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Study on the Intelligence Structure of Current

Differential Protection in Transmission Line of UHV Based on Agent

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Abstract

At present, action criterions of Phase-segregated current differential protection in Transmission line of UHV include the criterion based on whole current, instantaneous value of fault and other changing from it. In different areas of fault, each criterion has different reliability and sensitivity. On the basis of deeply analyses and study of the principle for Phase-segregated current differential protection, this paper combines intelligence Agent technology, and creates an intelligent protection structure which can choose reasonable action criterion according to the place of fault, and it can make the reliability and sensitivity of Phase-segregated current differential protection in Transmission line of UHV improved.

Keywords: Transmission line of UHV, Phase segregated and differential current Protection, Action criterion, Intelligent Agent

With the rapid development of the global economy, the power demand is more and more growing, large-scale, high-capacity and long-distance power transmission has become a form of modern power system development. But comparing UHV transmission with the traditional HV and EHV transmission, the obvious economic and technical superiority are presented, especially, they are widely applied to attention in foreign and China power system [1]. In order to satisfy the development of the Northwest power grid to solve large-capacity power send out from west to east, adopting UHV transmission is a general trend, so the country's first of UHV transmission lines has been built in china: the 750kv single system about 146km from GuanTing to LanZhou East. Compared with other EHV(330kv,500kv,etc), the 750kv transmission lines UHV brings about greater capacity of current and longer distance transmission, the too high voltage and capacitance current caused by short circuit impact on the   System reliability and stability. To achieve this, we should learn from foreign experience in the design of protective relaying UHV transmission lines, fewer detours, and speed up the pace; On the other hand, we must in-depth study line protection and create the basis for the theory for the design and manufacture of UHV line protection, but also to ensure the stability operation of system.

1.　Phase-segregated current differential protection

1.1 Principles and characteristics of the Phase-segregated current differential protection

The basic principles: It transferred the time-lable current information and data packets by communication link from the end to the other end; it realizes the balance and phase calculations between two ends. From this, we can judge whether the breakdown will happen or not.

Looking from the principle of protection, Phase-segregated current longitudinal differential protection is an ideal situation; it is not affected by the oscillation, the mode of operation and the resistance [2]. Meanwhile, the Phase-segregated differential current protection, without the introduction of voltage avoid a transient voltage secondary circuit complexity in ultra-high voltage power grid, so comparing with the longitudinal direction for the protection and longitudinal distance (zero sequence) protection, Phase-segregated current longitudinal differential protection principles are simple, almost without affecting by the voltage transformer (TV) lost, contact compensate, same tower or many other factors, it has long been considered to be professionals ideal transmission line protection program[3].

Their characteristics are manifested mainly in the following aspects:

(1) Current differential protection only measured on the current value, and does not calculate the fault distance impedance. The influence of greater arcing resistance to the protection does not exist in the EHV and the UHV system.

(2) The current differential protection makes the measurements for the current balance and phase at both ends, so the fault phase can be elected clearly, and makes the fault phase correct easily.

(3) The current differential protection system is not influenced by system oscillation. When the system is oscillating, the direction of current at the two ends is the same as it is normally operating and they have the identical swings of phase. Even when the oscillation system fault protection device is able to act correctly according to different current phase.

(4) Current differential protection is not affected by voltage and current of opposite phase in the contact compensate system. Because the protection methods only relate with the current numerical and phase at both ends, it does not involve the phase relationship between voltage and current.

In addition, differential current protection is not affected by the load current and the problems in the three-phase short-circuit death zone. Therefore, in approaching UHV transmission line protection, the technology of phase-distance differential protection will replace the high-frequency technology, and become the mainstream technology of UHV transmission line protection [4].

1.2 The issues which exist in UHV current differential protection

UHV which carries with a capacity of current for a long-distance owns economic and technical advantages, but also it will face two major problems: First, because of the high voltage circuits and the high insulation costs, if it can promptly lower voltage level after the fault? Second, because the transmission line brings about the larger electric capacity current, the impact is particularly large for protection.

For the first issue, as storage elements exist and its energy cannot mutate, it will exert over -voltage in the UHV fault lines when it puts into empty and breaks the fault. To ensure that the insulator was no breakdown when the over-voltage presents, the program can be taken:

(1) Increasing the level of insulation (but increase investment);

(2) Through the rational allocation and choose arrester to prevent the electrical equipment damage from the over-voltage (but it will generate conduction from lightning arrester to earth, and expand the scope of protection);

(3) Adding shunt induct coil (but it will result the operation complexity between it and breaker)

(4) Set up a reasonable order for protective actions and circuit breaker tripping in order to limit the over-voltage (operating experience of UHV lines in Russian proves that the method is effective at certain extent).

Regarding the second question, the 750kv transmission line is composed of six divide wire. Comparing with 500kV transmission lines, its wire diameter increases, its impedance declines, and its capacity of transport makes greater. But also the distributed capacitance current increases between different phases and phase to earth, the current both ends of the lines isn't balance in the normal functioning of state, thus it results poor current, and it will become even more noticeable in failure. The problem may be not serious on the general the differential current protection of the HV and EHV long line, but for the UHV transmission line, it may be fatal. So on the EHV of long line, studying current differential protection should be given sufficient attention.

1.3 Action criterions apply to current differential protection of UHV transmission lines

After study in 750kv transmission line, the capacitive current will reach or surpass $100\%I_e$ when the best transmission radius is more than 1000km [6, 7], with the growth of line, capacitive current is also growing. Simulation experiments prove that the flow of capacitive current passing through differential relay can be achieved 1270A in none measures and normal working, and it accounts for 52.88% of the flow through the current phase. To protect from malfunction, it is necessary to increase the differential fixed threshold value of the protection, but it will reduce the protective sensitive, and make it difficult to set, it can easy lead to protection malfunction[7]. Therefore, high voltage shunt reactor are inserted in the actual transmission line to compensate part of capacitive current, reduce the influence and increase sensitivity of capacitive current differential protection, but when the line is longer, the circuit will still be larger capacitive current, it will affect the normal operation of the protection.

Therefore, how to raise the sensitive of protection at the same time, improve the reliability of the protection movement, is the focus for us. At present, it is more effective way to study in the criterion. there are usually two ways of Criterions used on, they are whole current and fault component, as well as Normalization criteria and the instantaneous value of the fault component criteria transforming from these. Their characteristics are following:

(1) The whole current action criterion:

$$\left| \dot{I}_m + \dot{I}_n \right| > \dot{I}_{zd}$$

$$\left| \dot{I}_m + \dot{I}_n \right| > K \left| \dot{I}_m - \dot{I}_n \right| + \dot{I}_0$$

if the criterion is Adopted during normal operation or external fault, the existence of load current will not have a huge impact protection, protection reliably can not cut off breaker, but in the case of an internal asymmetric fault or sending out large load by big electric resistance, the protection will doesn't action, and reduce its sensitivity.

(2) The criterion of fault components:

$$\left| \Delta \dot{I}_m + \Delta \dot{I}_n \right| > \Delta \dot{I}_{zd}$$

$$\left| \Delta \dot{I}_m + \Delta \dot{I}_n \right| > K \left| \Delta \dot{I}_m - \Delta \dot{I}_n \right|$$

The criterion of phase constituted differential protection is maid of mutations current after system failures in each phase current volume, due to adopt a fault component currents, it eliminates the impact of load current from the principle, the capability of transit resistance has been markedly strengthened, and higher sensitivity of the action. However, we need some time to eliminate the DC component, it has not higher speed.

On the basis of criteria similar to the birth:

(3) The criterion of normalization:

$$\left| \frac{\dot{I}_m}{\left| \dot{I}_m \right|} + \frac{\dot{I}_n}{\left| \dot{I}_n \right|} \right| > K \left| \frac{\dot{I}_m}{\left| \dot{I}_m \right|} - \frac{\dot{I}_n}{\left| \dot{I}_n \right|} \right|$$

By simulation the criterion is applicable to the all conditions for import as fault components, it respond quickly in the region, and has certain the high reliability to external region.

(4) The fault component criteria based on the instantaneous value:

$$\sum_{k=t_0}^{t_k} \Delta i_m(k) \bullet \Delta i_n(k) \geq E_{dz}$$

$$\sum_{k=t_0}^{t_k} \left| \Delta i_m(k) \right| \geq k \sum_{k=t_0}^{t_k} \left| \Delta i_n(k) \right|$$

The criterion maid use of instantaneous value can be avoided as the complex Fourier calculate, and reduce the time of action, at the same time it has the actions properties of against time. The more internal fault is serious, the more the current fault component is greater, and the speed is more faster that the fault was judged, it replenish the insufficiency to the serious fault for failures of rapid response to, the differential protection in internal fault has the best sensitivity.

Different criterion has itself expertise, in order to enhance the protection of UHV, We designed a agent architecture from the perspective of artificial intelligence, the agent architecture can dynamically choose different criteria in different fault region, it can coordinate each other and choose reasonable, it can effectively improve the reliability and sensitivity in the UHV transmission lines.

2. Intelligent Agent

"Agent" is also known as act on behalf of someone in a responsible position, in a sense, it has the characteristics of commercial activities with factor, it has the ability of their own reaction, coordination and decision-making according to environmental changes. The technology of Intelligent Agent has become one of the tasks of the fastest-growing in artificial intelligent field, it is a collection of autonomy, social response, adaptability and coordination of integrated, an intelligent entity formed by the hardware or software. Their identity is mainly manifested in the following aspects:

(1) Autonomy: Agent operation is noninterference directly by human or other agent, its implementation is different from ordinary procedures controlled entirely by outside, not as objects, the definition of its internal transfer from the outside, Agent has a certain extent for the state of their internal and the action;

(2) Society: Agent can achieve coordination and interaction with the external environment or other agents through a

certain language (e.g. KQML);

(3) Response: Agent has the ability of perceiving the environment and responding and impacting on the environment in time;

(4) The nature of adaptation: Agent has the character of opening, it enable to adapt the inference activities gradually , and expand, restrict or amend their own state of local knowledge, keep the target at the right time;

(5) Coordination: with the environment or with other Agent: consultations, cooperation and coordination work.

3.The individual Agent Architecture applied to differential protection

According to the features of differential protection, we have built a differential protection Agent with intelligent behavior; it can automatically choose different criteria of differential protection according to the different fault to achieve the greatest sensitivity and reliability. Its structure is as follows:
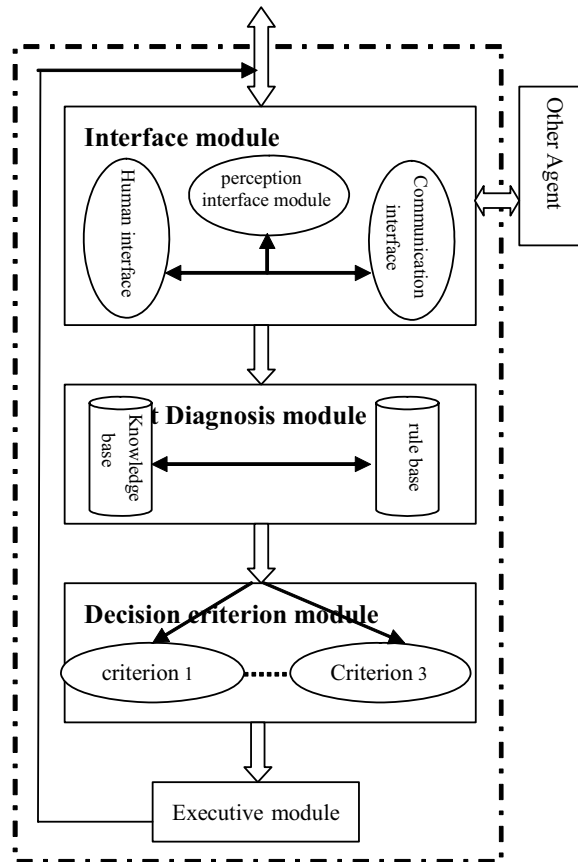
Figure 1. Structure of individual agent

The structure consists of six modules, each module fulfills its task as commitment, here there are some main functions:

(1) Interface Module

Interface Module includes perception interface module, human interface module and communication interface module three parts.

Perception interface module which is the interface between Individual Agent and the surrounding environment, it is used to Percept the changes for the environment around; the man-machine interface module is the interface between Individual Agent and the user interaction, it is used to receive user information or instructions and return to the results of implementation; Communication Interface module is used to exchange the information with other agent, help each other, and accomplish a tasks with cooperate.

(2) Fault diagnosis module

Fault diagnosis module analysis the fault information transmitting by perception interface module for calling the knowledge base and rule base, and find out the cause of the malfunctions, identify faults component and judge fault types. This is very important to select accurate criterion for decision criterion module at the back;

(3) Decision criterion module

There are many criterions in the decision criterion module, as: the whole current action criteria, the fault component criteria based on the instantaneous value and the criterion of normalization. They can select correctly relevant criterion through diagnosing different fault type by Fault diagnosis module, (e. g fault in or out), carry out correct action result, the sensibility and the credibility of protect get valid exertive.

(4) Executive module

Executive module carry out the correspond behavior according to the result performance of the decision criterion module.

The protect model makes use of a forerunner artificial intelligence technique research result, feels fault of transmission line passing by perception interface module on the basis of extensive use for fixed fault position[10] and fault diagnosis[11], delivers the possession information that has been diagnosed by fault diagnosis module to decision criterion module, then selects relevant action criterion by Decision criterion module. While examining a fault to break down and may take place in the area, it chooses the fault component criteria based on the instantaneous value (4) as lord protection, so it can raise the sensitivity of protection in the area; While examining a fault to break down and may take place out the area, it chooses the whole current action criteria (1) as lord protection, it may raise the credibility of the action when tremendous exaltation exterior break down. The criterion of normalization (3) is look on as near protection backup for this line, after it is delayed, if lord protection can act credibility, the protection return, otherwise it breaks down this line after certain time, it can achieve the greatest sensitivity and reliability.

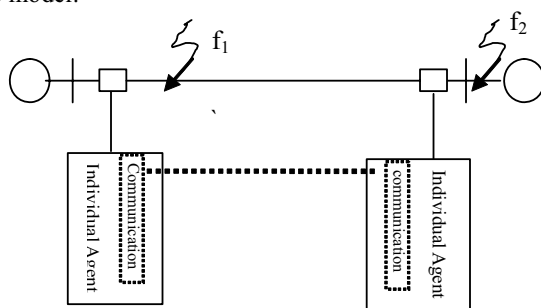## 4. Emulate result

Following fig is a emulate model:

Figure 2. The simulate model in 1000KV power transmission

The paper has calculated to a power system of 1000KV by making use of a ATP emulate procession for electromagnetic transient status. Electric source is expressed with concentrate parameter, line is expressed with LCC, and concrete parameter is as follows:

Power: $E_M=1000\angle0$ kV, $E_N=1000\angle\delta$kV; $Z_{M1}=0.4225+j29.85\Omega$, $Z_{M0}=0.1865+j26.71\Omega$, $Z_{N1}=0.4225+j29.85\Omega$, $Z_{N0}=0.1865+j26.71\Omega$.

LCC model using lines: about 50m high towers, three-phase horizontal arrange in a row, 22m of an average height to earth, 24m of the distance between the two phase, 45.5m of an altitude on average and 34.6m of the distance for two overhead ground wire, protection angle is 24 ° ~ 28 °. voltaic wire are maid of eight separatist wire, each of wire diameter is 35mm and 400mm between them, diameter of the entire split wire is about 1000mm.

In addition, there is compensation in tandem with the capacitor and Shunt Reactors compensation. The compensation will reach 110%. Total installed capacity of compensation 25800MVAr shunt reactor, 13500MVAr series capacitor.

The simulation results show that: when the fault break down inside the sanctuary at f_1 point, the lord protection criterion which is constituted of the instantaneous value and the fault component can rapid cut off breakers at the two ends of lines; When the fault occurred outside the sanctuary at f_2 point, the lord protection criterion which is constituted of whole current action criteria can refuse to cut off the line. Intelligent Protection realized in different regions of the fault, will automatically, and the dynamic select the different criterion, the sensitivity and reliability of the protection have been effectively raised. But the coordination among different segments and protections on Transmission line will be the contents for next step to study.

