journey needs, the first admission ticket expense, the middle-grade basic mealexpense and the lodging allowance according to the single the price computation; (A)

At the Second step:

They calculate the expense above according to team preferential price ;(B)

At the Third step:

They make the determination satisfaction price, and the price must be situated between A and B.

The above fixed price method seems very reasonable, having the big attraction, but in fact by no means so. I thought that, we should count the opportunity expense tourists take on their voluntarily travels as the cost, and carry on the fixed price by the addition rate which is lower than the normal addition rate.

Because travel agency's fixed price method is insufficiently scientific, they intensified the low level price competition among themselves, creating various travel agencies to be busy at excessively reflected to the price information, neglecting the service competition difficulty with touse the advertisement competition and so on, which caused the China Travel Service to management with small profits and slow accumulation. Moreover, a deeper level crisis will cause the travel agencies to reduce the cost by keeping the prices of products or services of traveling transportation business agents, the traveling hotelsand the traveling scenic areas, which will pull down other the profits of other traveling industries and cause the profits of the entire profession to drop (internal friction drop), and be disadvantageous to the platelive enterprise's management.

Fourth, the phenomenon of rathe downfall is common.

According to the rule of marginal-revenue-decrease progressively, the production may be divided into three stages

(1) Rising stage

(2) Reascending the stage

(3) Dropping stage

Rgarding the enterprises,the rise stage may develop through job holders's specialization, the big purchase, and so on. But the drop stage is caused by enterprises, which surpass the best scale or have management questions. The author thought that, the process during which the enterprises do not achieve themost superior scale before transferring to the drop because of the management questions, may be called rathe downfall phenomenon.

Regarding a bigger scale travel agency, the management questions are mainly: the influence of the plan system remains to the modern management, the small travel agencies have already marched into the management badmire before they had the implementation genuine personnel specialization,.

Many resolvents are as follows:

Regarding the large-scale travel agency, we should eradicate the remaining influence, establishing the modern system.

Regarding the small travel agencies, we should introduce the specialized talentedperson as soon as possible, accelerating accumulation.

Many innovations are put forward.

(1) Seizes the initiative, forestalls to develop the new traveling resources, facilitates the difference formation, raises loyalty.

(2) Adjustment of methods of fixed price, profession teamwork.

(3) Half opening management.

(4) Give many low-value-presents to the tourist group according to the different sex and the age, such as traveling scenery postcard and so on. These small presents should have this travel agency symbols.

(5) Try to listen to the tour guide explanations.

(6) May accept the suit afterwards, lets the consumer have the opportunity to divulge.

(7) Subdivides the market, serves for the specific crowd, and specially designs traveling projects to adapt the specific crowd's.

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Data Collection System of EEG Based on USB Interface

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Abstract

This article introduces a EEG synchronous sampling system and its hardware composing principle and software design method which is based on USB interface IC FT245BM, simultaneous and high speed 16 bit ADC IC ADS8320 with 16 channels, and 8 bit SCM AT89C51. This system can fully enhance the veracity of data measuring, and show its superiority in the precise measurement of the EEG parameters. This system has come into operation and produced good effect.

Keywords: EEG, USB, Synchronous sampling

1. Introduction

Electroencephalograph (EEG) is a sort of technology which magnifies and records the bioelectricity in human brain tissues and reflects the electronic activities of the brain. Because EEG reflects the "live" functional situations of the brain tissues, so since 1930s it appeared, it has been exerting important effects to diagnose nervous system illnesses. This technology mainly utilizes electroencephalograph to check and diagnose nervous system illnesses such as falling sickness, brain trauma and brain knub.

The traditional EEG machine had big volume, was not easy to move and can not be applied in ambulance, field and other situations. With the development of electronic technology and computer technology, the synchronal collection and automatic analysis functions of several brain electronic conduction signals have gradually become the main development directions for the EEG machine with functions of checking, diagnosing and monitoring. At the same time, the medical instruments is transforming to the orientation for the community and family. Because of the popularization of family and hospital PC especial the notebook PC, adding the abroad usage of convenient USB interface, it is very necessary to establish computer EEG collection system based on USB interface. It can not only convenient for checking nervous system illnesses, but suit for family usage. When the patient feels headache, it can timely record the brain waves to find out relative illness and help to diagnose for the doctor.

2. Characters of brain wave signal

Based on different frequency ranges, the brain wave signals can be divided into four sorts of wave. The first sort is the wave α which is in 8Hz~12Hz, 10μV~100μV, and indicates that people is in ease situation. The second sort is the wave β which is in 16Hz~30Hz, 10μV~50μV, and indicates that people is in working situation. The third sort is the wave δ which is in 0.5Hz~3Hz, 10μV~200μV, and indicates that people is in deep sleeping situation. The fourth sort is the wave θ which is in 4Hz~7Hz, 20μV~150μV, and indicates that people is in dreaming situation. In a word, at this time, the brain wave signal is very weak, and the pressure range is in 10μV~200μV, the frequency range is in 0.5Hz~30Hz (Zhang, 1998, p.1-11). Except that, the brain wave signal has the following characters. First, the characters of randomicity and equability are very strong. Second, the brain wave signal has character of nonlinearity. Third, the background of collected brave wave signal is very complex, including the interference of 50Hz AC signal, and contact noise of electrode and skin, common mode of electrode and terra and so on. Those characters are several places what we should especially notice when designing the brave EEG collection system.

3. Hardware system

3.1 Overall design

The system structure is seen in Figure 1. The whole system is composed of six components including brain wave signal sampling, difference magnification, multiplexing selection, smoothing circuit, AD sampling controlled by SCM, and data transmission. The complete flow of this system is presented as follows.

(1) Inspect brain wave signals through electrode sensor and input it into the protective circuit to limit the pressure.

(2) Implement difference magnification to the brain wave signals.

(3) Because the high speed photoelectricity isolation circuitry (IL715) is very expensive, so we would try to reduce the channels amounts of photoelectricity isolation when designing. According to the character that the practical brain wave signal sampling has 16 channels, so we adopt two pieces of CD4051 which chooses 1 in 8 to implement multiplexing selection and decide the sequence of these 16 channels signals, so AT89C51 only needs four data lines to control the input of 16 channels input of brain wave signals.

(4) Before SCM AT89C51 select one channel of brain wave signals to input through multiplexing selector, these signals must pass smoothing circuit which includes high pass filter and low pass filter.

(5) The brain wave signals through smoothing enter into ADS8320 to transform, and then the transformed data enter into the P1 portal of SCM through photoelectricity isolation circuitry IL715.

(6) Under the control of SCM AT89C51, data are transmitted to PC or notebook PC through USB interface FT245BM passing P3 portal.

3.2 Design of difference bioelectricity amplifier

The design of difference bioelectricity amplifier is the key part for exact sampling brain wave signals. We adopt the medical amplifier general instrument amplifier chip INA128 of INA series made by American BB Company which has the advantages of low power, low temperature excursions, high precision and high restraining ratio of common mode, and the concrete parameters include that (1) when the plus is bigger than 100, CMRR = 120 dB, (2) the maximal input maladjustment pressure is 125μV and the maximal input maladjustment pressure excursion is 1μV/°C. Therefore, INA128 is a perfect bioelectricity amplifier.

3.3 Smoothing circuit

The smoothing circuit is composed of low pass filter circuit and high pass filter circuit. For the low pass filter circuit, we consider that the transition band of the first order filter is too wide and that will influence the effect of smoothing. To make the transition band become narrow, we can implement cascade through same filters, and cascades are more, the changes from band pass to band resistance are more rapid (that is the transition band is narrower). Because Butterworth filter is flat response filter and its phase characters are better than Chebyshev filter, Anti-Chebyshev filter and ellipse function filter of same order, so we take Butterworth filter as the low pass filter in the preprocessing circuit. At the same time, because the frequency of the collected brain wave signals is low frequency which frequency is in about tens Hz, so we set up the cut-off frequency at about 40Hz, accordingly the fourth order Butterworth filter completely accords with the requirement of the design. For the high pass filter, we adopt passive filter which initiation frequency is 0.5 Hz, R1 = 330 KΩ and C1 = 1μF.

3.4 Structure design of hardware

Generally speaking, when we choose A/D converter, we always require the data collection system not only possesses the characters of high speed and precision, but also has the characters of low pressure, small volume and low power. ADS8320 is the gradual approach parallel 16 bit low power CMOS high speed A/D converter made by Burr-Brown Company which linearity degree is ±0.05%, its work power supply is in the range of 2.7V~5.25V, and its sampling frequency can maximally achieve 100kHz, and when the power supply is in 2.7V and the sampling speed is 100kHz, its power waste is only 1.8mW, and when the sampling speed is 10kHz, its sampling power waste is only 0.3mW, and under non-transformation situation, it can be in close mode, at this time its power waste can reduce to 100μW. ADS8320 has synchronic parallel SPI/SSI interface, so the ports occupying the microprocessor are less. Its differential input signal range is 500mV~Vcc (work power supply). Its encapsulation adopts 8 MSOP small volume type. Simultaneously the above characters also make ADS8320 very suit for portable battery power supply system, which can establish bases for the future portable medical equipments.

For USB interface chip, we choose FT245BM made by Britain Future Technology Device Intl. Ltd. FT245BM brings FIFO output cushion with 384 bytes and FIFO input cushion with 128 bytes and possesses the data transportation ability of 1M byte/s. Its USB agreement has been solidified in the chip convenient for using. When SCM checks TXT# is in low voltage, data can be read in the module, and when TXT# is in high voltage, FIFO with 384 bytes is full and data can not be read in the module. When SCM checks RXF is in low voltage, the module has data already, and SCM can read out data from the module, and when RXF is in high voltage, the module has no data. The main hardware structure of the system is seen in Figure 2.

4. Software system

4.1 Software design of slave machine

The program of SCM includes the following modules such as main program, system initialization, data sending and data incepting. The main program module is a very pivotal part in the whole software design, and except that it completes the application functions such as SCM system initialization and designing system, the more important is that it will organically combine various subprograms and manage and control these subprograms and offer the corresponding

program portals for those subprograms, accordingly actualizes the function of the whole system. The parallel initialization program module mainly completes the basic settings including the baud rate, parity bit, setting communication agreement, opening parallel port and stopping for the parallel communication. The sending and receipting subprograms complete the sending and receipt of the data. The system running begins form the main program which exerts the original flow, and actualizes the users' engaged functions. Only when the parallel stopping request is produced, the system turns to process the parallel communication subprogram, accordingly complete once the receipt and sending of the data, and the parallel communication ends and the program returns.

4.2 Software design of master machine

When USB facility inserts the PC, the operation system will request installing device. FIDI Company offers two sorts of drivers including VCP and D2XX (DLL) for the USB interface facility based on FT245BM. Different drivers require different PC software design methods. We choose the former sort here. When choosing installing VCP driver, the operation system will simulate the USB interface facility based on FT245BM into parallel communication ports, and the operation to this dummy parallel ports is same to the operation to the USB interface facility, so in the application program we can utilize the parallel communication control to predigest the design of the PC port software. At present, the mature parallel communication controls include MSCOMM, SPCOMM, and PCCOMM. This article adopts Labview 8.20 (Yang, 1999, p.34-35) and MSCOMM to complete the software design of the PC port based on VCP. It is easy to utilize MSCOMM to compile the programs aiming at the parallel port operation, because MSCOMM has plentiful attributes and affairs closely relative to parallel communication, and offers various operations to the parallel ports. According to the attributes, methods and affairs offered by MSCOMM, it can complete the read-write to the dummy parallel ports FT245BM, and avoids the operations to the USB interface.

Therefore, we define the main communication agreements of the master machine and the slave machine. First, starting collection order is to output decimal number 20 or hex number &14H to the parallel port. Second, stopping collection order is to output decimal number 0 or hex number &00H to the parallel port. The convenient agreement and powerful figure function of Labview 8.20 can help us to actualize the data collection and storage of the brain wave signals, and the dynamic display, scanning, replaying of the brain waves and other main function, and according to the present data base of brain wave signals, to implement data comparison and make pre-diagnosing to assist the doctor's diagnosing. At present this system has been used and obtains good effects in the clinic.

5. Conclusions

This article introduces a sort of high speed and low power waste brain wave signal collection system which convenient for the doctor's diagnosis and prevention of the illness. In addition, because this system possesses the characters of small volume, low power waste and stable performance, it not only suits for the portable usage through battery power supply, but also suits for timely records of brain wave signals at home, which embodies more human cares to the patients.

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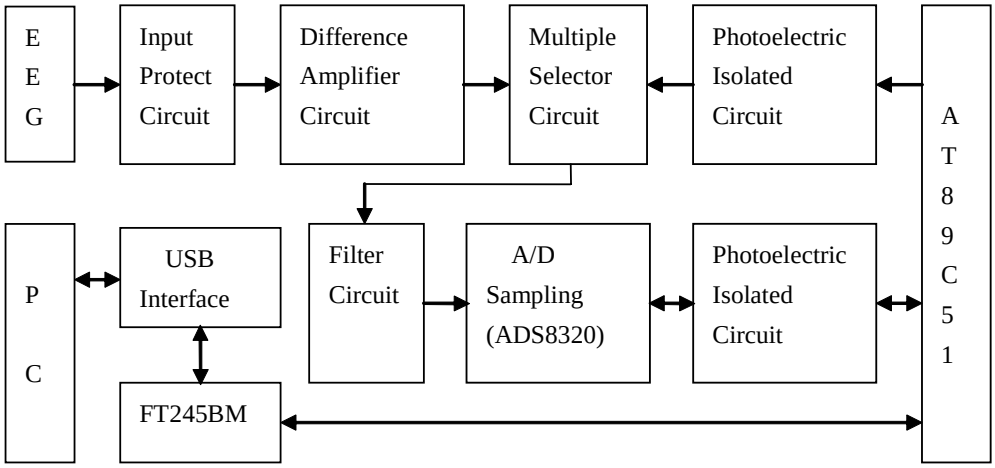

Figure 1. System Structure Diagram

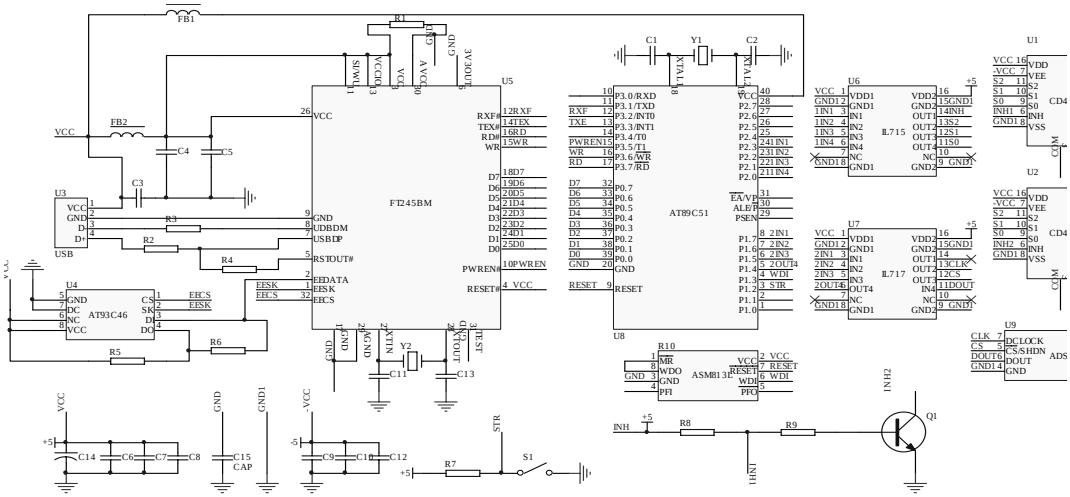

Figure 2. Hardware Structure Diagram

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Effect of the First Coagulating Bath Composing on the Structure of PES Membrane

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Abstract

Make PES flat-sheet style membrane through the method of dual-bath coagulation method. Change the composing of the first coagulating bath and make the casting membrane liquid stay in the first coagulating bath for enough time and control the surface and interior structure of the membrane at the same time. Study the interior and exterior structure when the DMAc mass fraction of first coagulating bath is among 0%-70%, and find out with the increase of mass fraction, the interior structure of membrane transits from the form of finger pore to the form of spongy pore, and when the mass fraction of the first coagulating bath achieves 70%, there is no structure with the form of finger pore, but the opening structure on the membrane surface appears when the mass fraction is 60% and increases with the increase of concentration. When the mass fraction of the first coagulating bath is among 0%-50%, the pure water flux of the membrane decreases with the concentration, and the rejection ratio of BSA change less, and when the concentration of the first coagulating bath exceeds 60% and the openings appear on the membrane surface, the pure water flux would ascend but the rejection ratio would markedly decrease.

Keywords: Dual-bath coagulation method, Flat-sheet style membrane, Surface opening

1. Introduction

At the beginning of 1960s, Loeb and his colleagues developed the method which used the phase inversion method to make asymmetrical separation membrane. Hence, the phase inversion method became one of main methods making asymmetrical membrane (Wei, 2005). The traditional phase inversion method influences dual-diffusion speeds through changing the temperature of coagulating bath to achieve the purpose of controlling the membrane structure. In 1991, Lin Yizheng put forward the method that adopted dual-bath coagulation method to make asymmetrical separation membrane and the casting membrane liquid was immerged into different coagulation baths in turn, and achieved the purpose of controlling the pore structure of membrane surface through dealing with the membrane surface by changing the composing of the first coagulation bath (Lin, 1991). This method can effectively controls the surface structure of the membrane, but if the stay time of casting membrane liquid in the first coagulation bath is increased, the membrane surface and interior structure can be the controlled through changing the composing of the first coagulation bath, accordingly the more plentiful membrane infrastructural materials can be offered for the mixed membrane and composite membrane.

This article adopts the dual-bath coagulation method, takes the DMAc liquor as the first coagulation bath and ultrafiltration water as the second coagulation bath, prolongs the stay time of the casting membrane liquid in the first coagulation bath, and studies the effect of the first coagulation bath mass fraction on the membrane surface and interior structure and changing situations of membrane pure water flux and BSA rejection ratio.

2. Experiment

2.1 Raw materials and reagents

The raw materials are membrane-based PES and BASF. The analytical reagents include N, N-NMP, DMAc, pure ethanol, glycerol and acetone, which are produced by Tianjin Fengchuan Chemical Reagent Technology Co., Ltd.

2.2 Process of membrane making

In the general membrane making process with dual-bath coagulation method, the stay time of casting membrane liquid in the first coagulation bath is very short, and the main function of the first coagulation bath is to preliminarily adjust the polymer or impregnant content on the membrane surface, and the membrane is fully formed by the second

coagulation bath (Zhu, 2005, p.17-19). Though the structure of the membrane surface can influence the dual-diffusion speeds to some extent and accordingly influence the interior structure of the membrane, but because the membrane surface is very thin and has few influences to the dual-diffusion, so the interior structure of the membrane is mainly effected by the characters of the second coagulation bath (Zhao, 2005, p.93-96). This experiment increases the stay time of membrane in the first coagulation, and make the interior of the membrane influenced by the first coagulation, and change the interior structure of the membrane through by the first coagulation bath.

The membrane making process is basically same to the common flow, which dissolves some certain PES in the DMAc, and adds PEG, then intensely mixes round to equal and stable polymer liquor. Take the liquor pressurized in 50℃ and placed to mix for 24 hours. Use the metal stick to quickly scratch the casting membrane liquid on the glass board to make the membrane, then put the glass board into the first coagulation bath and stay for enough time to make the first coagulation bath and materials in the membrane liquid fully exchanged, finally put the glass board into the water bath. Because the first coagulation DMAc mass fraction adopted in this experiment is between 0%-70%, quite a few parts of membranes have been coagulated in the first coagulation bath. When the concentration of the first coagulation DMAc exceeds 50%, the membranes can not be fully formed in the first coagulation bath.

2.3 Performances and tokens of the membrane

2.3.1 Pure water flux mensuration of the membrane

We adopt the ultrafiltration evaluation device made by Tianjin Motimo Group to measure the flux. Select one piece of membrane without surface bugs and place it on the flat poor, press it, adjust the pressure to 0.1MPa and maintain the water temperature in 25℃, and when the system becomes stable, measure the flux of the membrane. Compute the water flux according to the following formula.

$$Q = \frac{V}{At}$$

Where, Q represents the water flux ($L/m^2 \cdot h$), V represents the volume of the permeated liquid (L), A represents the effective acreage of the membrane (m^2) and t represents the ultrafiltration time (s).

2.3.2 Rejection ratio mensuration of the membrane

Select BSA with 67 thousand molecular weight as the solute, and select cushion liquor of PH=7.4 to confect BSA liquor of 1 g/l, and maintain the liquor temperature of 20 ℃, filtrate that liquor by the PES membrane made, take out the original liquor and the corresponding sieved liquor, then measure their absorbencies by UV2450 ultraviolet spectrometer. The computation formula of rejection ratio is $R = \frac{E_o - E_S}{E_o} \times 100\%$.

Where, R represents the rejection ratio, E_o represents the absorbency of the original liquor and E_s represents the absorbency of the sieved liquor.

3. Experiment results and discussions

3.1 Effect of the first coagulation bath on the membrane structure

From Figure 1, we can see that with the increase of the content of DMAc in the coagulation bath, the interior of the PES membrane transits from the form of finger pore to the form of spongy pore. When the mass fraction of the coagulation bath achieves 70% (see A3 in Figure 1), the opening structure on the surface of the PES membrane appears, which aperture is about among 0.1-2 μm enough passing polymer of high molecule.

For the cross section structure of the membrane (see B1, B2 and B3 in Figure 1), with the increase of mass fraction of the coagulation bath, the long and big finger pores gradually becomes short and small and the spongy pores gradually becomes more and more, finally the sponge pore structure is formed. The coagulation bath with 30% of DMAc (see B1 in Figure 1) forms the classic finger pore structure, and the coagulation bath with 70% of DMAc (see B3 in Figure 1) forms the multi-pore sponge structure. Because the membrane fully immerges in the first coagulation bath, the interior and exterior of the membrane are preliminarily coagulated in the first coagulation bath. In A1 of Figure 1, because of much water contents, fewer DMAc contents, quick dual-diffusion speed, high concentration grads of nonsolvent water between the interior and exterior of the casting membrane liquor, and quicker diffusion speed than the solvent, much nonsolvent makes the parts of poor phase in the casting membrane liquor grow up quickly and form the finger pore structure. With the increase of DMAc in the coagulation bath, the concentration grads of the water decrease, the diffusion speed decreases, the separation speed slows down, and the finger pores become denser and smaller. The DMAc contents of the first coagulation bath in A3 and B3 of Figure 1 are very high and achieve the contents of casting membrane liquor, and the water contents are very low, which can make the casting membrane liquor only separate but not coagulate, and forms the disperse poor phase and rich phase structure of the polymer, and after entering the second coagulation bath, the rich phase coagulates to form membrane and the poor phase form multi-pore structure. Because of equal decentralization of the poor phase and rich phase in the membrane, so the opening structure also appears on the surface layer of the membrane.

3.2 Effect of coagulation bath composing on pure water flux of the membrane

The common membrane is composed of dense function layer on the surface and the under support layer. Usually the function layer is thin and the support layer is thick. The interior multi-pore support layer mainly influences the membrane water flux, and the pores in the support layer are smaller and less, the flux is lower. At the same time, when the big pore structure appears in the surface function layer of the membrane, the water flux will increase (Li, 1994, p.329-340).

In Figure 2, with the increase of DMAc mass fraction in the coagulation bath, the pure water flux presents the tendency descending first and ascending then. When the DMAc mass fraction is among 0%-50%, the pure water flux of PES membrane descends. When the DMAc mass fraction is in 50%, the pure water flux of PES membrane achieves the minimal value. When the DMAc mass fraction is among 50%-70%, the pure water flux of PES membrane begins to ascend.

The water content of the coagulation bath is the main factor to influence the microstructure that the casting membrane liquor coagulates to the membrane. When the water content is high, in the instant that the casting membrane liquor contact with the coagulation bath, the dual-diffusion is very intense, and the surface layer with dense structure on the surface of the casting membrane liquor, and the interior forms bigger finger pore structure, and when the water content is low, the dual-diffusion and membrane forming speed are slow, the surface layer of the membrane is thick, and the interior of the membrane forms spongy pore structure (Sun, 2003, p.102-105). Therefore, when the DMAc mass fraction of the coagulation bath is among 0%-50%, with the increase of DMAc concentration, the structure of the support layer of the membrane transits from finger pore to spongy pore, and the finger pore becomes smaller and smaller, the surface layer of the membrane becomes thick with it, and the pure water flux descends (He, 2003, 2151-2157). When the DMAc concentration exceeds 50%, the separation process not only becomes slow, but can not complete separation in the first coagulation bath because of too high DMAc contents, and the separation of rich phase and poor phase appears, the solidifying process would be completed in the second coagulation bath. Here, the opening structure appears on the formed surface of the membrane, and the interior of the membrane is multi-pore spongy pores, and because of existence of surface opening, the function layer almost has no effect on the water flux. So the pure flux ascends again when the DMAc concentration exceeds 50%.

3.3 Effect of coagulation bath composing on BSA rejection ratio of the membrane

The rejection ability of the membrane is mainly embodied by the function layer of the membrane. The pore of the function layer is bigger and the rejection molecular weight is higher. The molecular weight of BSA is 67 thousand, and when a few openings with several microns appear on the surface of the membranes, the membrane almost has no any rejection ability to BSA liquor.

In Figure 3, when the mass fraction of the coagulation bath is among 0%-50%, the rejection ratio of PES membrane to BSA is in 60%-70%, without large changes. But when the DMAc concentration exceeds 50%, the rejection ratio of PES membrane to BSA descends rapidly, and the membrane formed in the coagulation bath with 70% of DMAc, the rejection ratio has descended to about 10%.

The change of the support layer has little effect on the rejection, so when the mass fraction of the first coagulation bath is 0%-50%, the rejection ratio of the membrane to BSA changes little. In the transiting process from finger pore to the spongy pore, the flux would descend, but because the function layer has no obvious changes, so the rejection ration would be maintained in a certain range. When the DMAc content in the coagulation bath exceeds 50%, the bug, that is the opening structure appears in the function layer, the rejection ratio of the function layer to BSA begins to descend, and the rejection ratio will descend rapidly with the increase of openings. When the DMAc content of the first coagulation bath achieves to 70%, the membrane surface is full of disperse big pore structure which can freely pass BSA molecules, and except for the adsorption of membrane itself to the BSA molecules, the membrane has no rejection ability to BSA molecules.

4. Conclusions

(1) Through extending the stay time of the membrane, the surface and interior of the membrane can be implemented pretreatment and accordingly the interior and exterior structures can be changed.
(2) When the DMAc mass fraction in the first coagulation increases, the interior structure of the membrane begins to transit form the finger pore to the spongy pore, and the spongy pores increase and the finger pores become smaller and less.
(3) When the DMAc content in the first coagulation bath exceeds 50%, the opening structure appears on the membrane surface and increases with the increase of the DMAc mass fraction.
(4) When the DMAc content in the first coagulation bath is under 50%, the flux of the membrane descends and the rejection ratio change little. But when DMAc concentration exceeds 50%, because the openings appear on the surface, the pure water flux rapidly ascends, and the rejection ratio to BSA descends rapidly.

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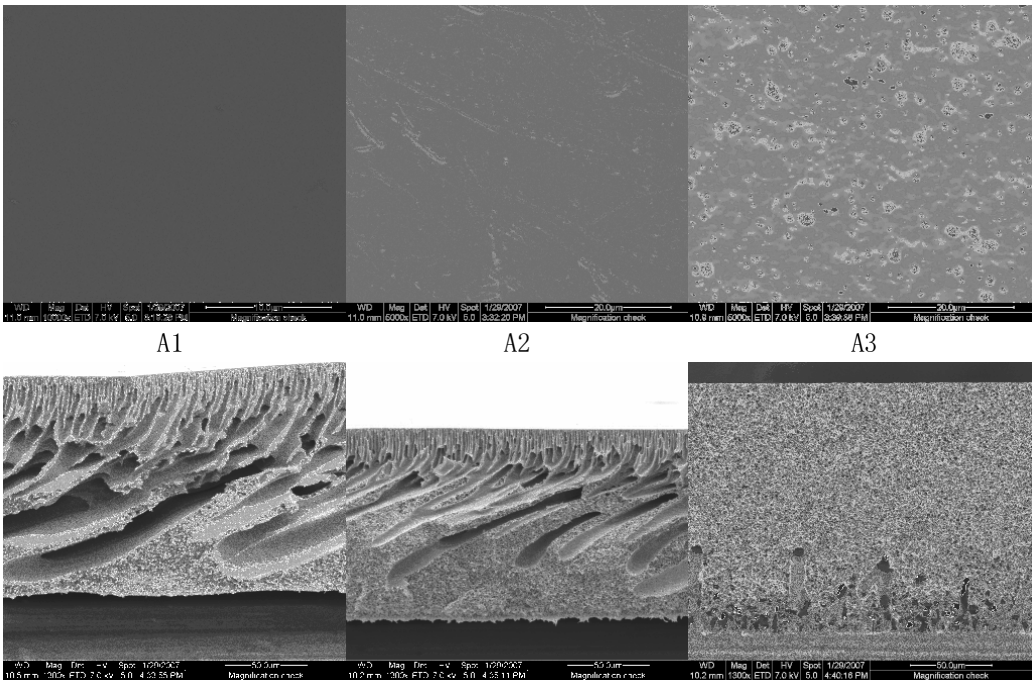

Figure 1. SEM Micrographs of External Surface (A1, A2 and A3) and Cross-section (B1,B2 and B3) Views of the Flat-sheet Type Membrane Prepared with Different DMAc Mass Fraction in Coagulation: (A1 and B1) [DMAc]=30%, (A2 and B2) [DMAc]=50% and (A3 and B3) [DMAc]=70%

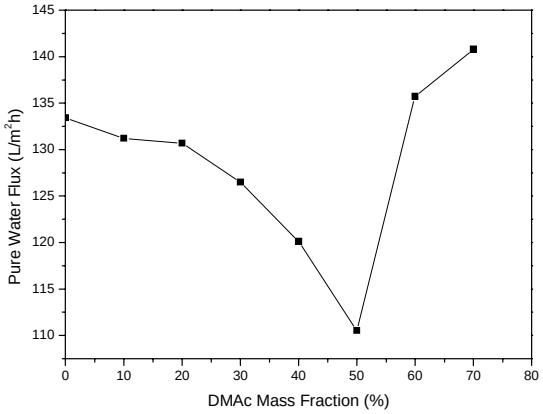

Figure 2. Effect of DMAc Mass Fraction in Coagulation on the Pure Water Flux of the Prepared Flat-sheet Type Membrane

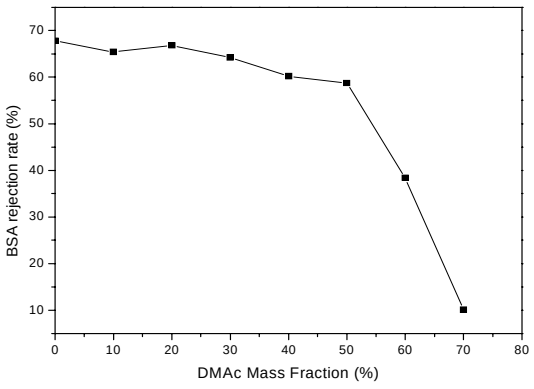

Figure 3. Effect of DMAc Mass Fraction in Coagulation on the BSA Rejection Rate of the Prepared Flat-sheet Type Membrane

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Modeling the Bi-directional DC-DC Converter for HEV's

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Abstract

Hybrid Electrical Vehicles-HEV's are the important ways to improve vehicle performance. The transformer isolated bi-directional DC-DC converters are the key components of the traction system in HEV's. This paper presents a detail mathematic model of isolated bi-directional DC-DC converter for HEV's. Approximate models are important mathematic methods especially for analysis and closed-loop control design converter circuits. These differential equations, which govern the converter operation, change periodically among a set of linear differential equations because of the switch effect. Basing on the time-scale the state variables was separate as fast-scale and slow-scale variables. The fast changing variable of the leakage inductor was eliminated by substitute the fast-scale variable into slow-scale variable equations, resulting in reduced order differential equations. From this set of reduced order differential equations the completely averaged model of the isolated DC/DC converter was derived. The simulated results reveal that the circuit and mathematical model are consistent very well. The averaged state variables can be treated as a small component plus a DC component, so the averaged model can be separated a dynamic small signal part and a DC part. This linearized small signal model is suit for control design and analysis at a steady point that is decided by the DC component. As an example a PI controller was design basing on the linear model.