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'Biological Pump' Overestimated: Study Challenges

How Life in the Oceans Removes Carbon from the Atmosphere

University of Southampton

Science Daily, June 29, 2007

Dr Andrew Yool of the National Oceanography Centre, Southampton, working with colleague Dr Adrian Martin and researchers from the University of Concepcion in Chile and Plymouth Marine Laboratory (Camila Fernandez and Darren Clark) calls into doubt one of the most popular means of assessing the strength of the so-called 'biological pump', which removes carbon dioxide from the air to the deep ocean.

Writing in the science journal Nature this week (Thursday 21 June, 2007) Dr Yool, a research fellow at the University of Southampton's School of Ocean and Earth Science, says: "For more than 20 years scientists have been using a simple formula to calculate how much 'marine snow' – dead plankton and detritus – leaves the upper, sunlit ocean waters and sinks to the deep ocean. When studying climate change, knowing how much carbon reaches deep water this way is important for understanding how much more can be stored in the oceans. Because it is difficult and time-consuming to measure sinking in the open ocean, the strength of the biological pump has routinely been estimated using a simple formula known as the f-ratio."

Dr Yool's team has demonstrated that a key assumption often made in using the formula is incorrect. The formula was first published in Nature in 1979 and has since been used extensively by scientists to extrapolate from small-scale experimental results estimates of what happens in the wider ocean. By making use of both research cruise data from around the world and an ecological model of the ocean's nitrogen cycle, Dr Yool's team was able to look more carefully at this assumption.

Phytoplankton (microscopic plants that have been dubbed the 'grass of the sea') require both nitrogen and carbon to grow. When they die gravity causes them to sink – the biological pump effect. In surface waters nitrogen mostly exists as one of two forms, nitrate or ammonium, traditionally thought to have different sources: 'new' nitrate arriving in surface waters by the upwelling of deep, nutrient-rich water, while 'recycled' ammonium is being produced when plankton die and decompose in surface waters. This means that by quantifying the amount of nitrate taken up by phytoplankton to grow scientists can estimate the sinking flux, since at equilibrium what goes down must come up. The f-ratio, which compares this nitrate-fuelled production to total production (including that fuelled by ammonium) is routinely used by oceanographers for the above reason.

But, according to Dr Yool, making this measurement might be a waste of time. He says: "Upwelling of deep water is not the only source of nitrate. There are two groups of bacteria that, by a process known as nitrification, convert ammonium into nitrate. It's only recently been discovered that they do this throughout the water column, from top to bottom. Previously it was thought to be relatively unimportant in surface waters and was largely ignored."

Since the f-ratio was first devised scientists have been improving their techniques to measure nitrification, and its importance has begun to be reassessed. If near-surface nitrification is significant then the f-ratio cannot be used to estimate the strength of the biological pump.

To examine the importance of nitrification, the group lead by Dr Yool brought together almost all of its oceanic measurements. They then used these to configure a global ocean model which contained a simple representation of the plankton ecosystem, and "ran" this model for 20 years. By using a double-accounting trick this simulation found that throughout much of the world ocean a substantial fraction of the nitrate taken up in primary production is actually generated through recent nitrification near the surface, and not through the re-supply of nitrate from the deep ocean.

At the global scale, they found nitrification to be responsible for around half of the nitrate consumed by growing phytoplankton. For scientists working on research cruises this means that more difficult measurements of sinking 'marine snow' itself may have to replace the simpler f-ratio experiments.

Dr Yool concludes: "These results suggest that it is not possible to quantify accurately the biological pump using only nitrate and the f-ratio. Since many scientists predict that the pump's strength may decrease in the future in response to climate change or ocean acidification, this work highlights the importance of developing more accurate ways to measure it."

R/S Analysis with Computer Algebra

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Abstract

In this paper, Hurst exponent is applied to study Shenzhen Stock component (SSC), which shows that the market is a chaotic system and Hurst exponent is valuable in stock market. The program package presented can be used in calculating R/S .

Keywords: Chaos, Hurst exponent, R/S

1. Introduction

Generally, one of the most commonly used indicators to study the fractal and chaos theory is the Hurst exponent based on the analysis of rescaled range. Hurst discovered that instead of following Brown motion and Gauss distribution, the most of nature phenomena, including river levels, temperatures, rainfalls, and sunspots do follow biased random walk. Hurst extended Einstein's work on Brownian motion that the distance that a random particle covers increases with the square root of time used to measure it:

$$R = T^{0.5} \tag{1}$$

Where R is the distance covered, T a time index. He found that the following was a more general form of equation (1):

$$(R/S)_N = (bN)^H \tag{2}$$

Where R/S is rescaled range, b is a constant, N is time index of a time series $\{x_t\}$ $(t = 1,2,\cdots,N)$, H is called as Hurst exponent. Equivalently, in logarithm, equation (2) becomes

$$\log(R/S) = H(\ln N + \ln b) \tag{3}$$

R/S analysis is a nonparametric method raised by Hurst studying ample empirical analysis. The procedure for calculating R/S is as follow:

Step1: For a given time series $\{x_t\}$ of length M , divide this time period into A contiguous subperiods of length N , such that $AN = M$. Label each subperiod I_a , with $a = 1,2,\cdots,A$. Each element in I_a is labeled $x_{k,a}$ such that $k = 1,2,\cdots,N$. For each I_a of length N , the average value is defined as:

$$e_a = \frac{1}{N}\sum_{k=1}^{N} x_{k,a}$$

Where e_a is average value of the M contained in subperiod I_a of length N .

Step2: The time series of accumulated departures $y_{k,a}$ from the mean value for each subperiod I_a is defined as:

$$y_{k,a} = \sum_{i=1}^{k}(x_{i,a} - e_a) \ (k = 1,2,\cdots,N)$$

Step3: The range is defined as the maximum minus the minimum value of $y_{k,a}$ within each subperiod I_a :

$$R_a = \max_{1 \le k \le N}\{y_{k,a}\} - \min_{1 \le k \le N}\{y_{k,a}\}$$

Step4: The sample standard deviation calculated for each subperiod I_a :

$$S_a = [\frac{1}{N-1}\sum_{k=1}^{N}(x_{k,a} - e_a)^2]^{\frac{1}{2}}$$

Step5: Each range, R_a, is now normalized by dividing by the S_a corresponding to it. Therefore, the rescaled range for each I_a subperiod is equal to R_a/S_a. From step1 above, we get A contiguous subperiods of length N. Therefore, the average R/S value for length N is defined as:

$$(R/S)_N = \frac{1}{A}\sum_{a=1}^{A}(R_a/S_a)$$

We can now apply equation (3) by performing an ordinary least squares regression on $\ln(N)$ as the independent variable and $\ln(R/S)_N$ as the dependent variable. The slope of the equation is the estimate of the Hurst exponent H.

Simple discussions are given as follows: If $0 \le H < 0.5$, the time series is anti-persistent. If $H = 0.5$, the time series is standard Brownian motion. If $0.5 < H \le 1$, the time series is persistent. Let the measure of the length of the cycle V be $V_N = \frac{(R/S)_N}{\sqrt{N}}$.

2. Design ideas

With applied computer algebra system Mathematica, we get some program packages as follows:

Hrra [ndata_,num_]:the average R/S value for each length N.

Hurstzh [ndata_]:the estimate of the Hurst exponent.

Where the variable ndata is the original data, the variable num is the length N for each I_a.

And the module hurstzh [ndata_] contains the module hrra[ndata_,num_].

3. Results

In this study, total 2392 Shenzhen stock components from 1992 to 2000 are used. From figure 2, we can easily observe the sequence data has a strong linear correlation. In order to eliminate the linearly dependence, applying $AR(1)$ regression to the component, we have

$$y_t = x_t - (a + bx_{t-1})$$

Where a and b is the coefficient of the $AR(1)$ regression model.
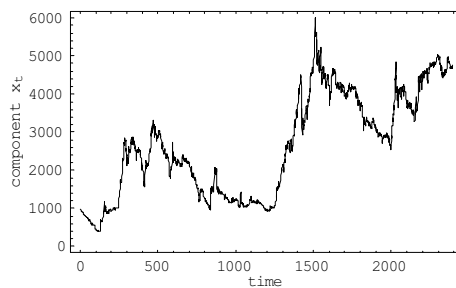

Figure1. Stock component original time series diagram
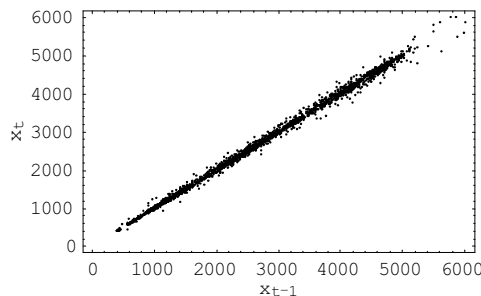

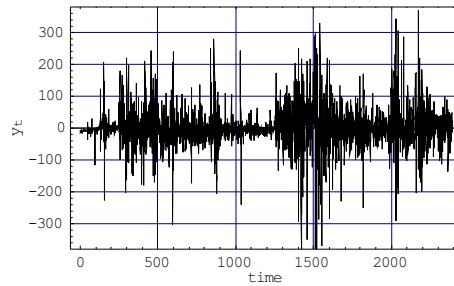Figure 2. $x_{t-1} - x_t$ Phase diagram

Figure 3. The sequence data after adjusting component to eliminate trend

According to the above theory, we get $y_t = x_t - (4.42191 + 0.998925 x_{t-1})$. And $F = 9.41441 > F_{0.05}(1,2377) = 3.84$ shows that there exists the dependency significant between x_t and x_{t-1} (figure 2). However, $DW = 1.93$ shows that the series $\{y_t\}$ is not clear dependency, that is to say, the linearly dependency of stock component series has been removed. Thus, we get ideal results by R/S analysis method.

We obtain the values $(R/S)_N$ and N (table 1) to be carried out fitting. Hence we get the fitted curve: $f(x) = -0.520362 + 0.659262x$, thus, Hurst exponent $H = 0.659262 > 0.5$ indicates that Shenzhen stock market has distinct fractal characteristics.

Table 1. The value $(R/S)_N$ and V_N of Shenzhen stock component series

N	$(R/S)_N$	V_N	N	$(R/S)_N$	V_N	N	$(R/S)_N$	V_N
2	0.707107	0.50000	24	5.12472	1.04608	108	13.1557	1.26591
3	1.10077	0.635527	27	5.5742	1.07285	132	15.7062	1.36705
4	1.42804	0.714022	33	6.09506	1.06101	198	19.5645	1.39039
6	1.95637	0.798834	36	6.55034	1.09172	216	20.7775	1.41373
8	2..43735	0.861734	44	7.40883	1.11692	264	24.9546	1.53585
9	2.65252	0.884173	54	8.43224	1.14748	297	23.3234	1.35336
11	3.0429	0.917468	66	9.78581	1.20455	396	29.0291	1.45877
12	3.22352	0.930551	72	10.4268	1.22881	594	33.6387	1.38021
18	4.28143	1.00914	88	11.9419	1.27301	792	46.8194	1.66365
22	4.81813	1.02723	99	12.3931	1.2355	1188	59.1688	1.71666

As shown in table 1, it is easily observed that the average orbital period of the system is 264 trade days (It can be judged by the Hurst exponent declining for the first time). To a certain extent, the objective of the state continued existence and the long-term memory cycle of Shenzhen stock market (SSMS) can be verified through this result.

4. Conclusion

Hurst exponent $H = 0.659262 > 0.5$ shows the fractal characteristics of SSMS. The calculations of Hurst exponent shows that the average orbital period of SSC is about 264 days(approximately 53 weeks), which shows SSMS has state persistence and long-term memory, and the memory cycle is 53 weeks, which means Hurst exponent is valuable in the investment in stock market. This is broadly consistent with the conclusion of some literature on SSMS. Furthermore, this conclusion confirmed the objective existence of the fractal characteristics of SSMS.

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Design Concept for Future Autos

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Abstract

As the primary transportation tools for modern people, Autos are facing a tremendous transform. With shortcomings which couldn't be overcome, Ancient animal-drawn vehicle had been replaced by motor vehicles. However, motor vehicles still have inextricable malpractices such as lower security, lower speed, dependent for energy sources, lacking of environmental protection, single purpose, lower efficiency, single directional and manual control etc. Future autos will settle these problems out and out. In the design concept, future autos will take multiple comprehensive values such as security, high speed, self-supporting power, environmental, all-purpose, high efficiency, multiple directional and intelligent controls etc., which will bring profoundly influences for human lives in many respects.

Keywords: Future Autos, Environmental Autos, All-purpose Autos

As the primary transportation tools for modern people, Autos are facing a tremendous transform. Auto industry is entering into the most important phase of "optimizing the integrated relationships from people to auto to environment". (Liang, 2006, p.22). Electronic technology of autos is developing for the direction of network and intelligence, in which electronic controlled equipment will offer stable, reliable and low-cost network connections by the CAN bus unit, engine, switches and sensors will be connected through LIN network and the intelligent control will completed. (Kang, 2007, p.60). In the future soon, when the traditional autos become the items on display in museum, people will feel the same feelings to the luxury autos such as Benz and BMW just like moderns feel to the ancient animal-drawn vehicles. With shortcomings which couldn't be overcome, Ancient animal-drawn vehicle had been replaced by motor vehicles. However, motor vehicles still have inextricable malpractices such as lower security, lower speed, dependent for energy sources, lacking of environmental protection, single purpose, lower efficiency, single directional and manual control etc. Future autos will settle these problems out and out. In the future, computer network or artificial intelligence will replace drivers to drive autos, in the process of driving drivers only need input the address of destination to automatic drive system in the car and the car will automatically run, and the vehicle collision avoidance and intelligent control system timely identifies the safe running distance through ultrasonic ranging, radar ranging or laser ranging and automatically avoids barriers in virtue of automatic brake protection system, the computer network connected with satellites continually offers navigational information for car, in the critical fork or on the point of destination, intelligent system will remind drivers to select or resume "manual control" through sound hints, then the car will automatically bear off intelligent driveway and arrive at the destination. With the development of ITS, various intelligent autos will be applied broadly. (Xiao, 2006, p.52). From the strict meanings, future intelligent autos have exceeded head and shoulders above the implemental meanings which are included in the traditional word "auto". In the design concept, future autos will take multiple comprehensive values such as security, high speed, self-supporting power, environmental, all-purpose, high efficiency, multiple directional and intelligent controls etc. This article will introduce these characteristics of future autos in the following text.

The first characteristic is the strong security. The high sensitive detector with collision avoidance will be installed in the car. When some dangerous things appear in the precautionary scope from every directions during driving, the vehicle detector will make rapidly reaction and perform the control orders for avoiding crash, so the bodywork can automatically avoid collision successfully. So, there are no cause troubles in the traffic, unless some most occasional accidents happen. Driving safety factor can be described by no risk at all. The approach which lets car predict forthcoming crash, and then adopts automatically measures to stop crash mainly is in virtue of a sort of technology which is called "V2V' to make effective communications among autos. Increasingly advanced and well-rounded GPS will make you accurately know where your car is in any time. The control system can track your speed and directions, input these information into your vehicle computer, so the computer can automatically control your car. In this aspect, General Autos did better than Volkswagen. They install the equipments of "special short-range communication" in their

New Approach to Fixing Spreadsheet Errors Could Save Billions

Oregon State University

Science Daily, June 28, 2007

Computer scientists at Oregon State University have created a new, much simpler approach to fixing errors in spreadsheets, a system that is easy to use and might help businesses around the world reduce mistakes and save billions of dollars.

The advances - which allow a non-specialist to identify and fix a problem by selecting from a short list of change suggestions -- were announced today at the International Conference on Software Engineering in Minneapolis, Minn. The new system, called "GoalDebug," is being licensed to a spinoff company in Oregon.

Spreadsheets, a standard bookkeeping and accounting tool used by businesses to track everything from payroll to accounts receivable, are one of the most common of all computer software programs. In the U.S. it has been estimated that 11 million people create about 100 million spreadsheets a year, which in turn might be managed by up to 60 million users. But they are notoriously prone to errors, experts say.

"Most users of spreadsheets are overconfident, they believe that the data is correct," said Martin Erwig, an associate professor of computer science in the OSU College of Engineering. "But it has been observed that up to 90 percent of the spreadsheets being used have non-trivial errors in them. In fact, one auditor has said he never inspected a single spreadsheet during his entire career that was completely accurate."