Keywords: HEV, Averaged method, Bi-directional converter, Linearization, Time-scale

1. Introduction

Hybrid Electrical Vehicles-HEV's are the important methods to improve vehicle efficiency, economize energy and reduce pollution (Su & Peng, 2002, pp.10-14.Peng, Li, & Su, 2004, pp.54-65). HEV's are the most prospective candidate to replace the conventional internal combustion engines-ICEs. In HEV's, it is required to have a relatively large power rate DC-DC converter for voltage matching and energy storage. Full bridge bi-directional DC-DC converters are a suitable choice for HEV's application because of their capabilities to deal with high power flow forward and backward according requirements, simultaneous they can realize the high power/volume ratio and high frequency easily.

Because of the switching effect, the converter circuits are strong non-linear systems from the viewpoint of control theory (Sun & Horst, 1992, pp.1165-1172. Chen, & Sun, 2006, pp.487–494. Vinod, Sun & Bonnie, 2003, pp. 381–389.). It is difficult to get the dynamic mathematical model to analyze and design the feedback control system basing on a uniform model, which depicts the whole system (Li, & Peng, 2004, pp.272-283.). The conventional analysis methods are very detailed, but these methods are usually to analyze the converter circuits themselves (Su & Peng, 2002, pp.10-14.Peng, Li, & Su, 2004, pp.54-65. Henry, Chung, Adrian & Cheung, 2003, pp.743-753.). Without the mathematical model it is also difficult to get the definite information of poles, zeros and the gain of the control system around the operating point. What's more important is how do the variations in the input voltage, the load current, or duty cycle affect the output voltage.

This paper is focus to develop the mathematical model for the bi-directional converter basing on the state space averaging theory (Sun & Horst, 1992, pp.1165-1172.). The converter circuits are divided into several operational modes in one period. Relaying on the semi conduct switch devices, such as the Mosfet/IGB, to force the converter from one operational mode to another. The whole circuits are discontinuous although in every operation mode it is possible continuous. Averaging approaches transform the discourteous converter circuits into continuous one (Sun & Horst, 1992 pp.1165-1172.).The averaged model is still a large-signal model however the dynamic small signal model can be derived from it. Taking advantage of the state space equations and transfer function of the small signal model, the control theories for the continuous system are applicable to converter circuits. The simulation experiment was carried out to validate the analysis.

2. Analysis of the operational modes

The transformer isolated bi-directional converter has dual active bridges with power transferred between them through an isolated high frequency transformer. Both two bridges consist H-bridge as shown in Figure1. From the fist bridge to second bridge is voltage step up and on the contrary is voltage step down. The first bridge converts DC voltage to square wave AC voltage and feed into the primary side of the transformer. The second bridge rectified the AC to DC voltage, which feed to traction motor.

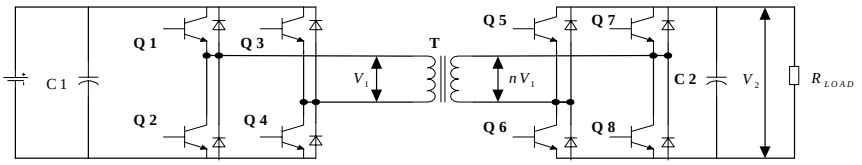


Figure 1. The bi-directional converter in HEV's

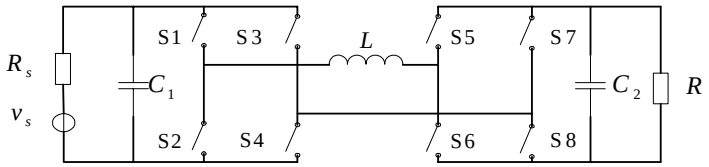


Figure 2. the simplification of the converter

In order to simplify the analysis, the device-level circuit is simplified as Figure 2. The switches are replaced with the ideal ones. The transformer is replace with is leakage inductor L. The voltages on both sides of the transformer are v_1 and nv_1. n is the ratio of the transformer. There are total four modes in one period [11], the current wave in the leakage inductor is as Figure 3.

Figure 3. The current wave of leakage inductor

The operational modes have been analyzed detailed in (Dedoncker, Divan & Kheraluwala, 1991.). Here just give the results of the four operational modes. The state space equations are as (1), (2), (3) and (4) in corresponding operation mode.

$$\begin{bmatrix} \frac{di_L}{dt} \\ \frac{dv_1}{dt} \\ \frac{dv_2}{dt} \end{bmatrix} = \begin{bmatrix} -\frac{4r_b}{L} & \frac{1}{L} & \frac{1}{L} \\ -\frac{1}{C_1} & -\frac{1}{r_s C_1} & 0 \\ -\frac{1}{C_2} & 0 & -\frac{1}{RC_2} \end{bmatrix} \begin{bmatrix} i_L \\ v_1 \\ v_2 \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{1}{C_1 r_s} \\ 0 \end{bmatrix} v_s \tag{1}$$

$$\begin{bmatrix} \frac{di_L}{dt} \\ \frac{dv_1}{dt} \\ \frac{dv_2}{dt} \end{bmatrix} = \begin{bmatrix} -\frac{4r_b}{L} & \frac{1}{L} & -\frac{1}{L} \\ -\frac{1}{C_1} & -\frac{1}{C_1 r_s} & 0 \\ \frac{1}{C_2} & 0 & \frac{1}{RC_2} \end{bmatrix} \begin{bmatrix} i_L \\ v_1 \\ v_2 \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{1}{C_1 r_s} \\ 0 \end{bmatrix} v_s \tag{2}$$

$$\begin{bmatrix} \frac{di_L}{dt} \\ \frac{dv_1}{dt} \\ \frac{dv_2}{dt} \end{bmatrix} = \begin{bmatrix} -\frac{4r_b}{L} & -\frac{1}{L} & -\frac{1}{L} \\ \frac{1}{C_1} & -\frac{1}{r_s C_1} & 0 \\ \frac{1}{C_2} & 0 & -\frac{1}{RC_2} \end{bmatrix} \begin{bmatrix} i_L \\ v_1 \\ v_2 \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{1}{r_s C_1} \\ 0 \end{bmatrix} v_s \tag{3}$$

$$\begin{bmatrix} \frac{di_L}{dt} \\ \frac{dv_1}{dt} \\ \frac{dv_2}{dt} \end{bmatrix} = \begin{bmatrix} \frac{4r_b}{L} & -\frac{1}{L} & \frac{1}{L} \\ \frac{1}{C_1} & -\frac{1}{C_1 r_s} & 0 \\ -\frac{1}{C_2} & 0 & -\frac{1}{RC_2} \end{bmatrix} \begin{bmatrix} i_L \\ v_1 \\ v_2 \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{1}{C_1 r_s} \\ 0 \end{bmatrix} v_s \tag{4}$$

These differential equations change periodically between a set of linear differential equations at the switch points. In every sub-interval, the equation has the standard linear form as $\dot{x}(t) = A_1 x(t) + B_1 u(t)$.

The state variable i_L vary faster than v_1 and v_2, so the system is belongs to two-time scale system[5]. The problem is a time-scale separation between slow and fast variables that permits to define boundary conditions. The boundary conditions are allowed to be complex and it generates an averaged model of the slow state variables. Taking as the fast variables as the boundary condition, the averaged model is a reduce order model and is simple to deal with comparing with the full order model (Chen & Sun, 2006, pp.487–494).

3. Averaging the two time scale system

From the analysis above, the converter mode switches periodically inside a set of ordinary differential equations. This kind of functions also belongs to variable structure systems-VSR from the viewpoint of control theory (Su & Peng, 2002, pp.10-14).To derive an averaged model for the slow variables than accounting for the fast variables, there are three steps (Sun & Horst, 1992, pp.1165-1172.Chen & Sun, 2006, pp.487–494). First assuming the slow variable is constant while response to the fast variables. Second the solution of the fast variables was replaced in the slow equations. Third averaging the slow variable as show by (Chen & Sun, 2006, pp.487–494). The transformer isolated bi-directional converter, which includes current leakage inductor that varies fast than the voltage in capacitor C1 and C2 Corresponding the state variables are separated two parts as equation (5). State variables X is called slow variable because of the small parameter ε, whereas state variables Y are called fast variables.

$$\begin{aligned} \frac{dX}{dt} &= \varepsilon f(t, X, Y) \qquad X(t_0) = X_0 \\ \frac{dY}{dt} &= g(t, X, Y) \qquad Y(t_0) = Y_0 \end{aligned} \tag{5}$$

where, $X \in R^n, Y \in R^m$ and $\varepsilon > 0$ is small parameter and both function are vector valued continuous functions.

Assuming the converter consists of ideal switches and linear passive components (R, L, C), it state space equations have the linear form as equation (6).

$$\begin{aligned} \frac{dX}{dt} &= A_{sx}^{(i)} X + A_{sy}^{(i)} Y + B_s^{(i)} U \\ \frac{dY}{dt} &= A_{fx}^{(i)} X + A_{fy}^{(i)} Y + B_f^{(i)} U \end{aligned} \tag{6}$$

where, $i = 1, 2, 3, 4$.

Neglecting turning resistor r_b of power switch, the fast variables i_L is as equation (7).

$$L\frac{di_L}{dt} = \begin{cases} v_1 + v_2 & [0 \quad dT_s] \\ v_1 - v_2 & [dT_s \quad T_s] \\ -v_1 - v_2 & [T_s \quad (1+d)T_s] \\ -v_1 + v_2 & [(1+d)T_s \quad 2T_s] \end{cases} \tag{7}$$

The solutions of equation (7) are as equation (8), where the fast variable i_L is

$$\begin{cases} i_L(0) = -i_L(T_s) = -\dfrac{\pi}{\omega L}\left[v_1 + (2d-1)v_2\right] \\ i_L(dT_s) = -i_L\left[(1+d)T_s\right] = \dfrac{\pi}{\omega L}\left[(2d-1)v_1 + v_2\right] \end{cases} \tag{8}$$

According the equation (1), (2), (3) and (4), substitute i_L into the slow variable v_1 in the interval of corresponding mode as equation (9).

$$C_1\frac{dv_1}{dt} = \begin{cases} \dfrac{v_s}{r_s} - \dfrac{v_1}{r_s} - \dfrac{v_1+v_2}{L}t + \dfrac{\pi}{\omega L}\left[v_1 + (2d-1)v_2\right] & [0 \quad dT_s] \\ \dfrac{v_s}{r_s} - \dfrac{v_1}{r_s} - \dfrac{v_1-v_2}{L}(t-dT_s) - \dfrac{\pi}{\omega L}\left[(2d-1)v_1 + v_2\right] & [dT_s \quad T_s] \\ \dfrac{v_s}{r_s} - \dfrac{v_1}{r_s} - \dfrac{v_1+v_2}{L}(t-T_s) + \dfrac{\pi}{\omega L}\left[v_1 + (2d-1)v_2\right] & [T_s \quad (1+d)T_s] \\ \dfrac{v_s}{r_s} - \dfrac{v_1}{r_s} + \dfrac{-v_1+v_2}{L}\left[t-(1+d)T_s\right] - \dfrac{\pi}{\omega L}\left[(2d-1)v_1 + v_2\right] & [(1+d)T_s \quad 2T_s] \end{cases} \tag{9}$$

Averaging the slow variable v_1 in one whole period $[0 \quad 2T_s]$, one can get the averaging value of variable v_1 as equation (10).

$$\frac{d\langle v_1\rangle}{dt} = \frac{1}{C_1T_s}\int_0^{2T_s}\langle v_1\rangle dt = -\frac{2}{r_sC_1}\langle v_1\rangle + \frac{2\pi}{\omega LC_1}\left[2d^2-2d\right]\langle v_2\rangle + \frac{2}{r_sC_1}\langle v_s\rangle \tag{10}$$

where, $\langle v_1\rangle = \dfrac{1}{2T_s}\int_0^{2T_s} v_1 dt$ denotes the average value in one period $[0 \quad 2T_s]$.

Similar to the state variable v_1, the slow state variable v_2 are as equation (11).

$$C_2\frac{dv_2}{dt} = \begin{cases} -\dfrac{v_1+v_2}{L}t + \dfrac{\pi}{\omega L}\left[v_1 + (2D-1)v_2\right] - \dfrac{v_2}{R} & [0 \quad DT_s] \\ \dfrac{v_1-v_2}{L}(t-DT_s) + \dfrac{\pi}{\omega L}\left[(2D-1)v_1 + v_2\right] - \dfrac{v_2}{R} & [DT_s \quad T_s] \\ \dfrac{-v_1-v_2}{L}(t-T_s) + \dfrac{\pi}{\omega L}\left[v_1 + (2D-1)v_2\right] - \dfrac{v_2}{R} & [T_s \quad (1+D)T_s] \\ -\dfrac{-v_1+v_2}{L}\left[t-(1+DT_s)\right] + \dfrac{\pi}{\omega L}\left[(2D-1)v_1 + v_2\right] - \dfrac{v_2}{R} & [(1+D)T_s \quad 2T_s] \end{cases} \tag{11}$$

Average the slow variable v_2 in $[0 \quad 2T_s]$. One can get the averaged equation (12).

$$\frac{d\langle v_2\rangle}{dt} = \frac{1}{C_2T_s}\int_0^{2T_s}\langle v_2\rangle dt = \frac{2\pi}{\omega LC_2}\left(-2d^2+2d\right)\langle v_1\rangle - \frac{2}{RC_2}\langle v_2\rangle \tag{12}$$

Rewrite the averaged slow variables v_1 and v_2 as state space form as (13).

$$\begin{bmatrix} \dfrac{d\langle v_1\rangle}{dt} \\ \dfrac{d\langle v_2\rangle}{dt} \end{bmatrix} = \begin{bmatrix} -\dfrac{2}{r_sC_1} & \dfrac{2\pi\left(2d^2-2d\right)}{\omega LC_1} \\ \dfrac{2\pi\left(-2d^2+2d\right)}{\omega LC_2} & -\dfrac{2}{RC_2} \end{bmatrix}\begin{bmatrix} \langle v_1\rangle \\ \langle v_2\rangle \end{bmatrix} + \begin{bmatrix} \dfrac{2}{r_sC_1} \\ 0 \end{bmatrix}\langle v_s\rangle \tag{13}$$

The averaged model keep the input components, control signal, load resistance, slow state variables. It describes the averaged behavior of the original system and can be compared with the device level circuit to verify the conclusions. The device level circuit and the model are setup under Ansoft/Simplorer environment. The simulation parameters are as following $r_s = 0.1\Omega$, $C_1 = 30\mu F$, $C_2 = 100\mu F$, $R_1 = 2\Omega$, $L = 40\mu H$, $V_s = 100V$, $t_{delay} = 5\mu s$, $d = 0.2$, $f = 20kHz$.