Sometimes the result is a paycheck delayed or a few dollars misplaced. But often the costs or financial misrepresentations are far more serious, and companies have lost millions or billions of dollars, Erwig said, occasionally drawing notice and ridicule in the national press. The overall problem for business and industry is sufficiently large that OSU's work has already drawn the attention of some large financial institutions.

Part of the problem, Erwig said, is that spreadsheet use and development is so common that it is frequently being done by people with very limited training or interest in computer software programming. These "end users" of computer software don't have the background to investigate codes, programs or formulas, they just want the program to work, and often erroneously assume that it does.

"There are dozens of places an error can be made," Erwig said. "A person can click their mouse in the wrong spot, a simple mechanical error. They could use a plus instead of a minus, add a row at the end of a data area instead of in the middle, and get a completely different result. And these errors can be awfully difficult to spot, especially with large spreadsheets that have thousands of cells."

What the new OSU systems do is try to identify the ways that humans commonly make mistakes and then suggest what the correct approach might have been. For instance, if someone sees a figure in a spreadsheet that seems suspicious or is clearly incorrect, they can plug in the correct number, and the OSU system can suggest several programming mistakes that might have created the error - which the user can then sort through and use to identify the problem. A study performed by Robin Abraham, a recent OSU doctoral graduate, has shown that in 80 percent of the cases, the needed change is among the top five suggestions produced by the system, and in 72 percent of the cases it is among the top two suggestions.

"With this approach, people still have ultimate control over the spreadsheet programs," Erwig said. "What we do is give them a prioritized list of where the problem most likely is. They can literally start at the top of the list, see if that's what went wrong, and if not, move down to the second option on the list."

OSU's GoalDebug system, which stands for "Goal Directed Debugging of Spreadsheets," gives end users a chance to explore, apply, refine, or reject suggested changes. This much simpler and systematic approach allows people with comparatively little training in computer programming to identify and repair errors, Erwig said, by looking at a short list of possible problems instead of combing through hundreds or thousands of cells.

Software engineers spend 70-80 percent of their time testing and debugging programs, a recent study concluded - and even for these professionals, finding and fixing errors took an average of 17 hours."Spreadsheet debugging problems are huge," Erwig said. "We believe there will be a significant demand for these products, a large market."

This work, he said, is one part of the EUSES Consortium - End Users Shaping Effective Software - that OSU leads, in collaboration with Cambridge University, Carnegie Mellon University, Drexel University, IBM, Pennsylvania State University, and the University of Nebraska. The consortium, directed by OSU computer science professor Margaret Burnett, in funded in part by the National Science Foundation, and is part of a national effort to help the users of computer software - often non-specialists without extensive formal training - better identify and solve problems.

Application of MIGA to Multi-objective

Optimization in Active Vibration Control

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Abstract

Based on the system reserve energy index as objective optimization function of the structure vibration system, sets up the multi-objective optimal disposition mathematical model which refer to the system control gain and the sensors and actuators placements, quantities, lengths of the active vibration control system, adopts the multi-island genetic algorithm (MIGA) as optimization strategy. Experiments with intelligent cantilever beam as an example, the vibration control effect is very distinct. Hence, approves the method correctness and feasibility.

Keywords: Vibration mode, MIGA, Intelligent structure, Optimal disposition, Multi-objective optimization

At present, the active control is most applicable for the low frequency vibration in the structure vibration system. To an ill control system, signal noise ratio maybe is very small or the vibration mode is unobservable and uncontrollable if the sensors located in nodal line of the controlled mode, and the system maybe could not be controlled if the actuators located in nodal line. The control gain and the sensors and actuators placements, quantities, lengths are effected to the control performance and cost in the active vibration control system. The sensor disposition target is maximizing the signal power of the definite structure excitation, and the actuator disposition target is minimizing the control force to exciting the structure.

Genetic algorithm (GA) is a random search algorithm borrowing ideas from natural selection and genetic mechanism of living nature. GA searches the optimal solution by simulating natural evolution, using code technology to act on the numeric string called chromosome, and simulating the evolution process of the population made up of the stings. As a parallel, random and self-adapting search strategy, GA has the global optimization advantage and very fits for treating the complex nonlinear optimization including the hybrid variable, such as discrete, continuous and integer variable. Multi-island Genetic Algorithm (MIGA), developed based on traditional GA (TGA), is a class of general-purpose search method providing a remarkable balance between exploration and exploitation of the results that is characteristics of GA. The main feature of MIGA that distinguishes it from the TGA is the fact that each population of individuals (i.e. set of probable solutions) is divided into several sub-populations called "islands." All traditional genetic operations, such as selection, crossover and mutation, are performed separately on each island. Some individuals are then selected from each island and are migrated to different islands periodically. The migration operation in MIGA keeps the diversity of probable solutions and hence increases the chance of obtaining the global optimal solution.

1. The sensors and actuators optimal disposition mathematic model

The system response is described based on the system modal, the intelligent cantilever beam vibration differential equation is:

$$\ddot{z}_i(t) + 2\zeta_i\omega_i\dot{z}_i(t) + \omega_i^2 z_i(t) = B_i U \tag{1.1}$$

where $z = [z_1(t) \ z_2(t) \ \cdots \ z_n(t)]^T$ is modal coordinate vector, ζ_i is the order i structure damping ratio, ω_i is the order i

nature frequency.

Given state vector $X(t) = \left[z^{\mathrm{T}}(t), \dot{z}^{\mathrm{T}}(t) \right]^{\mathrm{T}}$, then, in the state space, the equation (1.1) becomes:

$$\dot{X} = A_0 X + BU , \ Y = \Phi X \tag{1.2}$$

where the parameters A_0 is system state matrix, B is system control matrix and Φ is output matrix:

$$A_0 = \begin{bmatrix} 0_{n\times n} & I_{n\times n} \\ -A_{21} & -2A_{22} \end{bmatrix}, \ A_{21} = \begin{bmatrix} \omega_1^2 & & & \\ & \omega_2^2 & & \\ & & \ddots & \\ & & & \omega_n^2 \end{bmatrix}, \ A_{22} = \begin{bmatrix} \zeta_1\omega_1 & & & \\ & \zeta_2\omega_2 & & \\ & & \ddots & \\ & & & \zeta_n\omega_n \end{bmatrix} \tag{1.3}$$

$$B = \begin{bmatrix} 0_{n\times m} \\ \tilde{B} \end{bmatrix}, \ \tilde{B} = \begin{bmatrix} B_{11} & B_{12} & \cdots & B_{1m} \\ B_{21} & B_{22} & \cdots & B_{2m} \\ \vdots & \vdots & \cdots & \vdots \\ B_{n1} & B_{n2} & \cdots & B_{nm} \end{bmatrix}, \ B_{ij} = K_a[\Phi_i'(x_{j2}) - \Phi_i'(x_{j1})] \tag{1.4}$$

$$\Phi = \begin{bmatrix} \tilde{\Phi} & 0_{m\times m} \end{bmatrix}, \ \tilde{\Phi} = [\Phi_{11}(L) \ \cdots \ \Phi_{mm}(L)] \tag{1.5}$$

where the parameters K_a is piezoelectric coupling coefficient, i and n denoting mode orders, j and m denoting piezoelectric piece quantities.

The system reserve energy index is the integral of the sum of the system vibration energy and the weighted control energy:

$$J = \frac{1}{2}\int_0^\infty (W_n + W_m)dt = \frac{1}{2}\int_0^\infty (X^{\mathrm{T}}QX + U^{\mathrm{T}}RU)dt \tag{1.6}$$

where the parameters W_n is the system vibration energy, W_m is the weighted control energy, U is the actuators input voltage, Q is the state weighted positive semi definite matrix, R is the control weighted positive definite matrix, and $Q = \begin{bmatrix} \alpha A_{21} & 0 \\ 0 & \beta I \end{bmatrix}$, $R = \gamma[I]$, and α, β, γ are weighted coefficients. The actuators input voltage

$U = -GCX$, where the parameters G is the control gain, C is the weighted matrix, and $G = \begin{bmatrix} G_1 & & & \\ & G_2 & & \\ & & \ddots & \\ & & & G_m \end{bmatrix}$,

$C = \begin{bmatrix} 0_{m\times n} & \tilde{C} \end{bmatrix}$, $\tilde{C} = \begin{bmatrix} C_{11} & C_{12} & \cdots & C_{1n} \\ C_{21} & C_{22} & \cdots & C_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ C_{m1} & C_{m2} & \cdots & C_{mn} \end{bmatrix}$, $C_{ji} = K_s[\Phi_i'(x_{j2}) - \Phi_i'(x_{j1})]$.

The control system is a linear quadratic performance index system, it satisfied the Riccati matrix differential equation, and it has progressive stability, G is the optimum control gain.

Given the initial condition $X(0)$, then, $X(t) = e^{At}X(0)$, and $A = \begin{bmatrix} 0_{n\times n} & I_{n\times n} \\ -A_{21} & -\tilde{B}G\tilde{C} - 2A_{22} \end{bmatrix}$, so, the system reserve energy index is:

$$J = X^{\mathrm{T}}(0)[\frac{1}{2}\int_0^\infty e^{A^{\mathrm{T}}t}(Q + C^{\mathrm{T}}G^{\mathrm{T}}RGC)e^{At}dt]X(0) \tag{1.7}$$

The active vibration control aim is attenuated the vibration energy as quickly as possible using less control energy. So, the system reserve energy index is objective optimization function of the structure vibration system. Obviously, the objective optimization function depended on the initial condition, which affects the optimal result directly. To avoid the initial state effect, the effective means is taken out the initial condition. Then, the objective optimization function is:

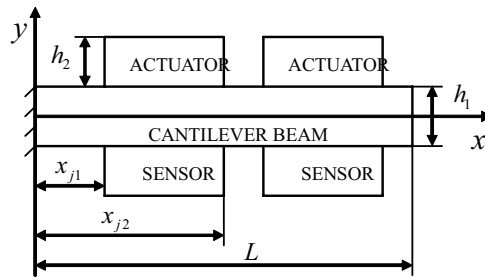$$J = \frac{1}{2} \int_0^\infty tr[e^{A^T t}(Q + C^T G^T RGC)e^{At}]dt \tag{1.8}$$

Figure 1. The beam sketch map

2. The optimal disposition of sensors and actuators in the intelligent cantilever beam

The intelligent cantilever beam sketch map is shown in figure 1. The intelligent cantilever beam and the piezoelectric pieces parameters are given in table 1.

x_{j1} and x_{j2} are the jth pair of sensor and actuator coordinate value of start point and end point. K_a is the piezoelectric coupling coefficient, K_s is the electromechanical coupling coefficient, and $K_a = \frac{1}{2} b_2 d_{31} E_2 (h_1 + h_2)$, $K_s = \frac{b_2 h_1 d_{31} E_2}{2C_p}$, where, C_p is the piezoelectric pieces capacitance, and $C_p = \frac{lb_2 e_2}{h_2}$, e_2 is the piezoelectric pieces capacitance inductivity, and $e_2 = 7.3 \times 10^{-12}$.

Table 1. The intelligent cantilever beam and the piezoelectric pieces parameters

Parameter/unit	The intelligent cantilever beam		The piezoelectric piece	
Length/m	L	0.475	l	xj2-xj1
Width/m	b1	3.5e-2	b2	3.5e-2
Thickness/m	h1	1.5e-3	h2	1 e-3
Density/(kg*m-3)	d1	2.7e3	d2	7.6e3
Young's Modulus/Pa	E1	7.47e10	E2	6.0e10
Piezoelectric Constant/C*N-1			d31	1.86e-10

2.1 The nature frequency calculation of the intelligent cantilever beam

The intelligent cantilever beam system vibration equation is:

$$\Phi(x) = Y_1 \sin \lambda x + Y_2 \cos \lambda x + Y_3 \sinh \lambda x + Y_4 \cosh \lambda x \tag{2.1}$$

The intelligent cantilever beam boundary conditions of the fixed end and the free end are $\Phi(0) = 0$, $\Phi'(0) = 0$ and $\Phi''(L) = 0$, $\Phi'''(L) = 0$. Put the boundary conditions into equation (2.1), then:

$$\begin{cases} Y_2 + Y_4 = 0 \\ Y_1 + Y_3 = 0 \\ -Y_1 \sin \lambda L - Y_2 \cos \lambda L + Y_3 \sinh \lambda L + Y_4 \cosh \lambda L = 0 \\ -Y_1 \cos \lambda L + Y_2 \sin \lambda L + Y_3 \cosh \lambda L + Y_4 \sinh \lambda L = 0 \end{cases} \tag{2.2}$$

In equation (2.2), the former two equations are put into the latter two equations, expressed in matrix:

$$\begin{bmatrix} \sin \lambda L + \sinh \lambda L & \cos \lambda L + \cosh \lambda L \\ -(\cos \lambda L + \cosh \lambda L) & \sin \lambda L - \sinh \lambda L \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix} \tag{2.3}$$

Given the determinant of coefficient equate zero in order to the coefficient Y_1 and Y_2 don't all equate zero. Then, $2 + 2\cos \lambda L \cosh \lambda L = 0$. The transcendental equation solution is:

$$\lambda_1 L = 1.8751 , \lambda_2 L = 4.6941 , \lambda_3 L = 7.8548 , \lambda_n L = (n - 0.5)\pi , (n \geq 4) \qquad (2.4)$$

The intelligent cantilever beam system nature frequency:

$$\omega_i = \lambda_i^2 \sqrt{\frac{E_1 I_1}{m_1}} \qquad (2.5)$$

where, m_1 is the intelligent cantilever beam unit weight, I_1 is the intelligent cantilever beam moment of inertia of cross-section to axis y, and $m_1 = d_1 b_1 h_1$, $I_1 = \dfrac{b_1 h_1^3}{12}$.

From equation (2.2) and equation (2.3), we obtain the expression with Y_1:

$$Y_2 = -\frac{\sin \lambda L + \sinh \lambda L}{\cos \lambda L + \cosh \lambda L} Y_1 , Y_3 = -Y_1 , Y_4 = \frac{\sin \lambda L + \sinh \lambda L}{\cos \lambda L + \cosh \lambda L} Y_1$$

Assumed value $Y_1 = 1$, then:

To the first order vibration mode, $\lambda_1 L = 1.8751$, $Y_2 = -1.3622$, $Y_3 = -1$, $Y_4 = 1.3622$;

To the second order vibration mode, $\lambda_2 L = 4.6941$, $Y_2 = -0.9819$, $Y_3 = -1$, $Y_4 = 0.9819$;

To the third order vibration mode, $\lambda_3 L = 7.8548$, $Y_2 = -1.0008$, $Y_3 = -1$, $Y_4 = 1.0008$.

2.2 The vibration node position calculation of the intelligent cantilever beam

According to the intelligent cantilever beam system vibration differential equation, the vibration equation corresponding to the order i nature frequency is:

$$y_i(x,t) = [E_i(\cosh \lambda_i x - \cos \lambda_i x) + F_i(\sinh \lambda_i x - \sin \lambda_i x)]\cos(\omega_i t - \varphi_i) \qquad (2.6)$$

where,

$$F_i = E_i \left(\frac{\sin \lambda_i L - \sinh \lambda_i L}{\cos \lambda_i L + \cosh \lambda_i L} \right) \qquad (2.7)$$

The transverse vibration total displacement is superimposed of all the vibration, then

$$y(x,t) = \sum_{i=1}^{\infty} E_i Y_i(x) \cos(\omega_i t - \varphi_i) \qquad (2.8)$$

where,

$$Y_i(x) = \left(\cosh \lambda_i x - \cos \lambda_i x\right) + \left(\frac{\sin \lambda_i L - \sinh \lambda_i L}{\cos \lambda_i L + \cosh \lambda_i L} \right)\left(\sinh \lambda_i x - \sin \lambda_i x\right) \qquad (2.9)$$

The node position of the order i mode can be calculate according to equation (2.9), if $Y_i(x) = 0$, then

$$\left(\cosh \lambda_i x - \cos \lambda_i x\right)\left(\cos \lambda_i L + \cosh \lambda_i L\right)$$
$$+ \left(\sin \lambda_i L - \sinh \lambda_i L\right)\left(\sinh \lambda_i x - \sin \lambda_i x\right) = 0 \qquad (2.10)$$

The transcendental equation solution is:

To the first order vibration mode, $x_1 = 0$;

To the second order vibration mode, $x_1 = 0$, $x_2 = 0.7739L$;

To the third order vibration mode, $x_1 = 0$, $x_2 = 0.5001L$, $x_3 = 0.8672L$.