The results are shown in Figure 4 and Figure 5. In the time domain, the trajectories of the averaged mode approximate the trajectories of the original system. The results of averaged model will be a useful approximation of the original

system although it is still nonlinear system because it includes the multiplication terms the complete method is to derive the linear small signal model.

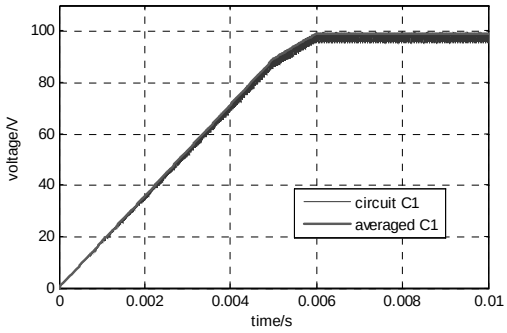


Figure 4. The comparison averaged and the device level variables in C1

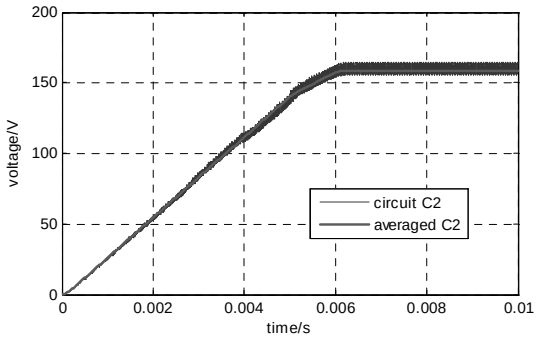


Figure 5. The comparison averaged and the level variables in C2

4. The AC small signal model

The averaged state variables consist of two parts, the DC component and the AC small component. These variables of the state variable and the duty cycle $d(t)$ can be separated as equation (14).

$$\begin{cases} \langle i_L(t)\rangle = I + \hat{i}(t) \\ \langle v_1(t)\rangle = V_1 + \hat{v}_1(t) \\ \langle v_2(t)\rangle = V_2 + \hat{v}_2(t) \\ \langle v_s(t)\rangle = V_s + \hat{v}_s(t) \\ d(t) = D + \hat{d}(t) \end{cases} \tag{14}$$

Substitute the equation (14) into the averaged equation (13), one can get the equation (15).

$$\begin{aligned} \frac{d(V_1+\hat{v}_1)}{dt} &= -\frac{2}{r_s C_1}(V_1+\hat{v}_1) + \frac{2\pi}{\omega L C_1}\left[2\left(D+\hat{d}\right)^2 - 2\left(D+\hat{d}\right)\right](V_2+\hat{v}_2) + \frac{2}{r_s C_1}(V_s+\hat{v}_s) \\ \frac{d(V_2+\hat{v}_2)}{dt} &= \frac{2\pi}{\omega L C_2}\left[-2\left(D+\hat{d}\right)^2 + 2\left(D+\hat{d}\right)\right](V_1+\hat{v}_1) - \frac{2}{RC_2}(V_2+\hat{v}_2) \end{aligned} \tag{15}$$

Equation (15) can be separated as three parts, that is the DC components, the fist order components and the high order component. The DC term are as equation (16).

$$\begin{cases} -\frac{2}{r_s C_1}V_1 + \frac{2\pi}{\omega L C_1}\left(2D^2 - 2D\right)V_2 + \frac{2}{r_s C_1}V_s = 0 \\ \frac{2\pi}{\omega L C_2}\left(-2D^2 V_1 + 2DV_1\right) - \frac{2}{RC_2}V_2 = 0 \end{cases} \tag{16}$$

The first order term is as equation (17). The voltage $v_2(t)$ was selected as the output variable, so the output equation is as equation (18). The equation (17) and (18) is the linear equation of original system (13).

$$\begin{bmatrix} \frac{d\hat{v}_1}{dt} \\ \frac{d\hat{v}_2}{dt} \end{bmatrix} = \begin{bmatrix} -\frac{2}{r_s C_1} & \frac{2\pi}{\omega L C_1}\left(2D^2 - 2D\right) \\ \frac{2\pi}{\omega L C_2}\left(-2D^2 + 2D\right) & -\frac{2}{RC_2} \end{bmatrix} \begin{bmatrix} \hat{v}_1 \\ \hat{v}_2 \end{bmatrix} + \begin{bmatrix} \frac{2}{r_s C_1} & \frac{2\pi}{\omega L C_1}\left(4DV_2 - 2V_2\right) \\ 0 & \frac{2\pi}{\omega L C_2}\left(-4DV_1 + 2V_1\right) \end{bmatrix} \begin{bmatrix} \hat{v}_s \\ \hat{d} \end{bmatrix} \quad (17)$$

$$\hat{v}_2 = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} \hat{v}_1 \\ \hat{v}_2 \end{bmatrix} \quad (18)$$

From the state space form, the transfer functions are as equation (19).

$$\hat{v}_2(s) = C(sI - A)^{-1} B\hat{u}(s) = G_1(s)\hat{v}_s(s) + G_2(s)\hat{d}(s) \quad (19)$$

The transfer functions are as equation (20).

$$G_1(s) = \frac{\hat{v}_2(s)}{\hat{v}_s(s)}\Big|_{\hat{d}(s)=0} \quad \text{and} \quad G_2(s) = \frac{\hat{v}_2(s)}{\hat{d}(s)}\Big|_{v_s(s)=0} . \quad (20)$$

The parameters in state equation (17) and (18) are as following $r_s = 0.1\Omega$, $C_1 = 30\mu F$, $C_2 = 100\mu F$, $R_1 = 2\Omega$, $L = 40\mu H$, $V_s = 100V$, $d = 0.2$.

Then the transfer function is simplified as equation (21) and (22).

$$G_1(s) = \frac{\hat{v}_2(s)}{\hat{v}_s(s)}\Big|_{\hat{d}(s)=0} = \frac{26.68 \times 10^8}{s^2 + 6.77 \times 10^5 s + 6.67 \times 10^9 + 5.32 \times 10^7} \quad (21)$$

$$G_2(s) = \frac{\hat{v}_2(s)}{\hat{d}(s)}\Big|_{v_s(s)=0} = \frac{1.5 \times 10^6 s + 10.005 \times 10^{11} - 33.32 \times 10^9}{s^2 + 6.77 \times 10^5 s + 6.67 \times 10^9 + 5.32 \times 10^7} \quad (22)$$

The bode diagrams of the $G_1(s)$ and $G_2(s)$ are as Figure 6 and Figure 7.

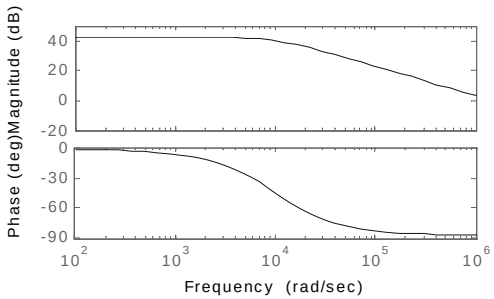
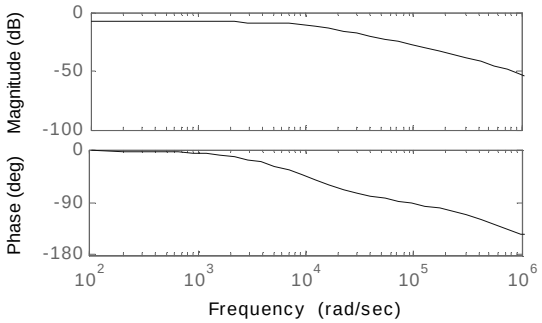


Figure 6. The bode diagram of G1(s)



A prototype of 10Kw bi-directional dc-dc converter was setup in lab. Figure 8 is the voltage wave in the fist and second side of the isolated transformer. Figure 9 is the voltage and current wave in the leakage inductor of transformer. The control strategy is phase shift control so between the first and the second side of the transformer there exist phase difference.

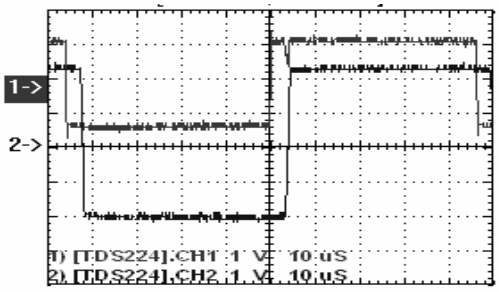


Figure 8. The first and second H-bridge waves

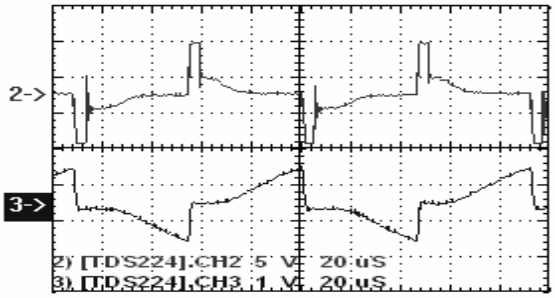


Figure 9. The voltage and current wave in leakage inductor

The reduced-order model of (17) and (18) can be used to predict the dynamic behaviors of bi-directional converter. The conventional analysis and design theory can be used to predict the characteristics of transformer-isolated bi-directional converter.

5. Conclusions

The transformer-isolated bi-directional DC-DC converter has four operation modes in a whole period because of the switching effect. Basing on the four differential equations the completely averaged model of the transformer isolated DC-DC converter was derived. The experiment results reveal that the device-level circuit and mathematical model are consistent very well. According the averaged model, the liberalized dynamic small signal components and the DC components of the averaged model are separated respectively. The static operation point can be decided by the DC equation. The linear small signal mode can be use to analyze and design control system using the control theories.

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Experimental Study on High Power Laser Welding of Ship Steel Plate

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Abstract

This article puts forward adopting the fast-flow axis high power CO_2 laser to weld the ship steel plate and mainly studies the influences of technical parameters to the seam. This article also analyzes and tests the welded products which are in the conditions of laser power of 8 kW, welding speed of 1m/min and focus position below 3mm of the workpiece. The results indicate that the distortion of laser welding is small, the ratio of depth and width are bigger than 2:1, and the structure is compact and has no deficiency and presents tiny martensite and few remnants austenite. Laser welding of ship steel plate can realize shaping double sides up one time with single side welding by choosing reasonable welding technical parameters. Therefore, the laser welding ship steel plate technique possesses high practical values.

Keywords: Laser welding, Penetration, Shipbuilding, Steel plate

1. Introduction

As the heavy industry with dense labor, capital and technology, the shipbuilding industry possesses important influences to the economic increase for countries in the world. In shipbuilding, the materials machining most are those steel plates with 3-12mm. Because macro heat input is used in the process of welding, so the welding components made by these steel plates will produce warp and distortion, which is the main problem faced by the traditional shipbuilding method (Guo, 2005, pp.81-84). When building the hull, about 25% of workload is to reprofile and flat the ship steel, and the traditional shipbuilding method is difficult to realize shaping two sides up once with single side welding comparing with the thick ship steel, usually needs to overturn the hull for welding, decreases the production speed and increases the workers' labor intensity. Comparing with the traditional welding method, the laser welding has high efficiency, small welding distortion, low labor costs and convenient construction, is easy to realize automatization, and can be the effective measure to enhance the shipbuilding quality and shorten the shipbuilding period, and the laser seams have high intensity of hauling (zhao, 2003, pp.5-8). However, this technique is still in the developing stage and many mechanisms need to be studied (S. Katayana, 2005, pp.193-198 & M. Kern, 2000, pp. 72-78 & X. H. Ye, 2002, p.1049). This experiment fully studies the laser welding technical parameters of ship steel plates, does the metallographic analysis, micro hardness analysis and mechanical performance test to the welding samples. The results can provide references for the production and application for the laser welding of ship steel plates.

2. Experimental conditions and procedures

This experiment adopts the RS10000RF fast-flow axis CO_2 laser which laser power is 0 -12kw and can be continually adjusted and which laser modes are TEM00+TEM01. The welding material is the ship steel plate St370-2 with thickness of 12mm, and which chemical composition includes 0.17% of C, 0.2% of Si, 1.40% of Mn, 0.04% of S, 0.30% of Cr, 0.30% of Ni and 0.30% of Cu. In order to reduce the requests of weld making precision and weld positioning precision, this experiment adopts single Y groove adding the welding wire which model is SG_2 and which chemical composition includes 0.07% of C, 0.84% of Si, 1.40% of Mn, 0.007% of P, 0.012% of S, 0.03% of Cr, 0.03% of Ni and 0.07% of Cu. Numerical control worktable with five axes can move the workpiece to adjust the laser welding speed. In the welding process, gas of He is the shield gas which blowing direction plumbs the laser beam, and it forms gas shade to protect the focusing system, and simultaneously it blows to single direction from the flank to block the forming of metal plasma.

In the process of experiment, we study the influences of main laser welding technical parameters including laser power, beam diameter, welding speed, focus error and side huffing flux to welding depth and width of seam, and observe and take pictures the melting area by metallographic microscope, and do micro hardness analysis and mechanical performance test.

3. Study on welding technology

The main technical parameters which influence the quality of laser penetration welding include laser mode, laser power density, beam diameter, welding speed, focus error, shield gas and its flux, where the beam mode has important influences to the quality of seams. Therefore, the quasi-fundametal mode or low-order mode should be adopted when welding.

3.1 Laser power

The laser power usually means the output power of the laser and the power density is one of most pivotal parameters in laser weld. The laser weld is closely correlative to the laser power density, and when the laser power density is lower than 10^6 W/cm^2, the laser weld belongs to category of heat exchange weld, and only when the laser power density achieves 10^6 W/cm^2, the deep penetration weld can be formed and "keyhole effects" appears. The "keyhole effects" is closely correlative to the laser power density which is more low, the "keyhole effects" is more unstable even can not be formed, and the melting pool is also small. The melting depth of laser weld is directly correlative to the laser output power density and which is the function of incidence beam power and beam diameter. Generally speaking, to a certain beam diameter, the melting depth increases with the increase of beam power, both almost present linear relation. Therefore, to enhance the power density, we can enhance laser power. Figure 1 shows the relation of melting depth and laser power when the beam diameter is definite, and the welding speed is 1 m/min. From Figure 1, we can see that the melting depth increases with the increase of power.

3.2 Beam diameter

This is a very important technical parameter, because in a certain output power, it will decide the density of beam power and the power density is the key factor for laser weld. But to laser beam with high power, it is difficult to measure, which is produced by the nature of the beam diameter. For laser weld, the condition of high effective deep penetration weld is that the power density on the laser focus must exceed 10^6 W/cm^2. We can adopt two methods to enhance the power density, one is to enhance the laser power, and the other one is to reduce the diameter of the beam. The power density has linear relation with the laser power, and has inverse-square ratio relation with beam diameter, so the effect of reducing beam diameter is better. In this experiment, to realize deep penetration weld, we choose beam diameter of 1 mm.

3.3 Welding speed

The welding speed mainly influences the melting depth and melting width of weld line, because in a certain laser power the weld melting depth almost has inverse-ration relation with the welding speed. When the welding speed is too fast, the "keyhole effects" will not be formed and so that the metal will not melt, the quenching speed is too fast, the intensity of seam is reduced, and pores of weld lines increase to influence the bending resistance intensity and surface of weld line because the harmful gases such as N_2, H_2, O_2 and CO are too late to transgress. So, the confirmation of welding speed upper limit is to prevent the metal has not been fully melt and the quenching speed is too fast so that the melt can not flow and fuse. Otherwise, the melting metal will incline to the top of the welded piece and form welding beads. However, when the welding speed is too slow, the bead produced by the superfluous heat exchange will extend to the side, and the heat influenced area will become too heat and extended, the seam metallographic structure crystal becomes thick, sometimes the cracking will appear, which will seriously influence the welding quality. When the welding speed achieves the lower limitation, the superfluous power absorption also will induce local evaporation loss and hollows.

3.4 Focus error

The focus error is the distance between the workpiece surface and laser focus, and when the workpiece surface is in the focus, the focus error is minus, whereas it is plus. The laser welding usually needs some focus error, because too high power density of the beam center at the laser focus is easy to vaporize and become bores. On various planes departing from the laser focus, the distribution of power density is relative well-proportioned. The focus error influences not only the laser beam on the weld piece surface, but also the incidence direction of beam, so it has important influences to the melting depth and seam shape. When the focus error reduces to a certain value, the melting depth will suddenly change, which will establish necessary conditions for producing penetration pores. The power density on laser stays point is biggest, and when the laser stays locate on the workpiece (plus focus error), the power density obtained by the workpiece decreases correspondingly, and the "nailhead" seam will be formed and melting depth will minish, and when the

laser stays locates in the workpiece (minus focus error), the melting depth will increase, so the minus focus error often be adopted when welding. Figure 3 is the relation curve between the focus position below the workpiece surface and the weld melting depth. We can see that with the moving of focus below the workpiece surface, the weld melting depth increases gradually, and when the focus locates about 3mm below the workpiece surface, the melting depth is most, and when the focus continues to move down, the melting depth will rapidly become shallow. In addition, the seam metallography indicates that when the focus position is too low, part materials on the tie-in part of welding workpiece can not be fully melted and form apertures. Therefore, the focus should locate 3mm below the workpiece surface when welding.

3.5 Kinds and flux of shield gas

The shield gas of the laser weld can not only protect the seam metal avoiding harmful gas and dissipate the plasma shield produced by the high power laser weld, but protect focusing lens avoiding metal steam pollution and spatter of liquid fuse. In the process of high power density laser weld, metal is heated and gasified, and forms metallic steam cloud above the melting pool, produces ionization and forms plasmas under the function of electromagnetically field, and if the plasmas are too much, the melting depth will reduce and the melting width will increase. To some extent, the laser beam will be weakened by the plasmas which exist on the workpiece surface as the second energy. The size of the plasma cloud and melting depth of seam will change with different shield gas. The influences of different shield gas to the melting depth of high power deep penetration are seen in Figure 4. From the Figure, we can see that when we select the gas of Ar as shield gas, the welding width will be shallower than other gases because the gas of Ar is easy to produce ionization by the high temperature metallic plasmas cloud produced in the welding process, shields part laser beams to the workpiece and reduces the welding effective power. Because the gas of He has fewest ionizations and lightest proportion and can quickly dissipate the ascending metallic steams produced in the metallic pool, so when we choose it as the shield gas, the ionizations will be restrained to the maximal extents and increase the melting depth and enhance the melting speed (Guan, 1998, pp.121-124). The gas flux also has some influences to the melting depth. The melting depth increases with the increase of gas flux, but too much gas flux will induce the surface hollow even penetration of the melting pool.

4. Analysis of experimental results

4.1 Macrographs of laser seam

Figure 5 and Figure 6 are respectively photos of seam top and cross section of the laser welding ship steel plates. From these two photos, we can see that comparing with traditional welding technique, the laser seam is very narrow and has big ratio between depth and width which is bigger than 2:1 and the overheating influential area is mall (only 0.3 mm). The seam cross section basically presents Y structure. Because of the adding of welding wires, the seam top and bottom present small protruding and there is no undercuts. The seam surface presents circuits of scale welding lines, and we cannot find deficiencies such as cracking pores after exploring examining. That indicates laser can complete penetration one time for the ship steel plates and realize the technology of shaping up from both sides by one side welding.

4.2 Microstructure analysis

The laser seam structure mainly is composed by tiny cryptocrystalline martensite and few remnants austenite which is seen in Figure 7, because under the function of high power laser, substrate and filling materials melt quickly and transform to high temperature austenite. Though the substrate and filling materials are mild steels, but under the function of laser fast melting and coagulating, the mild high temperature austenite quickly cools and transforms to martensite. This martensite is different comparing with the conventional welding structure (Zou, 1994, pp.186-189), and it is mainly composed by abundant tiny batten martensite and other few tiny piece martensite, because the carbon contents in high temperature austenite are too late to be averaged in the laser quick melting and coagulating process, present distribution fluctuating of carbon component, and the batten martensite forms in the low carbon area and the piece martensite forms in the high carbon. These two kinds of tiny martensite coexist and mix, and form cryptocrystalline martensite.

Figure 8 is the SEM photo of laser welding substrate. We can see that it is composed of ferrite and pearlite.

4.3 Mechanical Testing

We use XHD-1000T Vickers sclerometer to test the hardness of laser seam and the load is 200gf. Figure 9 presents the microscopical hardness traverse distributions of seam top area A, middle area B and bottom area C which take the seam center line as the baseline and crosses from one side to the other side of the substrate. From the hardness distributions, we can see that the hardness distributions are basically equal in the laser seam, and hardness average value is HV380 and the basic hardness average value is HV200. When plumbing to the seam, hauling the tested piece, we can obtain the hauling intensity is 536 N/mm^2, and the rupture point locates in substrate and there is no cracking in seam. When plumbing to the seam, cold bending the tested piece, there is no rupture through 180^0 cold bending. The above mechanical tests indicate that the laser seam has better comprehensive mechanical performances which include not only good hauling resistance intensity but good bending resistance tenacity.

5. Conclusions

The experiment indicates the following aspects.

(1) The technical parameters including welding speed, power, focus error and side huffing gas flux have prominent influences to the welding depth and width, and these parameters connect and restrict each other.

(2) Taking the gas of He as the shield gas, when the laser power is 8 W, the welding speed is 1m/min and the focus locates 3 mm below the workpiece surface, it is feasible to continually weld ship steel plates of 12 mm for high power CO_2 laser, and the welding speed is fast and the welding is credible and small distortion and can realize shaping up from both sides by one side welding.

(3) The above results show that the laser weld possesses comprehensive performances such as good technology, structure and intensity and the technology of laser welding ship steel plates has better practical values.

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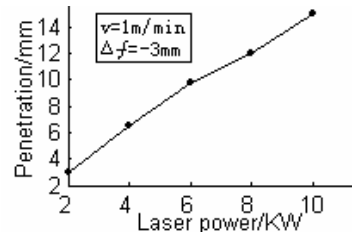

Figure 1. Laser Power vs. Weld Penetration

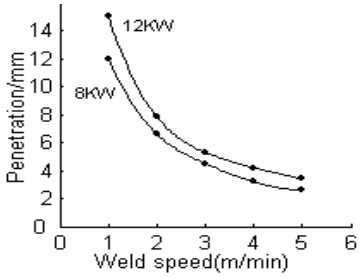

Figure 2. Effect of Weld Speed on Weld Penetration in Different Powers

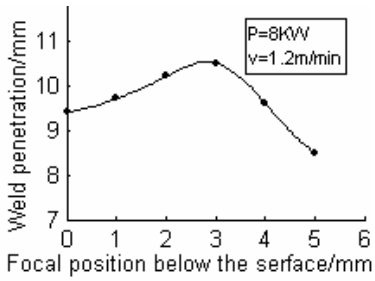

Figure 3. Effect of Focal Position on Weld Penetration

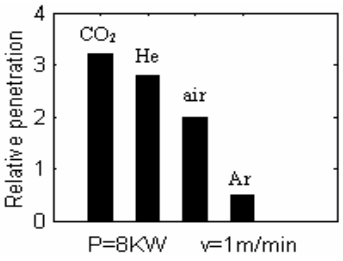

Figure 4. Effect of Different Shielding Gases on Weld Penetration

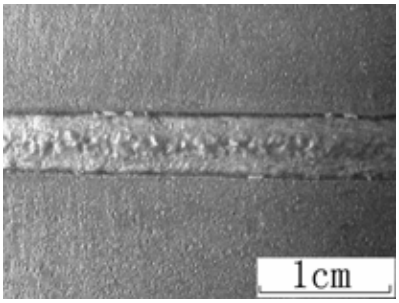

Figure 5. Macrographs of Welding Seam Top

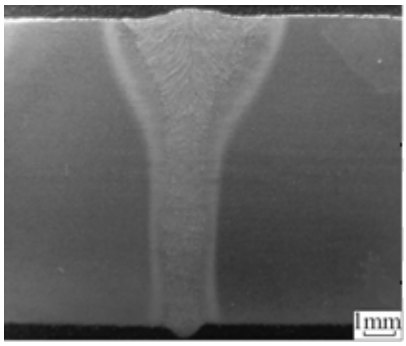

Figure 6. Macrographs of Welding Seam of Cross Section

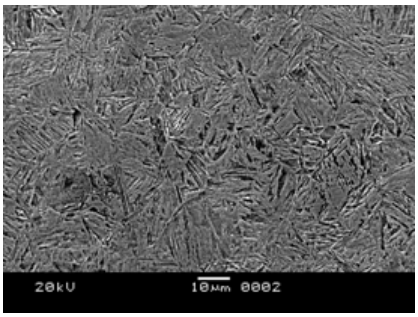

Figure 7. Microstructure of the Laser Welding Seam

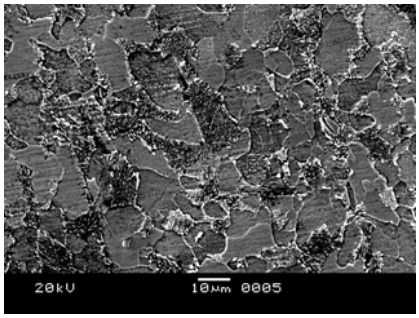

Figure 8. Microstructure of Substrate for Laser Welding

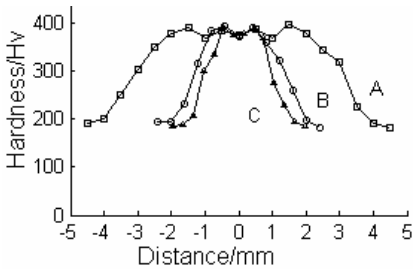

Figure 9. Hardness Traverse Distribution in the Laser Welding Seam

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The Pre-set Peeling Testing Method of the Hydroetangling Wood Pulp-PET Fiber Composite Web Materials

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Abstract

Hydroetangling wood pulp-PET fiber web, which is an excellent wipe material. But some fate short coming-particle peeling, arising when it used as wipes, and the peeling particle would do harm to some devices. Therefore, this case even worse when the fabric damping. The four pre-set peeling tests have been signed for this phenomenon, which have imitated some situations of the pre-set peeling under the mechanics functions. The statistics from these tests, combined the analyzing of the different raw materials and processes of the hydroetangling wood pulp-PET fiber web, are regular and convincible. So it is indicate that the pre-set peeling conditions can be explained well by these four testing methods, which are reasonable and feasible.

Keywords: Spunlace nonwovens, Wood pulp-PET fiber web, Pre-set peeling, Pre-set peeling test

Hydroetangling wood pulp-PET fiber web is an excellent wipe material, for it has good flexibility, drapability, moisture absorption and dust absorption (Xing, 2003, p.165-178). But its particle peeling is deadly short coming. For example, there will be some particle peeling when wiping the precision electronic products, that seriously affect the performance of the electronic product, especially after absorbing moisture (Shen, 2003, p.105-114). Some wood pulp-short fiber is easily floating, for it is not fully entangled with polyester fiber in spunlacing district (Ma, 1999, p.25-27), that is why wood pulp cloth easily particle peeling by outside force. But now there is none usefully testing method and uniformly standard by international. It makes factory and customers inconvenient.

In this paper, it is mostly analysis the problem of wood pulp composite cloth's particle peeling. The four pre-set peeling tests have been signed for this phenomenon, which have imitated some situations of the pre-set peeling under the mechanics force. The statistics from these tests, combined the analyzing of the different raw materials and processes of the hydroetangling wood pulp-PET fiber web, are regular and convincible.

1. Experimental

1.1 Materials

Six sample of hydroetangling wood pulp-PET fiber web (the wood pulp fiber > 2mm more than 90%); sample A, B, C and D has the same rational number of spunlacing (6-8), E has 11-14, F more than 15; sample A and E is 70g/m^2, B, C, D and F is 68g/m^2; the ration between wood pulp tissue and polyester is 55:55 (A, B, E), and 60:40 (C, D, F).

1.2 Experimental Instrument

Y522 Disk Fabric Abrasion Machine (Changzhou Fabric Mechanism Factory), YG7011A-1 Automatic Washing Machine (Wuxi Fabric Machine Factory), Y802A Eight Basket Oven (Changzhou Fabric Machine Factory) , FA2104 Electronic Scales (precision: 0.0001g, made by Shanghai Precision & Scientific Instrument Co,. Ltd), electric fan, cloth web, adhesive tape etc..

2. Design of Particle Peeling Testing Method

Samples should be prepared by the treatment of gas conditioning before test, 24h (Guo, 1998, p.22-23) in the state of standard atmosphere or in the same condition. The test must be repeated three times, and calculate the average.

2.1 Disk Abrasion Method

It is imitated the situation of grating. There is two abrasion method: grinding wheel and wrapped by cloth grinding wheel abrasion. The first method produce: weigh the disk sample (Φ11, signed W_1), choose 280# grinding wheel, 6r/min, 5min, signed W_2 after abrasion, then calculate the particle peeling ratio.

2.2 Beat Method

It is designed for the state of mechanical colliding. The sample (30*30cm) signed W_1. Hanged the sample, connected vertical sample by electric fan, beat 5min. Weighed the sample after particle peeling and signed W_2.

2.3 Garment Wash Method

Hydroetangling wood pulp-PET fiber web sometimes need to be dropped liquid, as operating coat would be adhibited blood and liquid medicine. This case makes different particle peeling. The test is imitated the particle peeling in the flexibility of damp. The sample (30*30cm) signed W_1. washed in the fabric web. The conditions see as table 1. Dried, Weighed the sample after particle peeling and signed W_2.

Table 1. The washing conditions

Method of flexibility	Load (N)	Temperature (℃)	Water level (cm)	Washing time (min)	Water level (cm)	First washing time (min)	Water level (cm)	Second washing time (min)	Dehydration time (min)
normal	19.6	40	10	3	13	3	13	2	3

2.4 Adhesive Tape Affix Method

Some wood pulp-short fiber is easily floating, for it is not fully entangled with polyester fiber or itself, that is why wood pulp cloth easily particle peeling by outside force. The adhesive tape affix the Hydroetangling wood pulp-PET fiber web, then separate, the tape would take floating short fiber away. The mount of short fiber is to estimate the particle peeling.