The calculation results are coincident with the MATLAB simulation results in figure 2.
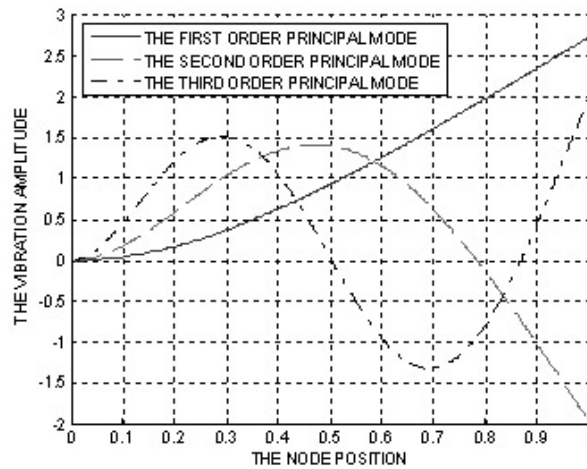
Figure 2. The cantilever beam principal mode

2.3 The maximum amplitude calculation of the intelligent cantilever beam

According to solid mechanics, the amplitude differential equation is:

$$\frac{d^2y}{dx^2} = \frac{M(x)}{EI_z} \tag{2.11}$$

The intelligent cantilever beam system displacement boundary condition is:

$$\begin{cases} \theta = 0, x = 0 \\ y = 0, x = 0 \end{cases} \tag{2.12}$$

Then, the maximum amplitude of the intelligent cantilever beam is:

$$y = -\frac{FL^3}{3E_1I_1} \tag{2.13}$$

where the parameter F is exciting force.

2.4 The optimal disposition mathematic model and constraint conditions

The optimal disposition mathematic model is:

$$\min J = \frac{1}{2} \int_0^\infty tr[e^{A^T t}(Q + C^T G^T RGC)e^{At}]dt$$

where, $\alpha = \beta = 1 \times 10^6$, $\gamma = 1$, $\zeta_i = 1 \times 10^{-2}$

The constraint conditions are:

$$\begin{cases} x_{j1} - x_{j2} < 0 & j = 1, 2, \cdots m \\ x_{j2} - x_{(j+1)1} < 0 & j = 1, 2, \cdots m-1 \\ G_j > 0 & j = 1, 2, \cdots m \\ x_{11} \geq 0, x_{m2} \leq L \end{cases} \tag{2.14}$$

3. The simulation calculation

3.1 Optimization strategy

The optimization strategy is multi-island genetic algorithm (MIGA), the parameters selected followed as: the initial population is [x11, x12, x21, x22, G], the initial scope is [0.0125, 0.2364, 0.3041, 0.4083, 0.001], and the initial range is [(0, 0.475), (0, 0.475), (0, 0.475), (0, 0.475), (0, 0.01)]; J>0; the number of sub population is 5; the sub population size is 15; the roulette wheel selection probability is 0.8; the crossover form is intermediate, and the crossover probability is 0.8; the mutation function is Gaussian, and the mutation probability is 0.01, and the migration probability is 0.2. The simulation calculation controls the former two orders vibration mode.

3.2 Analysis of the simulation result

According to the parameters, the optimal results are shown in table 2, and the relational curve of object function value

x11	REAL	0.0743599054984189
x12	REAL	0.429058973981081
x21	REAL	0.0001656285411831
x22	REAL	0.0003864043097445
G	REAL	4.50291833945152e-6
J	REAL	0.039199e14

In MIGA, every design point has a fitness value, and fitness value based on the object function value and the constraint penalty function value. The migration probability keeps the diversity of global search and hence evolves much enough generations. After local convergence, such as the generation 230 and the generation 640, there is a phase step, and the local convergence direction is accordant to the global convergence, which avoids the precocity.
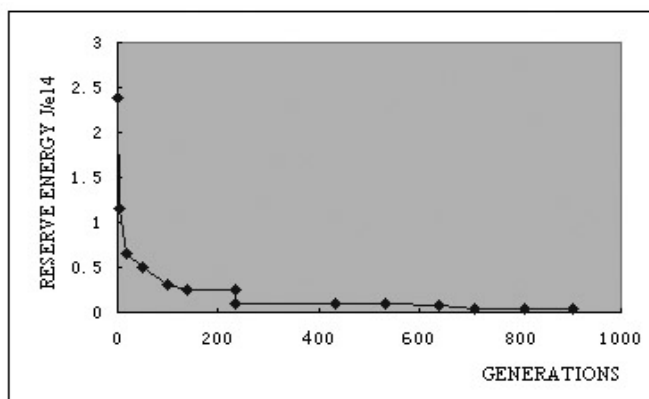
According to the intelligent cantilever beam active vibration control system optimal solution procedure and simulation experiment, obtained the optimal result, which includes the system control gain and the sensors and actuators placements, quantities, lengths. In conclusion, the optimal disposition mathematic model and the optimization strategy are correct and feasible, and the control affect in evidence in active vibration control.

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Radio Frequency Ablation Vaporizes

Inoperable Kidney and Liver Tumors

Cedars-Sinai Medical Center

Science Daily, June 29, 2007

Hollywood talent manager Louis Bershad, 68, whose clients include many top actors in town, recently underwent a routine MRI for kidney stones only to learn from his urologist that he also had a tumor in his left kidney. The tumor turned out to be malignant.

Facing a new diagnosis of kidney cancer, Bershad recalls, "The room seemed to go black, then I could only envision a long treatment journey that would likely require open surgery, and intensive chemotherapy, both of which can have complications and result in a lot of missed time from work."

Bershad's physician discussed treatment options with him, and based on several factors, including his general health, the extent and location of his tumor, and the stage of the cancer, he recommended a new, non-surgical procedure called radio-frequency ablation (RFA). "I considered my options carefully – and the choice was clear, says Bershad, I didn't want to go through an operation or the loss of my kidney."

When Bershad met Peter J. Julien M.D., chief of Thoracic Imaging and director of the Radio-frequency Ablation Program at Cedars-Sinai Medical Center's S. Mark Taper Foundation Imaging Center, the cloud lifted. Julien, an interventional radiologist, is one of the pioneers of RFA. The procedure requires only local anesthesia and avoids the scars and complications associated with traditional open surgery. Because RFA involves no cutting, it is also a viable option for individuals previously thought to be too old or sick to withstand surgery.

During RFA, an interventional radiologist carefully guides an ablation needle into the center of the tumor using imaging techniques such as ultrasound or CT scan. The probe is connected to a radio-frequency generator that delivers alternating electrical current (radio-frequency energy) to the tumor producing heat up to 140 degrees Fahrenheit. This causes cancerous cells to shrink and die, but healthy tissue is spared because the probe cools as it is removed. "My doctor asked me to come back for an MRI in three months, so that he could make sure the tumors were gone," Bershad explained.

Bershad was diagnosed with stage II renal cell carcinoma. In adults, the most common type of kidney cancer is renal cell carcinoma (renal adenocarcinoma), which begins in the cells that line the small tubes within the kidney. According to the Kidney Cancer Association, renal cell carcinoma affects more than 32,000 people per year, and the exact cause of the disease is unknown. It is most common in people between 50 and 70 years old, affecting men more often than women.

Typically, surgical removal of kidney tumors (nephrectomy), which has been the standard of care for kidney cancers, results in hospital admissions of 7 to 10 days and postoperative recovery time of 6 to 8 weeks. By comparison, RFA is not only minimally invasive with a short recovery time, but it also allows for the kidney to be preserved. RFA also avoids postoperative complications such as pain, pneumonia, injury to the organs and scars.

Although the procedure is new and more data are needed, it appears to result in survival rates that are comparable to those of radical or partial nephrectomies. Beyond that, it may well offer hope for patients with liver cancer.

"RFA has emerged as an alternative treatment for inoperable liver cancer, and has been shown to vaporize tumors as well as slow cancer progression in larger tumors," said Julien who explains that preliminary results in patients with liver lung and kidney cancer are promising. "It is possible that this procedure may someday completely replace surgery for kidney cancers in many patients,".

Bershad, who underwent the procedure at Cedars-Sinai Medical Center six months ago, said that he returned to work and resumed his daily activities only one day after the procedure. Today, he remains cancer free.

Looking back, he expresses relief that the cancer was in an accessible place and caught in time. He says, with a sparkle in his eye, "I feel very lucky. My lifestyle remains untouched: I'm active and I work, swim and play with my Dobermans as if it never happened. If you have a cold, you lose more time than this."

"Thanks to Dr. Julien, the RFA procedure worked out brilliantly, Bershad concludes, "I want people to know that this

Application of Vandermonde

Determinant in Combination Mathematics

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Abstract

Given an application of Vandermonde determinant in Combination mathematics, that is, proved several important combinatorial identities by using Vander monde determinant.

Keywords: Vandermonde determinant, Application, Combinatorial identities

1. Introduction

There are many methods about the proof of the combinatorial identities , such as direct checking computations , making use of exponential and generating function , permanent , number theory , differential and integration . In this paper, we proved several important combinatorial identities with Vandermonde determinant by using algebraic method, which is simple and clear than any other methods.

2. Lemmas

Lemma 1 Assume D_n be a Vandermonde determinant with order n composed by $1,2,\cdots,n$. M_j be confactor of D_n deleting row n and column j .

Then

$$M_j = \prod_{m=1}^{n-2} m! C_{n-1}^{n-j}, \qquad j = 1,2,\cdots,n \tag{1}$$

Proof when $j = 1$; equality (1) is right.

When $1 < j < n$;

$$M_j = \frac{\prod_{m=2}^{n}(m-1)}{j-1} \cdot \frac{\prod_{m=3}^{n}(m-2)}{j-2} \cdot \cdots \cdot \frac{\prod_{m=j}^{n}(m-j+1)}{j-(j-1)} \cdot \prod_{m=j+2}^{n}(m-j-1)\cdots[n-(n-1)]$$

$$= \frac{(n-1)!(n-2)!\cdots(n-j+1)!(n-j-1)!\cdots 2!1!}{(j-1)!}$$

$$= \prod_{m=1}^{n-2} m! \frac{(n-1)!}{(j-1)!(n-1)!}$$

$$= \prod_{m=1}^{n-2} m! C_{n-1}^{n-j}.$$

Equality (1) is right.

When $j = n$; it is easy to see that equality (1) is right .

Hence: equality (1) is right .

Lemma 2 Assume D_n be a Vandermond determinant with order n composed by $1,2,\cdots,n$. S_j be cofactor of D_n deleting row 1 and column j .

Then

$$S_j = \prod_{m=1}^{n-1} m! C_n^j, j = 1,2,\cdots n. \tag{2}$$

Proof
$$S_j = \frac{n!}{j}M_j = \frac{n!}{j}\prod_{m=1}^{n-2}m!C_{n-1}^{n-j} = \prod_{m=1}^{n-1}m!C_n^j.$$

3. Theorems

Theorem 1:
$$\sum_{j=1}^{n}(-1)^{n+j}j^{n-1}C_n^j = n!. \qquad (3)$$

Proof assume that

$$D_n = \begin{vmatrix} 1 & 1 & \cdots & 1 \\ 1 & 2 & \cdots & n \\ 1 & 2^2 & \cdots & n^2 \\ \cdots & \cdots & \cdots & \cdots \\ 1 & 2^{n-1} & \cdots & n^{n-1} \end{vmatrix} = \prod_{m=1}^{n-1}m!, \qquad (4)$$

expand D_n along row n , from Lemma 1 we can derive :

$$D_n = (-1)^{n+1}\prod_{m=1}^{n-2}m!C_{n-1}^{n-1} + (-1)^{n+2}2^{n-1}\prod_{m=1}^{n-2}m!C_{n-1}^{n-2} + \cdots$$

$$+ (-1)^{n+j}j^{n-1}\prod_{m=1}^{n-2}m!C_{n-1}^{n-j} + \cdots + (-1)^{2n-1}n^{n-1}\prod_{m=1}^{n-2}m!C_{n-1}^0$$

$$= \sum_{j=1}^{n}(-1)^{n+j}j^{n-1}\prod_{m=1}^{n-2}m!C_{n-1}^{n-j}$$

$$= \prod_{m=1}^{n-1}m! \quad \text{(from equality (4))},$$

Thus

$$\sum_{j=1}^{n}(-1)^{n+j}j^{n-1}C_n^j = n!.$$

Theorem 2:
$$\sum_{j=1}^{n}(-1)^{j+1}C_n^j = 1. \qquad (5)$$

Proof Assume D_n be a Vandermond determinant with order n composed by $1,2,\cdots,n$ .expand D_n along row 1 , from Lemma 1 we can derive :

$$D_n = S_1 + (-1)^{1+2}S_2 + \cdots + (-1)^{1+j}S_j + \cdots + (-1)^{1+n}S_n$$

$$= \prod_{m=1}^{n-1}m!C_n^1 + (-1)^{1+2}\prod_{m=1}^{n-1}m!C_n^2 + \cdots + (-1)^{1+j}\prod_{m=1}^{n-1}m!C_n^j + \cdots + (-1)^{1+n}\prod_{m=1}^{n-1}m!C_n^n$$

$$= \sum_{j=1}^{n}(-1)^{1+j}\prod_{m=1}^{n-1}m!C_n^j = \prod_{m=1}^{n-1}m! \quad \text{(from equality (4))},$$

Therefore

$$\sum_{j=1}^{n}(-1)^{j+1}C_n^j = 1.$$

Theorem 3:
$$\sum_{j=0}^{n-1}(-1)^jC_n^j(n-j)^i = 0, \qquad (1 \le i \le n). \qquad (6)$$

Proof Assume D_n be a Vandermond determinant with order n composed by $1,2,\cdots,n$ .The sum of the product of both the element of row 1 of D_n and the algebra cofactor of the corresponding element of row n of D_n is zero, from Lemma 1 we can derive:

$$0 = \sum_{k=1}^{n}(-1)^{n+k}M_kK^{i-1} = \sum_{k=1}^{n}(-1)^{n+k}\prod_{m=1}^{n-2}m!C_{n-1}^{n-k}K^{i-1}.$$

Let $j = n - k,$ from equality (2) we can derive:

$$0 = \sum_{j=1}^{n-1} (-1)^{2n-j} \sum_{m=1}^{n-2} m! C_{n-1}^{j} (n-j)^{i-1},$$

Thus

$$0 = \sum_{j=0}^{n-1} (-1)^{j} C_{n-1}^{j} (n-j)^{i-1}. \tag{7}$$

Since

$$C_{n-1}^{j} = \frac{(n-1)!}{j!(n-1-j)!} = \frac{n!}{j!(n-j)!} \cdot \frac{n-j}{n} = \frac{n-j}{n} C_{n}^{j}, \tag{8}$$

Substitute (8) into (7) we can derive:

$$\sum_{j=0}^{n-1} (-1)^{j} C_{n}^{j} (n-j)^{i} = 0, \quad (1 \le i \le n).$$

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Interface between the Embedded Processor

Nios Ⅱ and the TDC Module and its Application

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Abstract

This paper introduces a design method for SOPC (System on Programmable Chip) based on embedded Nios II soft-core processor. The interface between the soft-core processor Nios II and the TDC module is given, and the initial programming technique and Nios II application programme is explained at the same time.

Keywords: Nios II, FPGA, SOPC, TDC

Introduction

High-resolution time interval measurement has been widely applied in the aerospace, communications, digital television broadband radar, logic analyzer, Digital Storage Oscilloscope modern testing equipment etc. With public transportation, technology, defense of the rapid development and awareness of precision measuring instruments growing, the demanding of ultra short optical pulses between narrow time interval and pulses high-precision measurement have become a remarkable research projects .TDC exclusive use of time-to-digital converter chip with Nios II soft-core processor time interval is a measurement system to achieve high precision measurement of the effective methods. The advantage is: High accuracy, debugging simple, low power consumption, real-time data processing, human-machine interface humanity, remote operation and owning embedded operating system. This work focuses on the following embedded Nios II soft-core processor and TDC–GP1 time-to-digital converter chip interface circuit and programming technology.

1. NIOSII Soft-Core Processor

A Nios II processor system is equivalent to a microcontroller or "computer on a chip" that includes a processor and a combination of peripherals and memory on a single chip. The term "Nios II processor system" refers to a Nios II processor core, a set of on-chip peripherals, onchip memory, and interfaces to off-chip memory, all implemented on a single Altera device. (Altera, 2005)Like a microcontroller family, all Nios II processor systems use a consistent instruction set and programming model.