The sample (5*20cm) signed W_1, took the same size tape affix fiber, then planished and separated, repeated three times, then weighed the fiber signed as W_2.

3. Validation of the Testing Method

3.1 Result of Test

The ratio of peeling can be seen from Table 2. The result accord the product characteristics. The different methods fluctuate the ratio a lot or have no rule. For example, the peeling ratio of sample E (beat method) is 0.07%, least, compared with other samples, also with other methods. It is showed that the peeling of the product is little, and any method can illuminate the characteristics.

Table 2 also shows that the ratio of peeling is related with the techniques. Sample C and D (68g/m^2, wood pulp tissue and polyester is 60:40, same rational number of spunlacing), sample D has a row in the forth rational number, and sample C has two, which entangles closer, it makes the ratio peeling of sample C is smaller than sample D. By garment wash method, sample D is 13.19% and C is 5.73%. otherwise, seen from sample E and F, the rational number of E is little than F, but E is 70g/m^2, wood pulp tissue and polyester is 60:40, and F is 68 g/m^2, 60:40, it makes the ratio peeling of E is smaller than F. For instance, E is 0.09% and 0.02%, compared with F being 0.21% and 0.09%, by disk abrasion method.

Table 2. The pre-set peeling percentage of different tests (%)

Hydroetangling Wood Pulp-PET Fiber Web Sample	Disk Abrasion Method		Beat Method	Garment Wash Method	Adhesive Tape Affix Method
	Grinding Wheel Abrasion	Wrapped by Cloth Grinding Wheel Abrasion			
A	0.60	0.26	0.22	9.08	2.72
B	0.85	0.38	0.26	13.04	2.90
C	0.48	0.16	0.18	5.73	1.58
D	0.90	0.55	0.29	13.19	7.86
E	0.09	0.02	0.07	3.2	0.19
F	0.21	0.09	0.15	3.34	0.87

In conclude, the four testing methods can reflect the degree of the product particle peeling, the statistics from these tests, according with the characteristics, are regular and convincible. So it is indicate that the pre-set peeling conditions can be explained well by these four testing methods, which are reasonable and feasible.

3.2Comparison of Experiment

There is none available method in domestic research, the aim of the experiment is to imitate some condition, reflect the degree of hydroetangling wood pulp-PET fiber web. The four methods have their own specialty. The disk abrasion method imitates the mechanical friction, it is mostly close to the practical situation, reflect the particle peeling truly, but it is too cockamamie, losing little (especially fiber itself), the scales changes little, so it requires instrument precision. The garment wash method is changed much after washing, it can imitate actually circumstance by agitating and kneading, mostly adapt to inspect product for medical treatment and sanitation. Because the product needs to absorb blood and medicine liquid, also it is bear outside force. The beat method uses instrument easily but the ratio of particle peeling is smaller than disk abrasion method, adhesive tape affix method is mostly simpleness and have better effect, the loss is only lower than garment wash method. This method is used by some medicine treatment manufacture which is clung together easily.

In a word, the comparison can be concluded by table 3.

Table 3. The four pre-set peeling tests comparison

Method	Aim	Result	Characteristic	Suitable Product
Disk Abrasion Method	Inspect situation of mechanical friction	higher ratio of peeling, reflect truly	Method is regular, operation is complexity, needs higher precision	Classic industry wipes
Beat Method	Inspect situation of mechanical beat	little ratio of peeling, reflect unobviously	Simple instrument, but control hardly	Barrier cloth, curtain
Garment Wash Method	Inspect situation of kneading in certain temperature and humidity	highest ratio of peeling, reflect obviously	More conditions, operation is complexity, close to actual environment	Functional product moistened by blood, as operation cloth, operation hole-cloth, operation overclothes and so on
Adhesive Tape Affix Method	Inspect the ratio of peeling in static	ratio of peeling is normal, reflect truly	Most basic	wood pulp spunlaced nonwoven

3. Conclusion

(1) There is no standard and available method in testing peeling of hydroetangling wood pulp-PET fiber web. The design can solve two problem: firstly, imitate some peeling situations, secondly, extend methods to other nonwovens.

(2) By the analysis of experiment, it is indicated that the four methods are realistical, reasonable and feasible.

(3) The four testing methods have their own characteristics, can inspect different functional hydroetangling wood pulp-PET fiber web, and select different method for different request, using reasonable.

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An Extreme Application of the Theoretical

Prediction Open-end Fund Redemption of Methods

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Abstract

The open-end funds have liquidity risk, one of the main reasons — the open-end fund huge redemption is elaborated, the paper uses the extreme value theory measure the liquidity risk. Through the analysis, we found that the extreme application fit to forecast open-end fund redemption amount of their probability of occurrence, and use maximum likelihood method to estimate the parameters and goodness-of-fit test. This paper also uses the Monte Carlo method to the results for further simulation experiments, and forecast the mean and standard deviation of the redemption of the fund. Fund managers may, under certain probability, predict funds for the redemption, resulting in an appropriate reserve of cash, avoiding reasonably the open-end fund which provides liquidity risk. That is a good prediction method.

Keywords: Open-end funds, Liquidity risk, Redemption, The extreme value theory, The cash reserve, Monte Carlo method

Introduction

The merits of an open-end fund in relation to closed-end funds lies in the size of the fund uncertainty, investors may need to keep the purchase or redeem fund, which may give rise to liquidity risk. That is why part of the current investor's pursuit the immediate and substantial proceeds to redeem fund shares. Investors invest in the liquidity requirements of fund, the higher the mobility corresponding greater the risk. Under the given risk level, open-end fund manager can not restrict to redeem for investors request. what he can do is to consider the prior rate of return among different investors most likely to redeem the amount, which guarantee an open-end fund in the portfolio have sufficient liquidity strong assets to meet investors foreclosure to request.

For fund managers, the key to risk control is the greatest extent to meet investor redemption at any time, predicting the redemption of fund shares accurately, and reserving the cash appropriately. But too much cash reserve fund will affect the ability to invest, thus affecting the value of the Fund. If the cash reserve is too small, and the huge redemption occurs (in a single opening day, only a net redemption of the Fund for shares of the Fund over the previous Fund's total share of 10%, that is, the fund had huge Redemption), fund managers will be faced with the realization losses due to the delay or redeem its credibility and influence, and even the liquidation of the Foundation faces danger. On the issue of cash reserve ratio there has already been some discussion (Wang, Wang & Pan, 2004, pp. 290-293), but the share prediction about redemption is rare. In addition, there are lots of decision-making factors which affect fund managers' decision in China market, there is a lot of short-term behaviours, which do not investment funds as a long-term investment but see Lee on the results, causing fund managers to sell some assets which have good prospects to meet the huge redemption. This will affect the Fund's ability to invest and its benefits, increasing liquidity risk. Predicting a huge amount of ways — through the application of extreme value theory, forecasting huge withdrawal of probability, fund managers will be able to avoid open-end fund liquidity risk.

1. Use extreme value theory to an open-end fund redemption volume model building

1.1Extreme Value Theory

The extreme value usually means that there are very few incident in people's experience, it also means that it occurs rarely. For example, in the natural environment, there are floods, earthquakes, droughts; In the social environment, the economic and financial fields about the stock price volatility display disproportionate changes which is usually smoothing consecutive volatility, such incidents occurring easily plummet in the stock market, soared and so on. From the beginning of the 1930s, many scholars begin to study extreme value theory. The results show: Extreme distribution can be the biggest (small) value distribution for a good description, we can use Frechet, Gumbel distribution to these random variables to propose and study. Jenkinson uses the theory which is applied to extreme risk research, a broad distribution of extreme types, and further made the one-dimensional model of extreme distribution perfectly. Pickands prove that classical limit theorem. Moreover, in the 1980s, many scholars had studied sequence which is not smooth of extreme and its behavior (characteristics) and interdependent phenomena. The mid-1980s, multivariable Extreme Value Theory of Statistical Inference had further development, and which is as the current maximum theoretical study of the hot issues. This paper is primarily discussing a peacekeeping Extreme Value Theory in the open-end fund redemption (Zhu, Zhang & Zhang, 2001, pp.72-76).

First, I'll introduce the concept of the order of Statistics, (X_i, $i=1,2...n$) order statistics, which were caught from the distribution function $F(x)$ which is as the overall sample. We order them from Max to Min such as $X_{(1)} \geq X_{(2)} \geq \cdots X_{(n)}$, called ($X_{(1)}$, $X_{(2)}$ $\cdots$ $X_{(n)}$)as order statistics. And $X_{(1)}$ = max ($X_{(1)}\cdots$ $X_{(n)}$), $X_{(n)}$ = min ($X_{(1)}$ $\cdots$ $X_{(n)}$) will be known as the great value of samples, samples minimum values, collectively known as Extreme samples, and their distribution is called extreme value distribution. That is, the incident occurs at a very small probability, and the incident occurring on the system has a significant impact disturbance. Extreme value distribution is grouped into type I, type II and type III. Study extreme distribution theory, collectively known as Extreme Value Theory. It is an important branch of the Probability theory study, random samples and random process of the extreme probability and statistical inference is its main study object.

In order to facilitate the application of statistics, Jenkinson (1955) generalized extreme value distribution model (GEV) (Zhu, Zhang & Zhang, 2001, pp.72-76).

$$G(x)=\exp\{-[1+\zeta(\frac{x-u}{\sigma})]^{-1/\zeta}\}$$

(1)

order $\{x:1+\zeta(x-u)/\sigma>0\}$

Extreme Distribution Type II and III respectively corresponding these situation $\zeta>0$ and $\zeta<0$. Type I is $\zeta \to 0$ to the limit. ζ is shape parameters, u is the location of the parameters, σ is a measure parameter.

1.2 Forecast open-end fund redemption of model

For the open-end fund managers, they need to predict fund redemption of the largest daily volume, the amount of cash is set aside according to redeem, when they forecast excessive redemption, they should consider liquidating part of their assets. So it is right to redeem the projection necessary. Many studies have shown that investors are redeemed with the characteristics of random acts, that is, the number of investor who wants to redeem is random, investors who want to redeem shares in the fund is also random. If we make each trading day as a unit of time, in every unit time, there will be occur many redemption issues. they can be redeemed on average volume of the order of priority, will have a maximum and minimum values, the great value is the greatest redemption amount in one day, the minimum value of the day is the minimum redemption amount in one day. Order X_i, $i=1,2...n$, this is a certain open-end fund redemption volume in a trading day; it can be viewed as a sample which derived from distribution functions $F(x)$ which is the overall sample. According to the size of its order: $X_{(1)} \geq X_{(2)} \geq \cdots X_{(n)}$. Here what fund managers are most concerned about is the largest amount of redemption -- or redeem the great volume. Take some time to observe (for days), if take a great value every day, there will be plenty of great value, the maximum value that can be distributed with a dimension maximum distribution. This paper selects Jenkinson (1955) which is generalized extreme value distribution model, the distribution function is:

$$G(x_i)=\exp\{-[1+\zeta(\frac{x_i-u}{\sigma})]^{-1/\zeta}\}$$

(1)

This is fitting to the actual distribution of the maximum value. Here is $1+\zeta(x_i-u)/\sigma>0$, x_i is the extreme value in every trading day, ζ is shape parameters, u is the location of the parameters, equivalent to the average value of the sample, σ is a measure parameter, which is a sample standard deviation, $i=1,2...n$.

2. The parameters of the maximum likelihood estimation (mle) and the test

2.1 Parameters of maximum likelihood estimation (MLE)

Extreme distribution model in the application used to be fit sample data sequence characteristics of the tail distribution, for a peacekeeping extreme distribution model, according to the data which is mainly known, estimating ζ, u, σ three parameters, and being to determine this distribution model is the type of extreme distribution.

To determine if this distribution model is the type of extreme distribution, a simulated data is used to conduct experiments. Getting the data which is from 1000 trading days of 1000 largest volume of redemption, which is the great value. Assuming a total of a certain open-end fund is 1.5 billion shares when the redemption amounted to 150 million copies, or that a huge withdrawal. In its daily transactions, there were huge probability of redemption should be minimal, so the simulation data x_i among [1 * 10^7, 1 * 10^8] changes that is the 1000 redemption of the largest samples of observations, $i = 1, 2, ..., n$.We applicant to the maximum likelihood method for parameter estimation.

Using the distribution function

$$G(x_i) = \exp\{-[1+\zeta(\frac{x_i - u}{\sigma})]^{-1/\zeta}\}$$

to get the likelihood function.

$$L = \exp\{-[1+\zeta(\frac{x_1 - u}{\sigma})]^{-1/\zeta}\}.\exp\{-[1+\zeta(\frac{x_2 - u}{\sigma})]^{-1/\zeta}\}\exp\{-[1+\zeta(\frac{x_i - u}{\sigma})]^{-1/\zeta}\}.....\exp\{-[1+\zeta(\frac{x_n - u}{\sigma})]^{-1/\zeta}\} \quad (2)$$

then get the logarithm

$$\ln L = -\sum_{i=1}^{n}[1+\zeta(\frac{x_i - u}{\sigma})]^{-1/\zeta} \quad (3)$$

Seeking the largest value of function $\ln L$, then changing for seeking the smallest value of

$$\sum_{i=1}^{n}[1+\zeta(\frac{x_i - u}{\sigma})]^{-1/\zeta} \quad (4)$$

Using Matlab software to calculate (4) - program, the three parameters were estimated value

ζ = 0.02, u = 1.0e +007×9.5127, σ =1.0e+007×2.0160.

Then putting the estimated value of ζ, u, σ into (1),getting that

$$G(x) = \exp\{-[1+0.02\times(\frac{x - 1.0e+007\times 9.5127}{1.0e+007\times 2.0161})]^{-\frac{1}{0.02}} \quad (5)$$

The estimated value ζ close to 0, this distribution model is Type I extreme value distribution, when $x_i \in$ [1, 2.0 * 10^8], we can look the Figure:

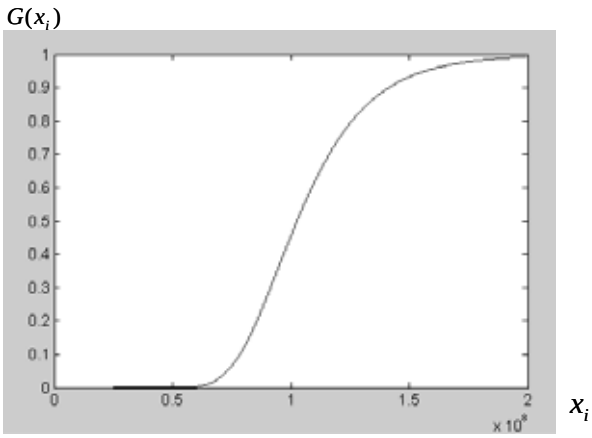

Figure 1. Probability on redemption of open-end fund

Using the matlab language to map program, we can see the probability distribution from Chart 1.

2.2 Distribution of goodness-of-fit test

χ^2 method of inspection is the non-parameter test of goodness-of-fit test(Yu, Wang & Pan,2003,pp.877-879), it is the right of its value in the range of data to group ,then calculating the frequency ,on that base , getting each inspection interval of the actual frequency and theoretical frequency differences and making a judgment. It uses the following statistics

$$\chi^2 = \sum_{i=1}^{l}\frac{(m_i - np_i)^2}{np_i} \quad (6)$$

n is the sample size, l is the number of groups, m_i is the Sample observations fall into the first i group of frequency, p_i is according to the original assumption which was based on the designated distribution obtained samples fall into the first i group of probability.