1.1Nios II Processor System Basics

The Nios II processor is a general-purpose RISC processor core providing:

Full 32-bit instruction set, data path, and address space

32 general-purpose registers

32 external interrupt sources

Single-instruction 32×32 multiply and divide producing a 32-bit result

Dedicated instructions for computing 64-bit and 128-bit products of multiplication

Floating-point instructions for single-precision floating-point operations

Single-instruction barrel shifter

Access to a variety of on-chip peripherals, and interfaces to off-chip memories and peripherals

Hardware-assisted debug module enabling processor start, stop, step and trace under integrated development environment (IDE)control

Software development environment based on the GNU C/C++ tool chain and Eclipse IDE

Integration with Altera®'s Signal Tap® II logic analyzer, enabling realtime analysis of instructions and data along with other signals in the FPGA design

Instruction set architecture (ISA) compatible across all Nios II processor systems

Performance up to 250 DMIPS

Altera's SOPC Builder design tool fully automates the process of configuring processor features and generating a hardware design that you program into an FPGA. The SOPC Builder graphical user interface (GUI) enables you to configure Nios II processor systems with any number of peripherals and memory interfaces. You can create entire processor systems without performing any schematic or hardware description-language (HDL) design entry. SOPC Builder can also import HDL design files, providing an easy mechanism to integrate custom logic into a Nios II processor system. After system generation, you can download the design onto a board, and debug software executing on the board. To the software developer, the processor architecture of the design is set. Software development proceeds in the same manner as for traditional, on-configurable processors.

2 NiosII and TDC–GP1 Module Interface

2.1 TDC-GP1 chip brief Introduction

TDC - GP1 chip is a dual-channel Universal time-to-digital converter chip, with the largest range of 200ms and accuracy of 125 ps. Chip supports two working range and kinds of work patterns and it has flexible work practices. TDC-GP1 use 44 pin TQFP package with TDC measurement unit, 16-ALU, RLC measurement unit and eight processor interface modules. The pin names and functions are listed in Table 1(Acam, 2001)

Table 1. TDC-GP1 pin description

Symbol	Pin	I/O	Description	Symbol	Pin	I/O	Description
RST_N	1	I	Reset(low active)	VCC_CORE	5,28,44		Core supply voltage
TEST	2	I	Test pin, must be connected to GND	GND_CORE	6,27,43		Core Ground
CLK_REF	3	I	Input external reference clock	VCC_IO	17,35,39		Supply voltage IO ports
CHARGE	4	O	Charge pin for RLC measurements	GND_IO	12		Ground of IO Ports
SENSE	7	I	Schmitt trigger input RLC-measurements	GND_IO	18,40		Ground IO ports
RLC_P4	8	O	Port 4 for RLC-measurement	DATA0-DATA3	13-16	I/O	Data bus
RLC_P3	9	O	Port 3 for RLC-measurement	DATA4-DATA7	19-22	I/O	Data bus
RLC_P2	10	O	Port2 for RLC-measurement	ADR0-ADR4	23-26	I	Address bus
RLC_P1	11	O	Port 1 for RLC-measurement	INTFLAG	34	O	Interrupt flag (high active)
ALE	29	I	Address latch enable	START	36	I	Start input
RDN	30	I	Read (low active)	EN_STOP2	37	I	enable stop input 2

WEN	31	I	WRN Write (low active)	STOP2	38	I	Stop input 2
CSN	32	I	Chip select (low active)	STOP1	41	I	Stop 1 input
PHASE	33	O	Phase Phase out for regulation	EN_STOP1	42	I	enable stop input 1

Features:

2 measuring channels with a resolution of 250ps

4-fold multi-hit capability per channel, double pulse resolution 15ns, retriggerable

2 measurement ranges ---a: 2 ns -7.6 μs --- b: 60 ns-200 ms

The 8 events of the two channels can arbitrarily be measured against one another. Negative times can also be measured.

The resolution can be adjusted accurately via software in the 'resolution adjust' mode.

Ports to measure capacities, coils or resistors

Variable edge sensitivity of the measuring inputs

Internal ALU for the calibration of the measurement result. A 24-Bit multiplication unit enables the results to be scaled.

Wide range for the reference clock: 500 KHz - 35 MHz

Surface mount TQFP44 package.

Extremely low power consumption, fully battery operation possible

8-bit processor-interface

TDC-GPl provides with the external processor interface, including eight data buses, 4 bit can operate 16 Registers address line, read, write, film elections, and so on. Another, to simplify the interface design, also provided the address latches line (ALE). The internal chip has 7 only write registers, 4 can write value control registers, 8 only read results registers. External processor control to write control registers and value registers through the address line, writing, film elections, latches, etc. By controlling different addresses on the value of the control register, the chip can initialize, choose different working conditions and adjust the edge signal sensitivity. After measuring, the chip interruption activate the external processor to start reading the results register, the results are worth reading to further optimize the processor computation, storage and output display. Application of the range1 Register is set to: Reg0:0x44; Regl: 0x4D; Reg2:0x01; Reg3:0xXX: Reg4: 0xXX; Reg5:0xXX; Reg6:0x02; Reg7:0x01; Reg8:0x00; Reg9:0x00; Regl0:0x80.

2.2 NiosII and TDC-GPl interface circuit

Embedded Processor NiosII put TDC -GPl module interface equipment as PIO for the general operation. Therefore TDC data module |, address, the election unit, literacy signals are included in the PIO Bus. Its interface circuit shown in figure 1,which TDC_DB [7 .. 0] of the eight data lines, control will be responsible for order entry to the control registers and results data from the results registers were read out; TDC_AD [3 .. 0] to address data line; TDC_ALE to address latches; TDC_CEN signal for the election unit; TDC_WRN to enable writing; TDC_RDN to enable reading; INTFLAG signs of disruption; START signal to begin; STOP 1 received no signal delay; STOP 2 received signal delay.
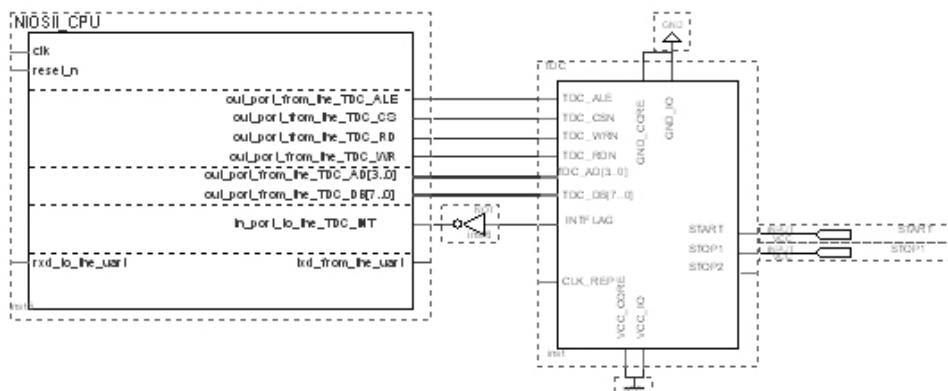

Figure 1. Interface between the Embedded Processor Nios II and theTDC Module

3. NiosII and TDC interface chip

Nios II processor uses modular structure software, including;(1)TDC-GPl initialization,(2) setting TDC-GPl chip channel,(3) working mode setting, (4)measurement the results,(5)measurement data display,(6)measurement data storage. For example, TDC - GPl can work in precision adjustable model. After the measurement, the results will be shown as the following a series of manipulations:(1) TDC chip be set in the state of writing through the assignment Control Register 7 shielding all of the input signal STOP.(2) Write control register 11, initialize the TDC and ALU.(3) Pointer at the control register 0, the chip work in a range 1, self-calibration mode characterized by a number of functions. Then write control register 1, the chips achieve precision adjustable, adjustable work on the accuracy of mode l.(4) Write control register 2.The result is that, The first pulse of channel two rise time and the access an article a pulse rise time for the poor.(5) Write control register 7, the abolition of the two channels on the STOP input signal shielding. Read measurements, circuit is SCM inquiries TDC - GPl chip interrupted output pins, chip interrupted when issued, that is, enter the break in service procedures in the home TDC chip in the reading of the state, NiosII processor visits the results register and read the results. (Liu, 2004).Then niosII processor computate and show the results, the following is the main part of the NiosII interface procedures.

3.1 Initialization TDC–GPl

As Embedded Processor NioslI put TDC–GPl module interface as ordinary operate equipment PIO; blocks all the data through IOWR_ALTERA_AVALON_PIO_DIRECTIO N (PIO base address, data) order to register for the PIO write, IORD_ALTERA_AVALON_PIO_DATA (PIO base address) orders reading operation. Below is the initialization procedures:

Void Initial_TDC( )   // Initialization

        {IOWR_ALTERA_AVALON_PIO_DATA (TDC_ALE_BASE, 1); // ALE write for 1

IOWR_ALTERA_AVALON_PIO_DATA (TDC_CS_BASE, 0);   // Chip selected TDC

IOWR_ALTERA_AVALON_PIO_DATA (TDC_WR_BASE, 0); //Write effective signal

IOWR_ALTERA_AVALON_PIO_DATA (TDC_AD_BASE, 0x7); //Write control register 7

IOWR_ALTERA_AVALON_PIO_DATA (TDC_DB_BASE, 0x00); //Shield all stop importation

IOWR_ALTERA_AVALON_PIO_DATA (TDC_AD_BASE, 0xb); // Write register 11

IOWR_ALTERA_AVALON_PIO_DATA (TDC_DB_BASE, 0x07); // Initialization of TDC and ALU

IOWR_ALTERA_AVALON_PIO_DATA (TDC_AD_BASE, 0x0); // Write register 0

IOWR_ALTERA_AVALON_PIO_DATA (TDC_DB_BASE, 0x44); // Choice range 1 to work

                                    // Both Automatic Calibration

                              Mode and Multiply fuction

IOWR_ALTERA_AVALON_PIO_DATA (TDC_AD_BASE, 0x3)   // Write register 3

IOWR_ALTERA_AVALON_PIO_DATA(TDC_DB_BASE,0x64)   // DIV_CLK_PLL=100

IOWR_ALTERA_AVALON_PIO_DATA (TDC_AD_BASE, 0x4)   // Write register 4

IOWR_ALTERA_AVALON_PIO_DATA(TDC_DB_BASE,0x16)

                              // SEL_CLK_PLL =64NEG_PH_PLL

                                    // => Res = 50ns*64/120/100 = 1/3.75 ns

        Float resolution = 1.0/3.75;

IOWR_ALTERA_AVALON_PIO_DATA (TDC_AD_BASE, 0x1); // Write register 1

IOWR_ALTERA_AVALON_PIO_DATA (TDC_DB_BASE, 0xCD); // Work in the precision adjustable mode

IOWR_ALTERA_AVALON_PIO_DATA (TDC_AD_BASE, 0x2); // Write register 2

IOWR_ALTERA_AVALON_PIO_DATA (TDC_DB_BASE, 0x19); //

                              Channel 2 first rising edge – Channel 1 first rising
edge   }
//Initialization finished

3.2 Measurement showed unit

    Void measure_TDC ()

      {Int valid = 0;

```
    Float nk0, nk1;
IOWR_ALTERA_AVALON_PIO_DATA (TDC_AD_BASE, 0x2);      // Write register 7
IOWR_ALTERA_AVALON_PIO_DATA (TDC_DB_BASE, 0x09); // open Stop1 and Stop2
IOWR_ALTERA_AVALON_PIO_DATA (TDC_AD_BASE, 0xb); // Write register 11
IOWR_ALTERA_AVALON_PIO_DATA (TDC_DB_BASE, 0x07); // Initialization of TDC and ALU
                                                  // Start measuring signal
      While (valid==0)
         {
Valid=IORD_ALTERA_AVALON_PIO_DATA (TDC_INT_BASE); //Inquiries interrupted signs spaces
            }
         IOWR_ALTERA_AVALON_PIO_DATA (TDC_WR_BASE, 1);      // Write enable
         IOWR_ALTERA_AVALON_PIO_DATA (TDC_WR_BASE, 1);      // Read enable
IOWR_ALTERA_AVALON_PIO_DATA (TDC_AD_BASE, 0x00); // Read addresses enable 0
         nk0= IORD_ALTERA_AVALON_PIO_DATA (TDC_AD_BASE, 0x00); // Read low results
nk1= IORD_ALTERA_AVALON_PIO_DATA (TDC_AD_BASE, 0x00);// Read high results
         nk1 = nk1 * 256;                            // Backspace
         nk1 = nk1 | nk0;                            //Merger
result = resolution * (float)(nk1);               // Calculate the final results
printf("result = %6.3fns\n",result);        // Standard output results displayed on the LCD
                           }
```

3.3 Data Storage Processing Unit

```
      Void Save_result( float result )
        {
           alt_flash_fd* fd;
           int ret_code;
           Float TDC_SAVE [100];
TDC_SAVE[k] =result;                          // K is the storage location counter
fd = alt_flash_open_dev("/dev/ext_flash");        // Open FLASH memory

        If (fd)
              { printf("open flash device successfully\n");
// LCD Display as standard output

              ret_code = alt_write_flash(fd, k*32,TDC_SAVE, 32);
             // storage data to the FLASH device
              If (!ret_code)
{ printf("save result on %d\n",k\n");}          // Show storage location
              alt_flash_close_dev (fd);
              printf("save result successfully\n");
              // close the FLASH
              }
        Else
           {printf("Cant open flash device\n");
              }
```

Return 0;

}

4. Conclusion

The work uses NiosII soft-core processor to design TDC-GPl time-to-digital converter chip interface circuits and interfaces driver. As NiosII soft-core processor design can use a lot of nuclear molding IP, and Nios II processors can link the external memory, LCD display, ethernet controller and USB, peripherals for the coordination and sharing of data. So we therefore based on the Nios II TDC module interface flexibility in the configuration of any treatment based on the Nios II Components of the products design, with the advantages of flexible and easy, low power consumption, simply debugging, testing of high precision and accuracy, real-time data processing, human-machine interface humanized, remote operation and embedded operating systems, etc.

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Angioplasty Procedure Has Potential to Damage Kidneys

Wake Forest University Baptist Medical Center

Science Daily, June 30, 2007

The most common procedure for clearing blocked kidney arteries can also release thousands of tiny particles into the bloodstream that can impair kidney function, according to researchers from Wake Forest University Baptist Medical Center and colleagues.

"This is the first data in humans to show that debris released during angioplasty and stenting of the kidney arteries can be harmful to kidney function," said Matthew Edwards, M.D., M.S., lead researcher and an assistant professor of surgery. "It raises important questions about how to most safely perform this very common procedure."

Edwards said that understanding more about potential complications from the procedure can lead to improved treatments. The study, reported in the current issue of the Journal for Vascular Surgery, suggests that having patients stop aspirin use before the procedure may lead to worse results. It also shows that stent size is important and raises questions about whether blocking or filtering out the debris, known as emboli, may be effective in improving results.

"New devices exist that may prevent the passage of this debris into the kidney and may lead to better patient outcomes," said Edwards. "We are currently conducting a clinical trial to explore this question."

As many as 3.5 million Americans over age 65 years have blocked kidney arteries that can lead to severe high blood pressure and kidney failure. These patients have a greater risk of having heart attacks or strokes, becoming dependent on dialysis, or dying.

In some cases, blockages are cleared by inflating a balloon-like device inside the vessel (angioplasty) and inserting a stent to keep the vessel open. The procedure is performed on about 40,000 to 80,000 people a year. Bypass surgery on the arteries is also an option, but few centers offer the complex surgery.

Based on laboratory studies, researchers have suspected that angioplasty releases particles into the bloodstream -- presumably made up of bits of clot and fatty plaque material from the blockage. The goal of the current study was to count the particles and determine if they are associated with impaired kidney function after the procedure.

In 28 angioplasty cases, researchers used a protection device to temporarily block the vessel at the site of the angioplasty and stenting. After the procedure, and while the protection system was still in place, researchers took a small sample of blood trapped by the protection device. The artery was then aspirated and flushed out to remove any remaining particles.

Laboratory analyses found a mean of 2,000 particles captured per blood sample -- many of them large enough to block the small vessels in the kidney.

"The more particles collected from a patient, the worse their kidney function," said Edwards. "Patients with higher levels of particles in their blood were more likely to have decreased kidney function after the procedure. Poor kidney function after kidney artery stenting has been previously demonstrated by our group to be associated with increased risk of heart attack, stroke or death in the future."

The results raise an important question: since the protection device was in place for the procedures, and it is designed to remove particles from the vessel, why did patients who had high particle counts before the artery was flushed also have worse kidney function afterwards" The researchers theorize that some blockages are more prone to releasing particles than others and that just putting the protection device in place releases particles that reach the kidneys.

"The study raises many questions, including how well the protection device works and can we predict which plaques are more prone to release debris," said Edwards. "We are currently conducting a clinical trial to try and answer these questions."

The new study, funded by the National Institutes of Health, will compare results in procedures performed with and without a protection device. The goal of the research is to determine the best way to conduct angioplasty so that results are comparable to or better than surgery. The current research was supported by the National Institutes of Health.

Co-researchers were J. Kimberley Hansen, M.D., Randolph Geary, M.D., Matthew Corriere, M.D., Jeffrey Pearce, M.D. and medical student Nicholas Mertaugh from Wake Forest and Joseph Rapp, M.D., and Xianmeng Pan, Ph.D., from the University of California at San Francisco.

A Study on the Quality systems-Modal

for Quality Management of Manufacturing

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Abstract

This paper outlines a study of the quality systems-model for quality management and quality assurance of manufacturing. The study presents as processes being closed-loop in nature. Comprehensive studies were made in connection with the general and practical ways of the quality management to deal with design of advanced making system. The thrifty quality management system may be simplified shall be structured and adapted to the activities and size of the particular organization.

Keywords: Quality management; Improvement model; organization; Process management

With the rapid development of advanced making, the study on the quality systems-model has become a new topic of project management domain.

The various quality systems-models are must introduced for various field and style and size project.

Problems associated with the quality failure have been caused by the quality systems-model itself and by the failings of the people charged with development.

Academic investigation is constrained by similar intellectual inadequacies. The following paragraphs therefore represent a modest but synoptic attempt not to resolve completely, but to clearly enunciate this problem. Using the 'quality' concept as a fulcrum for discussion, we trace lines of argument from its existence as a management fact, backward to its origins within systems-model and forward to its effects on quality.

In recent years many making factories of our county have been faced with the problem of how to introduce new quality systems-model and to make product higher.

The reasons for the failure that quality systems have sustained stable quality conformity are varied. The first and most obvious result is that improvement in quality assurance will never be unable to keep up with the free market's appetite. Second, as procedures process model need depend upon the complexity closes the loop of the work, improvement of process model will usually need a period even a few period. And finally, a large system will result in raising greatly costs. Some people claim that the solution is to pass ISO certification. But certification does not full lead to higher quality.

Because the needs of organizations vary, it is not the purpose of this International Standard to imply uniformity of quality management systems. The model of an organization's quality management system should be configured in a manner that is appropriate to its unique activities.

In recent years, China has experienced development boom in quality certification of ISO that has impetus to many technological fields and especially to the quality management. The ISO 9000 family of standards has been developed to help organization improve quality, communication and competitiveness in national, regional and international trade.

Sine the document is generic in nature and intent, only generic guidance is presented. An organization doesn't be stressed to implement unnecessary requirement under this International Standard. For each organization, it is intended that all requirements of this International Standard be applied. However, tailoring may be acceptable in certain situations. Each organization will need to select and employ the most appropriate methods and tools from the content of this International Standard. The organization shall establish a quality management as a means of ensuring that the product and/or service conform to requirements. The quality management system shall be structured and adapted to the activities and size of the particular organization.

We need search for the pipes that can transfer our information of quality, and the ways we will apply them to give us the speed, reliability and security we need in quality management system. The quality systems-model for quality management provides a challenge to the people who develop it. We have accepted the task of the quality systems-model for quality management.

What is the idea about 'quality'? There are many different interpretations such as degree of excellence, fitness for purpose, value for money and conformance to specification or requirement. This can create confusion and misunderstanding.

Within the ISO 9000 family of standards, the term 'quality' is used in the context of achieving sustained customer satisfaction through meeting customer needs and expectations within an organizational environment committed to continual improvement of efficiency and effectiveness. Quality, in this sense, is critical to business success. Customer needs and expectations are typically expressed in the form of specified requirements. Such requirements typically contain relevant characteristics and their values.

A customer can be regarded as internal or external to the organization. Customer is used in a 'process' sense in which an organization is made up of a cascade of processes. Each and every process within an organization has both a supplier and a customer. Each and every customer has apperception of 'process' that the supplier should aim to meet in the most efficient and effective manner.

We know that a process is using resources to transform input into output. An output from one process can be an input to another process. In this way, many processes can be combined in a process chain. (See Figure)
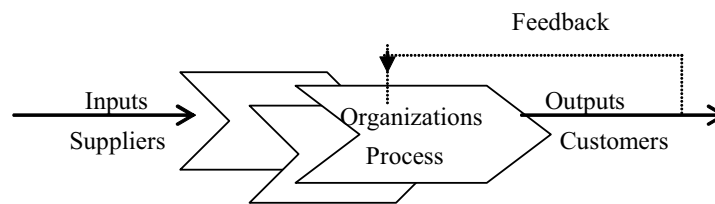

Figure 1. Process and Feedback Model Chain

To ensure all processes be operated as an efficient network the organization ought to undertake an analysis of how all processes, inputs and outputs interrelate. As an example, figure 1 shows the organization in a 'process and feedback model chain' relationship between a supplier and a customer. Note that the feedback inputs and outputs flow in different directions in the Figure.

Leading and operating an organization successfully requires managing in a systematic and visible model. Success can result from implementing and maintaining a management system that is designed to continually improve performance by addressing the needs of all customers. Quality management process model displayed in Figure is a new conceptual presentation of the quality management system requirements specified in International Standard. The model reflects graphically, the integration of essential content in quality management system.

Simultaneity, the organization should consider establishing channels for communication with all interested parties to enable timely transfer of information and informed responses well by all parties.

This process model is to be generally meaningful. By far the greatest usage of process model occur we designing system in order to decide the path of quality management systems and improvement. All elements of a complete quality management system may be placed within this quality management process model. It is an effective to reduce quality management processes or systems, time, cost and risk.

Quality management system is a logical rather than a physical system element; therefore, success is measured by the quality of a single entity rather than many manufactured entities. The quality management system does not wear out. If faults are encountered, there is high probability that each was inadvertently introduced during development and went undetected during testing.

You replace defective parts during the quality management system maintenance, but you have few, if any, spare parts. That is maintenance often includes correction or modification to design. The organization should initiate technical and administrative disciplines to control changes during design and development processes. Such changes should be determined, recorded, reviewed and approved by appropriate personnel before their implementation. Personnel should have the organizational freedom to raise and resolve quality problems.

To minimize effects of errors and to maximize productivity, verification should be carried out at important points in the processing sequence. Verification at each stage should relate directly to finished product and/or service specifications or an internal requirement, as appropriate.

Upper–level managers with no background in quality systems-model for quality management are often given responsibility for system development. If he or she is willing to learn the ways that can be used to quality systems-model for quality management, apply effective methods of control, disregard mythology, and become conversant in a rapidly changing technology.

A manager of quality management should be appointed for the purpose of coordinating quality activities, awareness of interested parties' expectations and reporting to the top management. The manager should be informed of all quality problems, monitoring and reporting on the level of achievements against the quality objective, determining opportunities for quality improvement, monitoring and reporting on quality-related customer relations, managing the internal audit system, aggregating customer needs and expectations that are not part of their explicit requirement, participating in all management meetings where quality matters are discussed. Top management shall demonstrate that customer needs and expectations have been determined and translated into applicable customer requirements. The manager must communicate with all constituencies involved with system development-customer, system developers, support staff, and others. Communication can break down because the special characteristics of the quality systems-model for quality management and the particular problems associated with its development are misunderstood. When this occurs, the problems associated with the quality systems-model for quality management crisis are exacerbated

To leverage this power of quality management, we'll need to make our quality systems-model considerably easier to use than they are today. Quality should be built in to all organizational processes. Inadequate planning and operation of any process could lead to deterioration of capability and potential loss of efficiency.

Therefore, the top management, at defined intervals sufficient to ensure its continuing suitability, adequacy and effectiveness, should review the quality management system.

The development of quality systems-model for quality management compels us to accept responsibilities or give up. The final outcome, people would run a speed, reliability and security quality world.

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A Primary Research on the Validity of Enterprise Encouraging

System Based on the Paradigm of Strategic Ecology Management

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Abstract

Aiming at the research results put forward by some Chinese scholars who claim that encouraging invalidations exist in Chinese enterprises. This article advances the following opinions. Some certain encouraging factors have no strong relativity with the enterprise performance, which cannot prove that the encouraging invalidation exists in the investigative sample enterprise. The present researches of the relationships between encouragement and enterprise performance are short of the systemic integration to the numerous influencing factors. But in the strategic ecology paradigm, when we design the interior mechanism between encouraging system and its validities, we should use the latest research results of ecologically behavioral economics for references, especial for analyzing the interior relationships between the enterprise strategy and the validity of the enterprise encouraging system. This article's research possesses guiding values for enterprise's governing and its further development.

Keywords: Encourage, Encouraging system, Strategy, Ecological management paradigm

1. Do encouraging invalidations exist in Chinese enterprises?

As early as in 2000, Chinese scholar Li Zengquan selected data about senior managers' annual salaries published by 748 listed companies in 1998, and carried through practical research on them for encouraging mechanism and enterprise performance of Chinese listed corporations. He took senior managers' annual salaries and their stock proportion as salary variable, ROE as variable of enterprise performance, to test the sample collectivity according to the proportion of asset scale, industry and state stock, and the area where the corporation was located. The results showed that the managers' annual salaries of Chinese listed companies was not correlative with enterprise performance, but closely correlative with enterprise scale, and put up obvious differences of district. In 2000, Yang Ruilong and Liujing took 1999 year's Chinese listed companies in household appliance industry as the samples of measuring research, sales incomes and ROE of corporation as enterprise's performance variable, and managers' salaries as dependent variable, carried through practical research to manager's salary, enterprise performance and stock structure, and found that the managing performance of enterprise was independent of the stock structure in household appliance industry. In 2005, Liling chose 2003 finance year's finance data of 38 listed companies in Chinese electronic industry, adopted the method of econometrics, and obtained that the changes of senior managers' salaries would arouse ROE the change of 0.62% at the same direction, and EPS the change of 0.940 at the same direction. This showed that the encouragement to senior managers had strong relativities with enterprise performances. To domestic corporations, the research of the relationships between senior managers' salaries and enterprise performance indicated that the encouragement of senior managers had no obvious relativities with enterprise performances. This result was different with the theoretic analysis and the Occident's scholars' opinions which thought these both aspects had strong relativities, or had this conclusion achieved the area of "+∞" in the encouragement of the "X" model? Of course it had not. If encouragement had not strong relativities with enterprise performances, and the above research was tenable, so did it prove the encouraging invalidation existed in the sample enterprises which were researched? And how should we implement encouragement to enhance its validities? If these problems cannot be solved, the performance of encouraging measure in Chinese listed companies will seem eyeless and disordered.

2. Should we start with whether measures or system to enhance the validity of the encouragement?

Most present articles which research the validity of encouragement all engage in qualitative research from the view of management, psychics and economics, and few establishes model to quantificationally analyze the validity of

encouraging system from the view of the systematology. The foreign researches demonstrate the relationships between employee encouragement and enterprise performance mostly from the aspect of senior managers' encouragement of salaries. The increase of stockholders' benefits can obviously reflect the improvement of enterprise performance in the finance index. In 2006, Liu Xinmin and Liyuan discussed the necessity of combination of material encouragement and immaterial encouragement implemented by entrepreneurs, and analyzed the dynamic optimum combinative conditions by which owners obtained the maximal encouraging effect with minimal encouraging costs through using the fussy optimum theory. In 2005, Zhang Dansong and Niu Wenxue studied the encouraging management of human capital in enterprise management by a measuring model of encouraging effect. They divided encouraging means into encouraging effect factor and protective effect factor, and pointed out the key factors in managers' encouraging management and made out the strategic guidance of encouragement based on the analysis of model. In 2006, Zhao Yanyan and Wang Huaiming analyzed the actualities of senior encouragement at the present in China, and discussed the relationship between the encouragement of senior managers and enterprise performances by means of describing statistics and multiple nonlinear regression method. The practical research showed that the enterprise performance took on positive correlation with managing layer's stock proportion, but it was not obvious, and the enterprise performance presented obvious positive correlation with managing layer's annual salary. In 2007, Shen Minghao and Su Xiaohua found that enterprise's finance risk presented minus linear relation with senior managers' stock tendency, and their shares took on nonlinear relation with the encouraging effect of enterprise (the managing layer's endeavoring level), making use of the practical research on listed companies. In the present restructuring of Chinese enterprises, because the managing layers went short of buying capitals, they are not likely to stock enterprises. So a realistic hypo-excellent proportion must exist in the present circumstance and it can inspire the managing layers' enthusiasms most effectively.

The encouraging system of enterprise is an important subsystem to form the enterprise system, but it is also an independent system. From the view of static state, the encouraging system consists of factors such as actuator, encouraging object, encouraging factors and encouraging method. From the view of strategic ecological management, it consists of five subsystems which include the subsystem of encouraging environment which means what conditions we implement the encouragement under, the subsystem of encouraging factors which means what we implement the encouragement by, the subsystem of encouraging implement which means how we carry through the encouragement, and the feedback subsystem of encouraging effect which means how to test and estimate the encouragement. In these subsystems, the connotation of the subsystem of encouraging object has extended to the group which consists of enterprises and their benefit relatives in the whole value chain under the guidance of the strategically ecological management paradigm. The final running state of the system lies on the running state of the every part and the mutual relations among parts. But how to evaluate the validity of the system across-the-board is still to be further discussed, so the measuring research to the validity of the encouraging system redound us to measure the encouraging system with the more scientific attitudes, identify its contributions to the actualization of strategic objects, improve the state of the whole system to the special object and make the whole ecological system of enterprise develop more stable and sustainable.

3. Whether should we start with the base of strategic ecology paradigm to enhance the validity of the encouragement?

With the increasingly more dynamic environment of the industry, more quickening of the technology innovation, more globalization of the competition, and more diversification of the consumers' requirements, enterprises gradually realizes that if they want to develop, they must create new value which is interested by consumers with other companies no matter what increasing their own abilities, or developing their new market. Enterprises must foster synergic economic groups taking the development as guidance. The theory of ecology and its ecologic thinking is the bridge to solve the strategic complexity problems. The advance of strategic ecological paradigm is a sort of breach of strategy managing paradigm, which is the strategic paradigm of facing future sustainable development and obtaining sustaining superior performance, and is the group which consists of enterprises and their benefit relatives, and is a complicated ecological system. The paradigm of strategic ecological management includes a series of relations of enterprise, which include not only the vertical relations with its providers, consumers, market intermediary agencies, but also the horizontal relations with its competitors, the enterprises of other industries, governmental departments, higher institutions, research institutions and benefit relatives etc.

From the view of the production function in the traditional economics, outputs are decided by the two basic factors including capitals and labor forces. In the condition that the restriction of capitals is not the key problem, the core of the enterprise management is which people are selected be the employees of the enterprise and how to perform encouragement and enhance employees' performances. The validity of the enterprise encouraging system directly decides whether the objects of enterprise developing strategies can come true. The strategic objects or actual objects of the organization all are implemented by human longtime activities and short-term activities. The behaviors which incline to the object are continually strengthened by human motivations and the requirements which induce the motivations. Numerous coherent behaviors finally achieve the object of the organization and the enterprise, so the human requirement and the fulfillment of the requirement in enterprise is the original start of the encouragement.