Statistical studies show: Sample size n is sufficiently large for which the original assumptions is true, the χ^2 statistics is similar to obey the distribution of freedom$l-k-1$, k is the number of the distribution which is to be guessing. In this question: l =15, k =3,we can calculate and obtain that $\chi_0^2 = 15.8 < \chi_{0.05}^2(11) = 19.6751$, therefore accept the original assumptions. That is the view of the more extreme distribution to fit statistical distribution of huge withdrawal is reasonable.

2.3 The issue needs to be clarified

The note of the ζ value:

By $\zeta > 0$, $\zeta < 0$ and ζ ? 0 three of the analysis found: $\zeta > 0$ with the smaller is more realistic. G(x) is distribution function. It is a graphic incremental curve, but the maximum value is smaller to 1. So it is fitting to the character of distribution functions.

The study found, when ζ is in the vicinity of 0 changing, the probability is not changing greater when the ζ is changing, while the graphics are not major changes, and when ζ is to take place after 1000 hours, the obtaining probability remains same.

3. The open-end fund redemption volume forecast

3.1 Predicting the probability of an open-end fund redemption

To put the obtaining three parameters into the distribution model and obtain the distribution function $G(x_i)$.At this point, if it is given a redemption amount, the distribution function can be calculated probability. For example: when x_i =2.0*10 ^{8} , $G(x_i)$ =0.9929.It means when the redemption is more than 2.0 * 10 ^{8} , the probability is p = 1-$G(x_i)$ =0.0071. The huge withdrawal occurred probability is 0.71%which is a very small possibility. The following table is adopting this method; we can see the occurrence probability of the huge redemption value.

Table 1. Probability on redemption of open-end fund

Redemption Shares (billion)	0.08	0.1	0.15	0.2	0.25	0.3
Probability	0.8811	0.4558	0.0682	0.0071	0.0008	0.0001

Through Matlab programming to complete this process. Meanwhile, Figure 1 also shows the probability value.

modulus using Monte Carlo method

In practical problems, there will always be some complex situations, it depends entirely on theoretical analysis of the numerical results to come is often impossible. This can be translated into some kinds of statistical probability model, using statistical simulation method can obtain intuitive numerical results. Statistical simulation calculation method is often called Monte Carlo method, knowing as stochastic simulation method, developing rapidly in recent years, applications become more extensive. It is a statistical probability theory which is applied to the field of numerical calculation method. It consists of two parts: first, it is necessary to solve the needs of practical issues into statistical probability model; secondly, inducing massive random numbers which complied with the required distribution to simulate the actual realization of the process, recording the outcome of each test, through dealing with these data to obtain estimating value.

In this paper, the simulation data may deviate from the actual situation, making the results inaccurate, using the Monte Carlo to correct them.. First, using the inverse transform method to generate random numbers, we can obtain

$$x = \frac{\sigma}{\zeta}\{-1-[\ln G(x)]\} + \mu \tag{7}$$

4. Conclusions

(1) By using maximum likelihood method to estimate parameters, we found that applying to type I Extreme Distribution theory to simulate the open-end fund redemption amount, we can reach a good outcome. When given a redemption amount which can be drawn on the probability of their occurrence or given a probability value, we can calculate the amount of the redemption fund. Fund managers can use Type I extreme value distribution model to predict the occurrence of a huge withdrawal.

(2) Using Monte Carlo methods to induce the "pseudo-random number," which could be better presented with the actual data, we have the data to better reflect the occurrence of the redemption, removing some human factors, making the forecasts accurately.

(3) Adoption of the above probability can see that the occurrence probability of huge withdrawal is very small and can be said to be occurred one time in several years or in hundreds of years. But the event will cause great losses, the fund managers should pay close attention to use this method to predict an open-end fund redemption amount of funds and set aside to do a good job.

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Study on Yarn Blackboard by Digital Image Processing Method

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Abstract

This article introduces a method which adopts the computer image manipulation to process the collected images of yarn black. Aiming at the hairiness and scratches existing in the yarn blackboard, we adopt the methods such as smoothness processing, threshold value division and image repairing to obtain a clear digital image without yawp points and exactly measure the yarn diameter. Comparing with the actual yarn diameter, the computed yarn diameter accords with the actual diameter, which proves that the yarn diameter measured by image processing method is accurate, exactly reflects the appearance features of the yarn such as slubs, neps and nips, and establishes the foundation for the automatic assessment of the yarn blackboard.

Keywords: Image processing, Yarn blackboard, Yarn evenness, Yarn diameter

1. Introduction

For a long time, the grade assessment of yarn appearance quality is to adopt the visualization inspection of manual blackboard, but because of the abuses of this method brought in the inspection such as waste time, hard sledding, personnel fatigue, uncertain results and bad precision and repetition produced by the subjectivity of the inspection personnel (He, 2002, p.59-60), people is taking up with using the automatic inspection system to replace the manual inspection all the while. With the development of computer and image processing technologies, the digital image processing technology has been abroad applied in the domain of textile inspection, and it has been an important research task at present and has important meanings for enhancing the yarn quality to actualize the objective assessment to the yarn blackboard evenness through computer image processing technology.

To inspect the yarn appearance quality through computer image processing technology, can not only overcome the abuses of inaccurate data results produced by the personnel subjectivity but also avoid the influences from measured condition, exactly inspect the slubs and nips of the yarn and the length and number of the neps and compute the variation coefficients of various yarn stain length, accordingly make the objective assessment of the yarn blackboard become possible. In the objective assessment process, the key is the image processing to the yarn blackboard.

Aiming at the characters of the yarn blackboard digital image, this article establishes a sort of processing method for the digital image of the yarn blackboard, obtains clear blackboard digital image, figure out the yarn diameters in the blackboard and compare them with the actual yarn diameters measured by CTT. This method establishes important bases for further studying the evenness quality of the yarn and objective assessment of yarn appearance.

2. Image collection of yarn blackboard

The image collection system adopted in this article is composed of steroscopic microscope, CCD camera, image card and computer. First adopt the Y381A blackboard machine to coil the yarn blackboard, magnify the yarn blackboard ten times through the microscope, and transform the optics signals into analog signals through CCD camera to input into the image collection card of the computer, finally transform them into the digital image. Figure 1 is the typical blackboard image of collected 40^s pure cotton fancy grade yarn and first grade yarn. From the figure we can see that, the blackboard includes important information of yarn appearance quality such as slubs, nips and neps, and yarn evenness in the image attach many filoplumes, interleaving with the nicks of the blackboard background. Therefore, to actualize the complete separation of yarn and blackboard background, we need establish a reasonable image processing method which can reserve the important characters such as the slubs, nips and neps when eliminating the filoplumes, and ensure the yarn diameter has no distortions.

3. Processing process of yarn blackboard image

To actualize the complete separation of yarn and blackboard, this article adopts the image processing method as follows: smoothness processing, threshold value division, and image repairing.

3.1 Smoothness processing

The yarn blackboard collected in this article has many filoplumes, and the filoplumes can not separate with the yarn, there are many nicks on the blackboard and the blackboard can not separate with the yarn well. These disadvantages bring many inconveniences for the following processing. So we adopt the neighborhood average method in smoothness smoothing to process the image.

This method is to utilize the average value of several pixel gray values to replace the gray value of every pixel. Supposed that there is an image f (x, y) with n × n pixels, we can get an image g (x, y) through smoothness processing, so we have (Liu, 2006)

$$g(x,y)=\frac{1}{M}\sum_{(m,n)\in s} f(m,n).$$

This smoothness filter can weaken or eliminate the high frequency component in the Fourier space, but doesn't influence the low frequency component, and the high frequency component corresponds with the part which has big changes of equal gray values in the area edge of the image, that is the parts with filoplumes and nicks in the image of yarn blackboard, after the filter sieves these components, the gray values of filoplumes and nicks parts will be lower than the yarn's, which will convenient for the following threshold values selection and image division to achieve the final purpose of processing.

3.2 Threshold value division

In the image of yarn blackboard through smoothness processing, the gray values of filoplumes on the yarn and the nicks on the blackboard would reduce. In addition, because the yarn blackboard is a good black and white image itself, if we want to well separate the yarn and blackboard and stand out the outline characters of the yarn, and the processed image should be easy to compute, the binary image processing is the best choice for the yarn blackboard. This article adopts the gray threshold method to perform the binary processing to the image. This method mainly selects one proper grade threshold value T, compares every pixel gray g (x, y) with it, and redistributes the pixel points that the gray point exceeds T with the maximal gray (such as 255), the pixel points that the gray point is below T with the minimal gray (such as 0), so the image after threshold value processing is (Liu, 2005)

$$g(x,y)=\begin{cases}255 & if \quad g(x,y)\ge T\\ 0 & others\end{cases}.$$

In the binary image processing, the selection of the threshold value is the key step, and the threshold value selected by the type differentiation analysis method can achieve the best effect. First, compute and input the gray direct block diagram (Phs (i)) of the image, second, compute the gray average value (Ave), gray type average value (Aver (k)) and type direct block diagram sum (W (k)).

$$Ave=\sum_{i=0}^{255}(i-1)Phs(i),\quad Aver(k)=\sum_{0}^{k}(i+1)Phs(i),\quad W(k)=\sum_{i=1}^{k}Phs(i).$$

Then, compute type separation index (Q (k))

$$Q(k)=\frac{\{[Ave*W(k)-Aver(k)]\hat{}2\}}{W(k)*(1-W(k))}.$$

So we can get the maximal value K of Q, and the best threshold value T = K -1 (Li, 1999).

Figure 2 is the yarn blackboard thorough processing.

3.3 Image repairing

Because of threshold value selection, the binary image through image division still has remains of small filoplumes, and many nicks on the blackboard surface have not been completely eliminated, so we need repair the yarn blackboard image divided after image division processing.

This article adopts the eight neighborhoods shrinking method and eight neighborhoods inflating method to process the image through threshold value division for eliminating the noise points on the background and the filoplumes on the yarn, staying useful information what we need to convenient for the yarn diameter computation.

The eight neighborhoods shrinking means that in an eight neighborhood image block with 3*3, if the gray value of the processing pixel is 0, so the gray values of other eight neighborhood pixels are 0 too. After that processing the background noise and the filoplumes on the yarn have been basically eliminated, but the thin-degree of the yarn would be thinner obviously, which will bring errors for the final experimental results, so we need inflate the yarn to recover the former useful information.

The eight neighborhoods inflating means that in an eight neighborhood image block with 3*3, if the gray value of the processing pixel is 255, so the gray values of other eight neighborhood pixels are 255 too. The repaired yarn blackboard image is seen in Figure 3.

Through the above image processing methods, we get clear binary image of the yarn blackboard without noise points. Form Figure 3, we can see that the yarn filoplumes and background nicks in the image have been completely eliminated and useful characteristic information such as slubs, nips and neps are hold.

4. Inspection and comparison of yarn diameter

The yarn blackboard after image processing is an excellent digital image, and we test the yarn evenness on the blackboard through quantitative analysis, and compare it with the actual yarn diameter measured by the yarn performance testing instrument.

4.1 Inspection of yarn diameter

Before the yarn image is analyzed, this article first uses the CTT yarn performance testing instrument made by American Lawson Hemphill Company measure the diameters of the used 40^s pure cotton fancy grade yarn and first grade yarn sample, and the testing results are seen in Table 1.

4.2 Computation of yarn diameter in digital image and comparison with measured yarn diameter

Scan the image in Figure 3 from the left to the right and from the up to the down, define the minimal unit in the image frame is pixel, and utilize the nether formula to converse the pixel number into millimeter, so the diameter of every yarn can be calculated.

$$1pixel \approx \frac{15}{1440} \times 25.4mm$$

Table 2 and Table 3 list the diameters of various yarns and corresponding yarn stains in the digital image.

Table 2 lists the diameters measured by the image processing method and the differences comparing with the actual measured yarn diameters in Table 1 for the fancy grade yarns and first grade yarns with normal appearance quality through eye inspection. From Table 2, we can see that the differences between the yarn diameters measured by the computer image processing method and actual yarn diameters are very small, which indicates that the yarn diameter measured by the image processing method has no distortions, basically accords with the actual measured results. In addition, according to the yarn diameter variation coefficient measured by CTT, the yarn has asymmetry of the appearance itself, which will induce data fluctuation in the image measure process. From data in Table 1 and Table 2, we also can see that the average diameter measured by the computer basically is smaller than the actual diameters, because the image processing process eliminates the filoplumes of the yarn, which means the testing results obtained by the computer image process method more accord with the objective requirements.

4.3 Inspection of yarn stains

Table 3 lists the diameters of the stains which the people think the blackboards in the Figure 3 contain yarn stains (2# yarn), and the diametrical deviations comparing with the actual diameter in Table 1.

In addition, according to American standards of ASTM-D2255-90 (Li, 1999) which institutes the diametrical deviations for the cotton yarn appearance stains, we can obtain the following results.

(1) The deviation of the slubs diametrical section is confirmed as +25%.

(2) The deviation of the nips diametrical section is confirmed as -40%.

(3) The deviation of the neps diametrical section is confirmed as +200%.

Through the comparison, we can see that after the slubs, nips and neps in people's eye are implemented quantitative processing through this image processing method, and the obtained stain diametrical deviations accord with the CTT standards, which indicates this image processing method can stay the character information of the yarn and further prove that the results utilizing computer image processing method accord with the inspection by the people's eye.

5. Conclusions

(1) The yarn blackboard image through this image processing method can basically eliminated the yarn filoplumes and blackboard nicks, actualize the effective separation of yarn and blackboard, obtain clear yarn outlines, and keep back useful information what we need, such as slubs, nips, neps of the yarn convenient for the following computation of the yarn diameter and judgments of the yarn evenness.

(2) The yarn blackboard image through this method can exactly obtain normal yarn diameter, and accord with the actual yarn diameter, which indicates that results through computer image measure have no distortions. In addition, this method can clearly reflect the deviations of slubs, nips, neps comparing with the actual yarn diameter, according with the American yarn appearance quality standards. The results indicate the computer image processing method can implement quantitative analysis to the yarn blackboard, more objectively evaluate the uneven sense effect of yarn blackboard, and eliminate the judgment coming from subjective factors.

(3) The image processing method is fit for not only the yarn blackboard image, but also the blackboard sample image, which can unify the processing methods of blackboard sample image and yarn blackboard image, and can offer more evidences for yarn grading, and more objectively evaluate the yarn appearance quality.

Therefore, this image processing method has application values, can completely substitute people's eyes for yarn grading, and obtain more exact and repetitive results than people's eyes. The inspected results can be stored in the computer, which can better evaluate the yarn appearance quality and establish bases for further automatically evaluate yarn

blackboard.