The value of ecological concept rests with that we can use it identify and foster whole set mutually interlaced relations, and make it possessing more strong increasing potentials of benefit, but we shouldn't stickle on the scale (the strategically ecological system can mean small competitive space of enterprise, or big one). So, under the guidance of strategically ecological paradigm, the encouraging system of enterprises also should emphasize the source of the resources of ecological system and relative resources, and it must integrate exterior forces to foster and enhance its own core abilities, and exert the leverage of the core abilities. The research to the corporate encouraging system, fastens on the research of the factors, implement of the encouragement and their relations with the enterprise performances, and localizes the interior encouraging system of enterprise. But the research and application of problems which include dynamic encouragement, encouraging combination, exterior cooperation of the encouragement and measure of the encouraging validity etc. are less at present. The traditional view of strategic managing paradigm has not explained the problems such as encouraging invalidation, the weak relative of salary and stock encouragement with enterprise performances. So, from the view of ecological system, we study the encouraging problems, that possess some certain values of academic research and meaning of realistic guidance.

When we think about the problem from the view of strategically ecological managing paradigm, the providers, consumers and middlemen are not only copartners but also competitors. The subsystem of encouraging object will be endowed a new connotation, so the benefit relatives all become the factors included by the encouraging system of enterprise, and the integrality of systematic research will directly influence whether the validity of encouraging system can be reflected objectively.

4. How should we develop the research of validity of enterprise encouraging system in strategic ecology paradigm?

The research about how to evaluate the encouraging system of enterprise, that is to say the validation of the validity of the encouraging system, has three defects at the present time.

The first defect is to be short of the integration of numerous influencing factors. Due to the different view of the research, the present influencing factors of encouraging system are distributed in the multi-layers and multi-dimensions, and form a big and complex factor group. But the interior relations among numerous factors lack systemic cleaning up, which neither makes against theoretic research, nor practical operation. This article thinks it should integrate the contributions of the researches on the validity of encouraging system, establish a theoretic frame which has interior logic relations and can reflect the influencing factors of the validity in encouraging system. To solve this problem, firstly we should integrate the research results such as agent theory, corporate governing theory and autonomy theory of encouraging system, establish the integrated factor frame which can reflect agent costs, governing structure and behavior space of encouraging system, and take it as the concept model. Secondly, we should adopt effective research methods and technical means to testify the hypothesis relation of the concept model based on the practical research.

The second defect is that it can not effectively answer the influencing relations and conditions between performance and validity. In theory, corporate performance should have a positive circulation relation with the validity of encouraging system, that is to say, generally speaking, good performance must present higher validity, and higher validity must induce the improvement of performance. But in practice, the beneficial circulation between corporate performance and the validity of encouraging system may be disturbed by exterior factors and occur breaking phenomenon. For example, in the old system of state-owned enterprises, the validity of encouraging system may have irrelevance with corporate performance, and in the management responsibility system, the validity of encouraging system obviously lies on the corporate performance.

Under the present corporate system in China, it needs data to judge the relation between performance and validity. Obviously, the simple relative relation can not offer satisfied explanations. The practical research by means of structural equation model offers the support of method to further open out the interior consequences.

The third defect is that most samples used in the domestic researches at present are traversal data of single year, without considering the time series effect of multiyear. Everyone knows that the validity of encouraging system has a close relation with many developing aspects of macro-economy, and the period which the company is developing in is an important variable. There are two methods to solve this problem. The first one is to adopt time series data which are the lengthways data distributed according to years. The second one is to adopt panel data which is the combination of time series data and traversal data.

The measure of performance is a complex systems engineering. The simple combination of indexes can not reflect the corporate performance level, so it must adopt reasonable systems frame. Some scholars' researches provide help for us. The famous systems frame models include the model of Sink & Tuttle, the PIMM model and the Family of Measures model (FOM).

Under the direction of strategically ecological managing paradigm, the corporate encouraging system should emphasize

the resources of ecological system and relation system which are the sources of the competitive predominance of the

enterprise, must integrate exterior forces to foster and enhance its own core abilities and exert its own leverage of core abilities. So, the research of encouraging system based on the strategically ecological paradigm must break through the analyzing frame of traditional encouraging system, start with the view of ecology and systems engineering, use the relative research results of behavioral economics as references, study the operative mechanism between strategically ecological managing paradigm and encouraging system, and carry through all-sided discussion from various layers and orientations to the managing encouragement.

It can use the data envelopment analysis and structural equation model to discuss the intergrowth mechanism among benefit relatives, search the ecologically relative conditions among factors in the system, and open out the structural relations between the validity of encouraging system and its influencing norms, between the governing factors and dependent factors. Through establishing the encouraging systems in Chinese corporations, researching their validities and give the measuring method of validity, testifying the relative consequences between the encouraging system and corporate performance which include unilateral influencing hypothesis, bidirectional influencing hypothesis and irrelevance hypothesis, it can realize the conversion from "traditional encouraging system" to "effective encouraging system". It also can use the methods such as the measuring analysis of statistical data and the statistical analysis of fieldwork questionnaires of enterprises to testify some conclusions coming from the above theoretic analysis, and further improve the establishment of the encouraging system.

5. Conclusions

The present researches to the relations between encouragement and the enterprise performances are short of the integration of numerous influencing factors.

Some certain encouraging factors have no strong relativity with enterprise performance, which can not prove the encouraging invalidity of sample enterprises which are investigated.

Under the strategically ecological paradigm, when we design the interior mechanism between encouraging system and its validities, we should use the latest research results of ecologically behavioral economics for references, especial for analyzing the interior relationships between the enterprise strategy and the validity of the enterprise encouraging system This article demonstrates this research possesses guidance value for corporate governing and development.

Through the design of corporate encouraging system, and testifying the positive influences of corporate encouraging system to corporate development based on the strategically ecological paradigm by the means of practical method, we hope the results can offer references for the reform of Chinese corporate development pattern.

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Strongly Convergence Theorem of m-accretive Operators

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Abstract

Let X be a real Banach space, we will introduce a modifieations of the Mann iterations in a uniformly smooth Banach space, $x_{n+1} = \alpha_n(\lambda u + (1-\lambda)x_n) + (1-\alpha_n)J_r x_n$, Where $\{\alpha_n\}, \lambda$ satisfied some conditions, then we will prove the strongly convergence of the sequence $\{x_n\}$ to a zero of accretive operators. This theorem extend (Kim and Xu, Nonlinear Analysis) results. (Kim, 2005, pp.51-60)

Keywords: Strong convergence, Non-expansive mapping, Accretive operator

1. Preliminaries

Recall that a (possibly multivalued) operator A with domain $D(A)$ and $R(A)$ in X is accretive if for each $x_i \in D(A)$, and $y_i \in Ax_i$ (i=0,1,2), there exits a $j \in J(x_2 - x_1)$ such that $(y_2 - y_1, j) \geq 0$. An accretive operator A is m-accretive if $R(I+rA)=X$, for each r>0. The set of zero of A is denoted by F. Hence $F = \{z \in D(A) : 0 \in A(z)\} = A^{-1}(0)$. We denote by J_r the resolvent of A. Note that if A is m-accretive then $J_r : X \to X$ is nonexpansive and F(J_r)=F.

In order to prove our results, we need the following lemmas:

Lemma 1: Assume $\{\alpha_n\}$ is a sequence of nonnegative numbers such that (Xu, 2002, pp.240-256)

$\alpha_{n+1} \leq (1-\gamma_n)\alpha_n + \gamma_n \delta_n$, $n \geq 0$, where $\{\gamma_n\}$ is a sequence in (0,1) and $\{\delta_n\}$ is a sequence in $\Box$ such that

(i) $\sum_{i=1}^{\infty} \gamma_n = \infty$;

(ii) $\limsup_{n\to\infty} \delta_n \leq 0$ or $\sum_{i=1}^{\infty} \gamma_n |\delta_n| < \infty$.

Then $\lim_{n\to\infty} \alpha_n = 0$.

Lemma 2: Let X be a smooth real Banach space and let J be the duality map of X. Then there holds the inequality

$\|x+y\|^2 \leq \|x\|^2 + 2\langle x, J(x+y)\rangle$, $x, y \in X$.

Lemma 3: Let $\{x_n\}$ and $\{y_n\}$ be bounded sequence in a Banach space X such that (Suzuki, 2005, pp.103-123)

$x_{n+1} = \gamma_n x_n + (1-\gamma_n)y_n$, $n \geq 0$. Where $\{\gamma_n\}$ is a sequence in [0,1] such that $0 < \liminf_{n\to\infty} \gamma_n \leq \limsup_{n\to\infty} \gamma_n < 1$, assume

$\limsup_{n\to\infty}(\|y_{n+1} - y_n\| - \|x_{n+1} + x_n\|) \leq 0$.

Then $\lim_{n\to\infty} \|y_n - x_n\| = 0$.

2. Main results

Theorem: Let X be a uniformly smooth Banach space, C a closed convex subset of X and $T : C \to C$ a nonexpansive

mapping such that $Fix(T) \neq \phi$. For any given sequence $\{\alpha_n\}$ in $[0,1]$, $\lambda \in (0,1)$ and $u, x_0 \in C$, defined $\{x_n\}$ by the iterative algorithm $x_{n+1} = \alpha_n(\lambda u + (1-\lambda)x_n) + (1-\alpha_n)J_{r_n}x_n$, (2.1)

(i) $\lim_{n \to \infty} \alpha_n = 0$ (ii) $\sum_{i=0}^{\infty} \alpha_n = \infty$. Then $\{x_n\}$ convergens strongly to a zero of A.

Proof: We first show that $\{x_n\}$ is bounded. Indeed, take a point $p \in Fix(T)$ to get, using the nonexpansive of J_r,

$$\|x_{n+1} - p\| \leq \alpha_n \lambda \|u - p\| + \alpha_n(1-\lambda)\|x_n - p\| + (1-\alpha_n)\|J_r x_n - p\|$$

$$\leq \alpha_n \lambda \|u - p\| + \alpha_n(1-\lambda)\|x_n - p\| + (1-\alpha_n)\|x_n - p\|$$

$$\leq \alpha_n \lambda \|u - p\| + (1 - \alpha_n \lambda)\|x_n - p\|$$

So we have for all $n \geq 0$, $\|x_n - p\| \leq \max\{\|u - p\|, \|x_0 - p\|\}$, (2.2)

So $\{x_n\}$ is bounded, and also $\{J_{r_n}x_n\}$. We have

$$\|x_{n+1} - J_{r_n}x_n\| = \alpha_n \|\lambda u + (1-\lambda)x_n - J_{r_n}x_n\| \to 0 \ (n \to \infty)$$ (2.3)

From (2.1) we have $x_{n+1} = \alpha_n(1-\lambda)x_n + \alpha_n \lambda u + (1-\alpha_n)J_r x_n$

$$= \alpha_n(1-\lambda)x_n + [1-\alpha_n(1-\lambda)]\frac{\alpha_n \lambda u + (1-\alpha_n)J_r x_n}{1-\alpha_n(1-\lambda)}$$

We set $\gamma_n = 1 - \alpha_n(1-\lambda)$ and $y_n = \frac{\alpha_n \lambda}{\gamma_n}u + \frac{1-\alpha_n}{\gamma_n}J_r x_n$

Then we get $x_{n+1} = (1-\gamma_n)x_n + \gamma_n y_n$ (2.4)

It easily to get $\{y_n\}$ (since $\alpha_n \to 0, \gamma_n \to 1$ and $\{x_n\}$ is bounded).

$$y_{n+1} - y_n = (\frac{\alpha_{n+1}}{\gamma_{n+1}} - \frac{\alpha_n}{\gamma_n})\lambda u + \frac{1-\alpha_{n+1}}{\gamma_{n+1}}(J_r x_{n+1} - J_r x_n) + (\frac{1-\alpha_{n+1}}{\gamma_{n+1}} - \frac{1-\alpha_n}{\gamma_n})J_r x_n$$

Since J_r is nonexpansive and $\frac{1-\alpha_{n+1}}{\gamma_{n+1}} < 1$, we get

$$\|y_{n+1} - y_n\| - \|x_{n+1} - x_n\| \leq (\frac{\alpha_{n+1}}{\gamma_{n+1}} - \frac{\alpha_n}{\gamma_n})\lambda \|u\| + (\frac{1-\alpha_{n+1}}{\gamma_{n+1}} - \frac{1-\alpha_n}{\gamma_n})\|J_r x_n\|$$

Since $\alpha_n \to 0, \gamma_n \to 1$, so $\limsup_{n \to \infty} \|y_{n+1} - y_n\| - \|x_{n+1} - x_n\| \leq 0$

Applying Lemma 3, we have $\lim_{n \to \infty} \|y_n - x_n\| = 0$, (2.5)

since $\alpha_n \to 0$, we get $\lim_{n \to \infty} \|y_n - J_r x_n\| = \lim_{n \to \infty} \frac{\alpha_n \lambda}{\gamma_n}\|u - J_r x_n\| = 0$ (2.6)

from (2.5) and (2.6) we get $\lim_{n \to \infty} \|x_n - J_r x_n\| = 0$ (2.7)

since z_t is the unique solution to the equation (1.1), we can write

$$z_t - x_n = (1-t)(J_r z_t - x_n) + t(u - x_n)$$

Apply lemma 2 to get

$$\|z_t - x_n\|^2 \leq (1-t)^2 \|J_r z_t - x_n\|^2 + 2t \langle u - z_n, J(z_t - x_n) \rangle$$

$$\leq (1-t)^2 \|J_r z_t - x_n\|^2 + \|J_r x_n - x_n\|(2\|z_t - x_n\| + \|J_r x_n - x_n\|)$$

$$+2 \langle u - z_t, J(z_t - x_n) \rangle + 2t \|z_t - x_n\|^2 \tag{2.8}$$

Since $\{z_t\}, \{x_n\}$ are bounded, there exists a constant $M>0$,

$$\langle u - z_t, J(x_n - z_t) \rangle \leq (t + \frac{\|J_r x_n - x_n\|}{t})M \tag{2.9}$$

So we get $\limsup\limits_{n \to \infty} \langle u - z_t, J(x_n - z_t) \rangle \leq tM \tag{2.10}$

Put $$p = Q(u) = s - \lim\limits_{t \to 0} z_t$$

Since J is uniformly continuous on bounded sets of X, we find that

$$\|J(x_n - z_t) - J(x_n - p)\| \leq \varepsilon_t, \text{ uniformly on } n. \tag{2.11}$$

Where $\varepsilon_t > 0$ and $\lim\limits_{t \to 0} \varepsilon_t = 0$, Let $\beta > 0$ satisfy $\|u - z_t\| \leq \beta$ and $\|z_t - p\| \leq \beta$

For all $t \in (0,1)$ and n. We have

$$\langle u - p, J(x_n - p) \rangle = \langle u - z_t, J(x_n - z_t) \rangle + \langle u - z_t, J(x_n - p) - J(x_n - z_t) \rangle + \langle z_t - p, J(x_n - p) \rangle$$

$$\leq \langle u - z_t, J(x_n - p) \rangle + \beta(\varepsilon_t + \|z_t - p\|)$$

It follows (2.10) that, for all $t \in (0,1)$,

$$\limsup\limits_{n \to \infty} \langle u - p, J(x_n - p) \rangle \leq tM + \beta(\varepsilon_t + \|z_t - p\|)$$

Let $t \to 0$, we can get $\limsup\limits_{n \to \infty} \langle u - p, J(x_n - p) \rangle \leq 0 \tag{2.12}$

Finally, we claim that $x_n \to p$ in norm. Apply Lemma 2 to get

$$\|x_{n+1} - p\|^2 = \|\alpha_n(1-\lambda)(x_n - p) + (1-\alpha_n)(J_r x_n - p) + \alpha_n \lambda(u - p)\|^2$$

$$\leq \|\alpha_n(1-\lambda)(x_n - p) + (1-\alpha_n)(J_r x_n - p)\|^2 + 2\alpha_n \lambda \langle u - p, J(x_{n+1} - p) \rangle$$

$$\leq (1-\alpha_n)\lambda \|x_n - p\|^2 + 2\alpha_n \lambda \langle u - p, J(x_{n+1} - p) \rangle \tag{2.13}$$

Applying lemma 1, and from (2.12) and (2.13) we conclude that $\|x_n - p\| \to 0$.

So the proof is completed.