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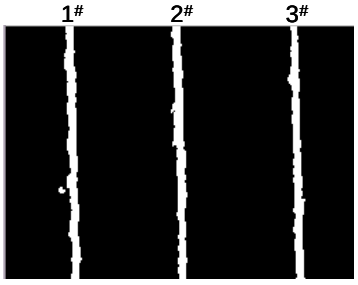
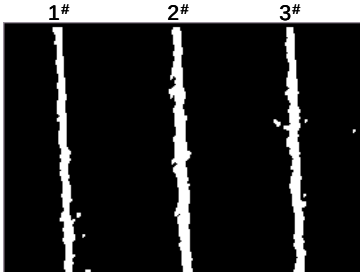
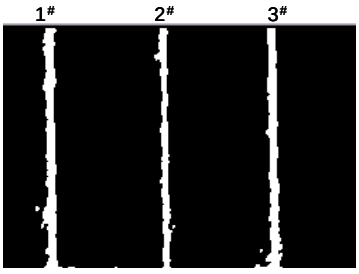


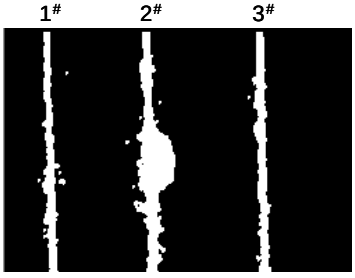
a. Fancy Grade Yarn Blackboard



b. First-grade Yarn Blackboard with Slubs



c. First-grade Yarn Blackboard with Neps



d. First-grade Yarn Blackboard with Nips

Figure 3. Yarn Blackboard Images through Image Repairing

Table 1. Actual measured yarn diameters

Yarn types	Actual measured diameter / mm	Diameter variation coefficient / %
40s Fancy grade yarn	0.166	14.65
40s First grade yarn	0.172	17.59

Table 2. Average diameter of normal yarn and deviation from actual yarn diameter

No.	Normal Yarns	Average diameter / mm	Deviation / %
1	Fancy grade yarn 1# yarn	0.164	1.2
2	Fancy grade yarn 2# yarn	0.165	0.6
3	Fancy grade yarn 3# yarn	0.158	4.8
4	First grade yarn with slubs 1# yarn	0.157	8.7
5	First grade yarn with slubs 3# yarn	0.175	1.7
6	First grade yarn with nips 1# yarn	0.170	1.2
7	First grade yarn with nips 3# yarn	0.170	1.2
8	First grade yarn with neps 1# yarn	0.157	8.7
9	First grade yarn with neps 3# yarn	0.170	1.2

Table 3. Yarn stain diameter and deviation from actual yarn diameter

No.	Abnormal Yarns	Stain points / mm	Deviation / %
1	First grade yarn with slubs 2# yarn	0.216	+25.58
2	First grade yarn with nips 2# yarn	0.102	-40.70
3	First grade yarn with neps 1# yarn	0.520	+202.33

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A Study on the Formation of Regional Brand Based on Industry Cluster

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Abstract

As a new economical development measure, the establishment of regional brand is a work with characters of specialty, technics and system. Regional brand is a sort of resource with independent principal part, but not appendant or decoration. The formation of regional brand is based on industry cluster, takes the regional history and culture as the background, adopts international brand registration method, accordingly enhances the international competition of regional industry cluster and establishes the international brand. The regional brand formation has close relations with industry cluster, and in the formation of regional brand based on industry cluster, various principal parts should exert influences together.

Keywords: Regional brand, Industry cluster, Relationship

1. Introduction

As a sort of industrial space organizing form between enterprise and market, industry cluster has active influences to the regional economy development. However, when the regional economy is prosperously developing, the industry cluster still has factors to restrict and influence the developments of regional economy, which include problems such as low technical content, strong product homogeneity and absence of brand support. Under this situation, to make domestic industry cluster breakout, upgrade and sustainable development and actualize enterprise to confront international brand in international market competition, the establishment of regional brand is the necessary choice.

Regional brand is the sum of enterprises which have considerable scales and strong abilities of making and production, high market occupancy ratio and influences and business reputations of enterprise brand. It includes two characters. One is regional character, and the regional brand is limited in the range of special area or city with strong regional feature and is the comprehensive embodiment of enterprise collective behaviors in some certain area. The other is brand effect which always represents the principal part and image of one local industrial products, holds the balance to the economical developments of that area, and forms reputation, attraction and loyalty of some certain industrial products in that area such as China porcelain capital, Jingdezhen, and China shoes capital, Wenzhou and so on. The appearance of regional brand indicates the industry cluster of this area has developed to some certain phase.

2. Relations between regional brand and industry cluster

Regional brand is established on the base of industry cluster, but it is different to industry cluster and is the high-level form of the development of industry cluster. It is not to simply list the same kinds of industries or relative industries, but to systematize the relations among enterprises in industry cluster. Though industry cluster also emphasizes the corporations among enterprises, but it further emphasizes enhancing the competitive ability of various enterprises in mutual competition, which standardizes the competitive activities through establishing orders. The establishment of regional brand cannot weaken the competition among enterprises, on the contrary it can induce enterprises entering “benign” competitive phase from malignant competition, and this competition with orders will inspirit enterprises to unceasingly innovate for obtaining the cognition of market. Therefore, industry cluster and regional brand have close and mutual promotion relations.

2.1 Influences of industry cluster to formation, spread and maintenance of regional brand

2.1.1 Industry cluster is the original impetus to form regional brand.

The formation of regional brand is gradually formed with the production and development of industry cluster, because large numbers of mutual associated enterprises and institutions are connected to be local network through specialization labor division and collaboration, which can not only overcome the decentralization and uncertain risks that single enterprise participate market trade, but also avoid low efficiency of grade enterprise. At the same time, these enterprises adopt flexible and professional production method, forms study and innovation mechanism through competition and cooperation, mutual

collaborations and complements, and drive regional developments and sustainable innovations of enterprises together. Just this industrial cluster with interior mechanism of centralization, competition, cooperation, study and innovation and flexible and professional production method, creates the marketing predominance of industry cluster, and accordingly forms the formation of regional brand. In all ages, the formation reasons of many regional brands rest with regional natural resources and industry cluster. In days with undeveloped economy, the regional natural resources have decisive influences to the formation of regional brand. For example, the resplendence of Jingdezhen porcelain industry just is derived from that Jingdezhen possesses special argils, so the regional brand of "thousand years' porcelain capital" comes into being. In modern society, with the development of economy, the advancement of technology and the fluidness increase of production elements, influences of natural resources to economy gradually are reduced, the opening degree of market, system environment and economical developments more and more decide the regional developments. Therefore, some regions may not possess special natural resources which some industries needed to develop, but because of historical accidental means or governmental guiding, they also can attract some relative enterprises in the industry to develop in the region, and form industry cluster. Because of self strengthening functions of industry cluster, through accumulations in period of time, enterprises which are centralized to special industry become more and more, and labor division becomes more and more elaborate, and the production scales become larger and larger. The centralization of enterprises, large scales and elaborate labor division make enterprises in the region obtain extensive scale economical effects and area economical effects, and costs of enterprises in the region are generally reduced, the products of these enterprises can fast occupy the market, compete with their competitors and occupy inside track in the market competition by means of their quantity, price, variety and other advantages. Finally, the region will become the main supply place for some products, and it influencing rage will gradually enlarge, accordingly it will form reputations and strong market influences of regional industry in certain regional range, that is to say, the regional brand is formed.

2.1.2 Industry cluster is the accelerator to spread regional brand.

After the industry cluster is formed, it can accelerate the spread of regional brand. In one region, enterprises in industry cluster can strengthen marketing network to get cooperated effects and build market predominance through establishing cluster regional integrated brand. Cluster with larges numbers of enterprises can centralize the powers of advertisement, utilize the colony effects, and form cluster integrated brand. For the advertisement drumbeating, it is easy to inspirit the enthusiasm of enterprises, and can change the situation that single enterprise doesn't want to devote much because of too many advertisement charges, and centralize resources of numerous middle-sized and small enterprises to develop advertisement drumbeating and make every enterprise benefit. At the same time, comparing with single enterprise brand, cluster integrated brand is more visual and direct, and has extensive and sustainable brand effects.

2.1.3 Industry cluster is propitious to maintain regional brand.

When the bargainers of the products have more information than the bargainees, the "lemon" market may occur, which makes commodities with low qualities drive out commodities with high qualities. Furthermore, the problems of "lemon" can not be stopped and solved by the market price mechanism. To solve these cheating behaviors that induce market failures or low efficiency of single enterprise or person, we have to effectively make and spread "active market information". However, industry cluster has advantaged predominance to avoid above "lemon" problems, make and spread "active market information". Thus it can effectively protect regional brand.

2.2 Promotion influences of regional brand to developments of industry cluster

The developments of industry cluster offer material bases for the formation of regional brand, on the contrary, the regional brand also will promote the developments of industrial cluster. Once the regional brand is formed, its influences will impel more enterprises relative to regional industry to centralize in the region, simultaneously many factors such as abundant capitals, plentiful labor forces, advanced technology and timely market information will swarm into the region ceaselessly, and these conditions offer powerful supports for the scale expanding and technical updating of the industrial cluster. Abundant capitals makes the scale expanding of industrial cluster become simple and easy, advanced industrial technologies create advantages for the technical updating of industry cluster, plentiful labor forces resources reduce the labor costs of enterprises in the region, and timely market information will ceaselessly induce enterprise in industrial cluster to adjust themselves and cooperate, adapt the demand changes of exterior market, and the market status of industrial cluster will be further strengthened. Into the bargain, because of the common attributes of regional brand, it needs cluster enterprises create and maintain itself together, accordingly making for the cooperation among enterprises and increasing the cooperated effects among enterprises.

Anyway, regional brand is the important invisible capital of regional industry, and tremendous fortunes of regional development. The tremendous influences of regional brand to regional development is indubitable, but as invisible capital, the exertion of influences must be restricted by the visible capitals. In nature, the invisible capitals and visible capitals cannot be separated. The visible capitals are the carriers of invisible capitals, and invisible capitals "arm" the visible capitals, which make them possess abilities obtaining additional benefits. In certain regional range, regional brand establishes the image of regional industry, radicates the status of regional industry, influences the cognition of exterior market to

regional industry, but which cannot means regional brand can independently exist being devoiced form industrial cluster. The industrial scales, centralization and market occupation rate formed by the industrial cluster are the original formation bases for regional brand, and without the predominance and monopolization of products, the regional brand can not be formed, and after the regional brand is formed, whether it can ceaselessly enlarge its influences or not more depends on further developments and grandness of industry cluster in the area of visible capitals, so as the visible capital principal part of regional brand, the development of industry cluster directly restricts the exertion of regional brand influences.

3. Forming mechanism analysis of regional brand based on industry cluster

The formation and management of regional brand is a system project with strong specialty and technology, and it is not the business of single enterprise, and its formation needs many principal parts including enterprise cluster, regional governments and industry associations to push together. Many aspects such as government, chamber of commerce, industrial associations and enterprises should actively devote themselves into the construction and maintenance of regional brand and exert their responsibilities and functions in the marketing of regional brand.

3.1 Government is the main propellent to form regional brand.

Better system and trade environment are guarantees to ceaselessly enhance formation and reputation of regional brand, and the government has its own predominance in the establishment of system by its special status. Industry cluster should find out its own orientation of special economy in the new situation and current of the whole country even global economical development. Firstly, the local government should list the construction of regional brand into the total layout of regional economical development in the developing process of regional economical development based on industry cluster. The government should fully exert local industrial predominance, gradually exert the centralized effect and scales effects of famous products, actualize industrial structure adjustment induced by famous products, resources scheme and industrial centralization induced by famous brand layout, form industrial regional brand by the centralized effect of industrial centralized place, establish industrial regional brand by famous enterprise cluster, and finally establish regional brand. The government should also establish developmental total strategy of regional brand according to the local concrete situations. Secondly, the government should centralize necessary policy resources to offer support conditions for the formation and development of regional brand through system innovation, for example, the government can decrease regional administrational costs and market trade costs, or the government can centralize powers and resources of relative departments effectively to form resultant forces to promote the construction of regional brand and establish a suit of effective work system, or the government increases its devotions and support the development of regional brand by special capitals. Thirdly, the government should try to mine and foster historical or cultural resource gifts, institute local regulations to regulate quality and market orders, strictly strike counterfeit behaviors in the industrial cluster, protect results of technical innovation and honest businessmen, and establish regional brand according to the law. Through above measures, the regional brand which is mainly impelled by the government can be formed. For example, France Airbus settled Tianjin, just because the government wanted to build cluster brand of our national plane making, and the manufacturing industry cluster of Shandong Jiaodong was mainly impelled by the local government, which wanted to construct the regional brand of industry cluster including electronic information, home appliances, autos, ships. At present, according to the characters and actuality with "low, small, dispersive, chaos" of our national cluster development, it is difficult to impel the formation of regional brand only depending on self power of cluster enterprises, so it is very important to enhance the marketing cognition and abilities of the government and exert the guiding functions of the government for establishing regional brand.

3.2 Various industrial associations are managers and supervisors to form regional brand.

Many agency organizations such as chamber of commerce and various industrial associations have indispensable agency status in the establishment of regional marketing and regional brand. Generally speaking, the rudiment of the regional brand is always endowed naturally by the market, but with the perfect of industrial cluster and implementation of regional brand strategy, the orientation, design, registration, drumbeating and spread of the brand will become very important. And the agency organizations should cooperate with the government, accept the governmental authorization by specialty function, assume missions such as industrial self-discipline, right maintenance, exhibition organizing, services, harmony and management, impel the establishment of professional market and institute regional industrial standards and use constitutions or regulations of regional brand through establishing regional enterprise catalogs, organize and lead enterprise to participate various project promotion meetings, trade fairs, products expositions, exhibitions, consulting meetings, proseminars, forums and other activities, support emphases enterprises by giving professional guidance such as technology, information and financing. The industrial associations can promote the sale of regional products and extend regional brand through these series of designed management activities.

3.3 Enterprises in cluster are the uppermost activity principal part to form regional brand and the maximal beneficial enterprises under the regional brand influences.

The resultant forces from government and agency organizations decide the direction and speed of enterprise development, and their functional cooperation is the important part for the enterprise development in the cluster. However the government and agency organizations only exert their assistant influences on the formation of regional brand, and the cluster

enterprises which are the leading actors in the production and management activities are the uppermost principal part to form regional brand. Firstly, enterprises in industrial cluster should try to decrease costs from basic managements through economical centralization, regulate interior management of enterprise from quality of products, build better bases of enterprise brand, establish enterprise brand establishing platform, enhance enterprise management diathesis and integrated image, quicken independent innovations, produce production with excellent quality, implement honest trade, improve product connotation and market covering rate, increase enterprise credit, reduce trade costs and finally enhance the comprehensive competitive power of enterprise. Secondly, enterprises should plan productions surrounding market opportunities and core enterprise, persist in the production direction of specialty, abandon the "small and complete" management ideas, and perform managements according to their own core abilities. Thirdly, enterprises should innovatively integrate local resources, integrate local or industrial special historical and social cultural resources into the resource system of industrial cluster, and really form the special industry and brand belonging to enterprise cluster, strengthen technical innovations and form regional brand supported by deep technical innovation ability. Fourthly, cluster enterprises should strengthen mutual cooperation among interior enterprises and produce effective cooperation and cooperation effects among enterprises, accordingly offer exterior environment with competitive powers for the survival and development of enterprises in cluster. In a word, enterprises are the eggs and concrete participators of regional brand formation, and enterprises offer basic guarantees for the constructions of enterprise brand and regional brand through optimizing self managements. For example, Wenzhou lighter, IT products of Silicon Valley, and software designed in Indian Banglore all had proved that the impulsion function and participation of enterprises in the formation of regional brand based on industry cluster.

4. Conclusions

In conclusion, three parties including government, agency organization and enterprises in cluster are organic integration with mutual associations and influences. "Invisible hands" and "visible hands" are all exerting influences, where, enterprises exerts basic functions of resources scheme, and the government has leading functions on industrial development, the establishment of industry environment, supply of common products and common services. The driving function is effectively exerted through relative agency organizations. Three parties are integrated, and constructed by the labor division mode of "leading status of government, agency function of associations, participant roles of enterprises", and finally promote the formation of regional brand on the base of industry cluster developments.

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