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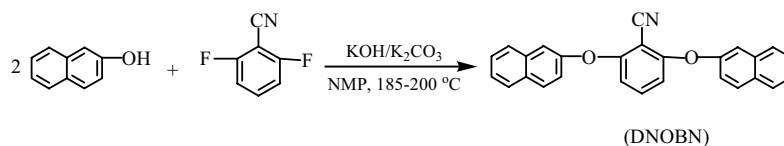
2.2 Monomer synthesis

2, 6-bis (β-naphthoxy) benzonitrile (BNOBN) was synthesized as shown in scheme 1 by nucleophilic aromatic substitution reaction of 2,6-difluorobenzonitrile with beta-naphthol in the presence of KOH and K_2CO_3 in high boiling solvent NMP under N_2 atmosphere.
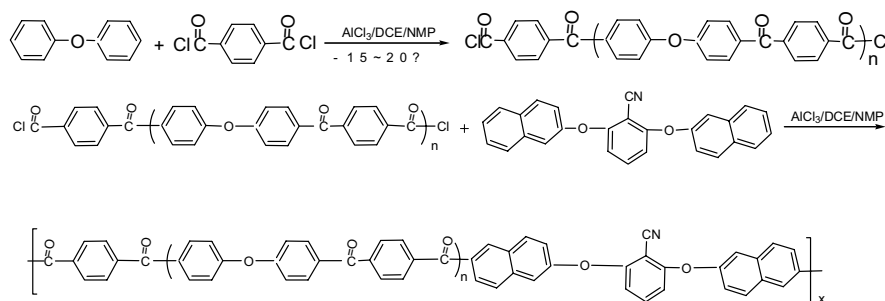

(DNOBN)

Scheme 1. Synthesis of BNOBN

To a 100ml, round-bottomed flask equipped with a mechanical stirrer, a thermometer, and nitrogen inlet and out tubes, and a Dean-Stark trap, 72 mmol of beta-naphthol, 60 mmol of KOH, 12 mmol of K_2CO_3, 35 ml of N-methyl-2-pyrrolidone (NMP) and 25 ml of tolune were added. The reaction mixture was heated to 140℃ until no further water was azeotropically distilled from the reaction mixture, and then temperature was raised to 170℃ to remove tolune. After being cooled to 40℃, 30mmol of 2, 6-difluorobenzonitrile was added and the reaction mixture was heated to185~200℃ and stirred at this temperature for 6h.After cooling to room temperature, the product was precipitated from water. The solid product was washed with water and recrystallized from the mixture of ethyl alcohol and 1,2-dichloroethane three times to give 8.073g of 2,6-bis(β-naphthoxy)benzonitrile(DNOBN). Yield 69%;Purity 97%; m.p.169~171℃; IR(KBr): v 3053, 2227, 1576, 1457, 1253cm^{-1}; H-NMRδ(CDCl$_3$): 6.54~6.56 (m,2H) 7.25~7.55(m,9H),7.47~7.55(m,5H),7.79~7.93(m,6H); Elemental Analysis calculated for $C_{27}H_{17}NO_2$; C, 79.45; H, 4.88; N, 4.53. Found: C, 79.22; H, 4.93; N, 4.35.

2.3 Polymer synthesis

The multiblock copolymers composed of poly (aryl ether ketone ketone) (PEKK) and 2, 6-bis (β-naphthoxy)benzonitrile(BNOBN) were synthesized as shown in scheme 2. A typical preparative procedure for polymer Ⅱ is described hereafter. Other polymers were also obtained in similar manner.

Scheme 2. Synthesis of polymers

To a 100ml, round-bottomed flask equipped with a mechanical stirrer, a thermometer, nitrogen inlet and out tubes. 8.01g (60mmol) of anhydrous AlCl$_3$ and 20ml of 1, 2-dichloroethane (DCE) were added. The flask was cooled to 0℃ using an ice-water bath, then a solution of 2.5mlof N-Methyl-2-pyrrolidone(NMP) in 5ml DCE was added dropwise with stirring over a period of 30min,and the mixture was stirred for 30min and then cooled to -15℃.Into the resulting suspension were added 2.030(10mmol)TPC,1.617g(9.5mmol)DPE with stirring and the reaction mixture was warmed to 20℃ over 0.5h and then the reaction was continued at this temperature for 2.5h.Then 0.1935g (0.5mmol)DNOBN was added into the reaction mixture and the reaction was continued at 20℃ for 5~6h.Lastly, a little diphenyl ether (DPE) was added to terminate the polymer. The reaction mixture was quenched with methanol (50ml) at 0℃ and the precipitated was crushed, washed with methanol and extracted with boiling methanol for 24h and allowed to dry in air. The air-dried product was heated at 100℃ overnight under vacuum to give the polymer Ⅱ.

2.4 Characterization

Elemental analysis was performed with Perkin-Elmer Model 2400 CHN analyzer. The inherent viscosities(η_{inh}) of polymers were measured in a 01wt% H$_2$SO$_4$ solution at 30℃.The FT-IR spectra of the polymers in KBr pellets (2%) were recorded using a Nicolet FT-IR (510P) spectrophotometer.^{13}C and ^{1}H NMR spectra of the monomer were recorded using a Bruker PC-A400 (400Hz) using CDCl$_3$ as a solvent and TMS as an internal standard. Differential scanning

calorimetry (DSC) curves were run on a Perkin-Eml er Pyris Ⅰ system with a N_2 gas flow, heating rate of 10℃/min ranging from 50℃ to 400℃,and sample weight of 5.0~7.0mg.Thermogravimetric analysis (TGA) was carried out on a Perkn-Emler 7 Series thermal analysis system with an increasing rate of 10℃/min,N_2 atmosphere at the flow rate of 40ml/min,scanning scope ranging from 50 to 750℃,and sample weight of 5.0~7.0mg.Wide angle X-ray diffraction (WAXD) was measured with a Rigaku D/MAX-ⅡA X-ray diffractometer, using CuKa radiation, at 30KV and 20mA.The diffractogramas were recorded at room temperature over the rang of 2θ=10~40º.

3. Results and discussion

PEKK oligomers with various molecular weight were first synthesized by controlling the molar ratio of DPE to TPC, according to the modified Carothers equation [20], i.e., $X_n= (1+r)/ (1-r)$, where X_n is the number-average degree of polymerization and r is the molar ratio of DPE to TPC. The calculated X_n and M_n of PEKK oligomers have been listed in Table 1. While in the synthesis of the multiblock copolymers composed of PEKK and 2, 6-bis (β-naphthoxy) benzonitrile (BNOBN), different molar ratios of BNOBN to DPE were controlled to obtain the copolymers. But the sum of moles of BNOBN and DPE should be equal to that of terephthaloyl chloride (TPC). The molar ratios and inherent viscosities of the polymers are also given in Table 1. Inherent viscosities (η_{inh}) reveal that the high molecular weight polymers were obtained in the given reaction medium since theη_{inh} values of the polymers were higher than the criticalη_{inh} value of the macromolecule. Thus, the polycondensation route is appropriate.

Table 1. Compositions and viscosities of the polymers

Polymer	BPOBN/DPE	X_n (PEKK) (oligomer)	M_n (PEKK) (oligomer)	Elemental analysis, %			η_{inh} copolymer (Dl/g)
				C	H	N	
Ⅰ	0/100			79.87(80.00)	3.87(4.00)		0.83
Ⅱ	5/95	39	11700	80.14(80.10)	3.99(3.97)	0.21(0.23)	0.78
Ⅲ	10/90	19	5700	80.23(80.20)	3.97(3.95)	0.41(0.44)	0.76
Ⅳ	15/85	12.3	3690	80.33(80.29)	3.95(3.92)	0.60(0.63)	0.74
Ⅴ	20/80	9	2700	80.40(80.37)	3.93(3.90)	0.79(0.82)	0.73
Ⅵ	25/75	7	2100	80.49(80.45)	3.92(3.88)	0.97(0.99)	0.69
Ⅶ	30/70	5.7	1710	80.56(80.53)	3.89(3.86)	1.13(1.15)	0.65

The elemental analysis values, i.e., C, H, and N content of polymers I~VII (Table1) are in close agreement with theoretical values confirming the proposed structure. The FT-IR spectra of all polymers show no absorption in the 1850~1720 cm^{-1} region indicating the absence of –COCl groups. All the spectra have a 1655 cm^{-1} stretching vibration for the C=O group, a 1586cm^{-1} stretching vibration for the C=C bonds of the aryl ring, 1494 cm^{-1}for the C=C asymmetrical stretching vibration, 1241 cm^{-1}for the ether group asymmetrical vibration of—Ar—O—Ar—, and 2231 cm^{-1} stretching vibration for CN group, except for polymer I where characteristic absorption for cyano group was absent.
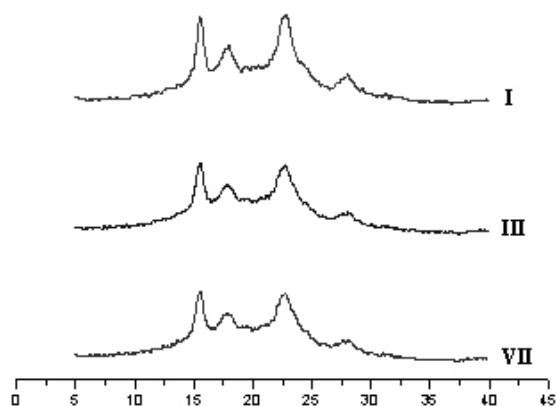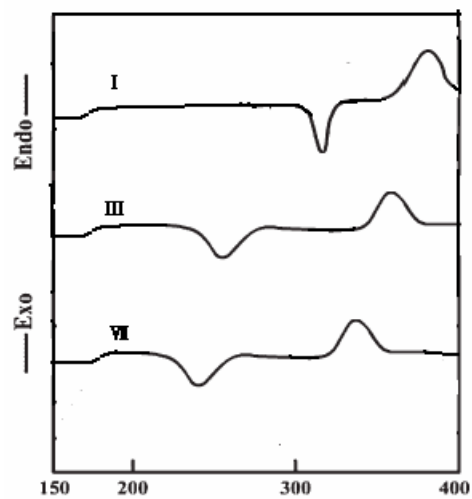

Figure 1. WAXD analysis of polymer I, III and VII

Figure 2. The typical DSC curves of the polymers

The glass transition temperatures (T_gs), the melting points (T_ms), and the crystallization temperatures (T_cs) of the polymers were determined by DSC and the results are given in Table 2. Although the polymer I (p-PEKK) had a higher TG (169℃), its T_m (385℃) was too high, which made it difficult to process. The T_g values of the copolymers increased with increase in concentration of BNOBN in the copolymer when the molar ratio of DPOBN to DPE ranged from 5/95 to 30/70. This gradual increase in T_g may be due to the gradual increase in concentration of cyano pendant groups and inflexible β-naphthalene rings, which hinders the free rotation of aromatic ring. As shown in table II, the melting points (T_ms) of the polymers gradually decreased with increase in concentration of DPOBN in the polymer because of the pendant cyano groups and 1,3-connected *meta*-phenylene linkages. The crystallization temperatures (T_cs) of the polymers also decreased with increase in concentration of DPOBN in the polymers. The results agreed with the WAXD results. The T_m of the p-PEKK homopolymer (385℃) can be reduced to 332℃ when the molar ratio of DPOBN to
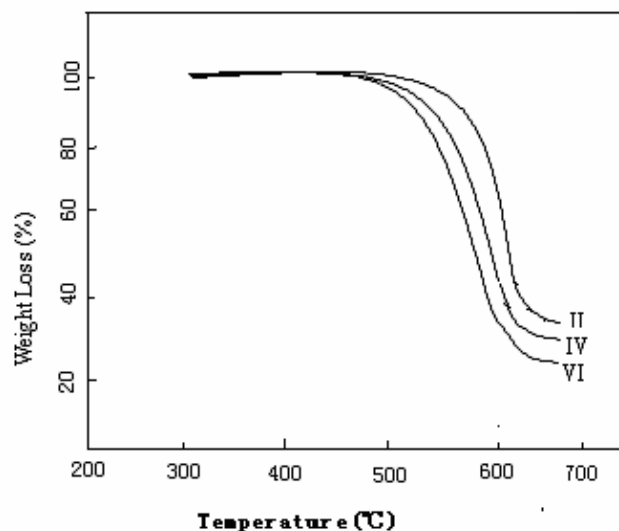
Figure 3. Typical TGA curves of polymer Ⅱ, Ⅳ and Ⅵ

The thermal stabilities of the polymers were investigated by TG.. The thermal decomposition temperatures (T_ds) of the polymers are also listed in Table 2. All the polymers are thermally stable up to 533 ℃. The thermal stability of the materials is affected by the content of BNOBN in the polymer. Polymer I (p-PEKK), without cyano and *m*-phenylene groups, has the highest thermal decomposition temperature (548 ℃), the thermal decomposition temperatures (T_ds) of the copolymers with 5-30 mol% BNOBN are observed between 533 and 545 ℃. The small variations in the T_ds of the resultant copolymers make the copolymers II-VII acceptable for heat-resistance applications. The typical TG curves of the polymers Ⅱ, Ⅳ and Ⅵ are illustrated in Figure 3. The temperature difference between T_m and T_d of polymer Ⅵ and Ⅶ was large, thus the fusion processing can be accomplished.

The solubility behavior of the polymers prepared in this study was determined for powdery samples in excess solvents at room temperature for 24 h and the results are listed in Table 3. It is shown that all the polymers are soluble in strong protic acid, such as aqueous sulfuric acid and in $CHCl_3$/CF_3COOH mixtures. The high molecular weights of the copolymers were verified by inherent viscosity measurements in concentrated sulfuric acid. A $CDCl_3$/CF_3COOH mixture was found to be a convenient solvent for NMR measurements. The content of BNOBN in the copolymers affects the solubility of the copolymers in organic solvents. It is known that polymer Ⅰ~Ⅱ shows poor solubility in NMP, DMSO and DMF. Polymer Ⅲ~Ⅵ can be only swelled in NMP, DMSO and DMF. Polymer Ⅶ (30mol% DNOBN can be dissolved in NMP, but only swelled in DMF, DMSO. However, all polymers prepared were insoluble in common solvents, such as THF, $CHCl_3$, DCE and so on. Thus, from the results above, we concluded that the multiblock copolymers have good resistance to common organic solvents.

Table 3. Solubility of the polymers

Polymer	H2SO4	CF$_3$COOH/CHCl$_3$	NMP	DMSO	DMF	THF	CHCl$_3$	DCE
Ⅰ	+	+	-	-	-	-	-	-
Ⅱ	+	+	+ -	+ -	+ -	-	-	-
Ⅲ	+	+	+ -	+ -	+ -	-	-	-
Ⅳ	+	+	+ -	+ -	+ -	-	-	-
Ⅴ	+	+	+ -	+ -	+ -	-	-	-
Ⅵ	+	+	+ -	+ -	+ -	-	-	-
Ⅶ	+	+	+	+ -	+ -	-	-	-

+: soluble, + -: swollen, -: insoluble

The η_{inh} values of the copolymers Ⅵ and Ⅶ when heated at (350±10) ℃ for different times are shown in Table 4. We concluded that no significant change in the η_{inh} values took place compared with that of the original sample. Thus, no cross linking took place when the copolymers of Ⅵ or Ⅶ were heated for 2 h, respectively. The results showed that the copolymers Ⅵ and Ⅶ appeared to have good thermal stability and also to have potential for fusion processing.

Table 4. η_{inh} values of the copolymers VI and VII at (350±10) ℃

Heat time (min)	η_{inh}(Polymer Ⅵ)	η_{inh}(Polymer Ⅶ)
0	0.69	0.65
15	0.68	0.66
30	0.70	0.67
60	0.68	0.68
90	0.69	0.66
120	0.70	0.67

4. Conclusions

The conclusions that can be drawn from the present study are as follows:

1. PEKK oligomers containing acyl chloride groups were first prepared by condensation of excessive terephthaloyl chloride (TPC) and diphenyl ether (DPE) for three hours. Then a series of multiblock copolymers composed of poly (aryl ether keotne ketone) (PEKK) and 2, 6-bis (β-naphthoxy) benzonitrile (BNOBN) were synthesized by poly-condensation of PEKK oligomers with BNOBN.

2. All the resulting polymers are semi-crystalline and the crystallinity and melting temperature of the copolymers were found to decrease with increase in concentration of 2, 6-bis (β-naphthoxy) benzonitrile (BNOBN) units in the polymers. The thermal decomposition temperatures (T_ds) of the copolymers with 5-30 mol% BNOBN are observed between 533 and 545 ℃. The small variations in the T_ds of the resultant copolymers make the copolymers Ⅱ-Ⅷ acceptable for heat-resistance applications.

3. The copolymer with 25~30 mol% DPOBN has a high T_g (187~192℃), a high T_d (533~535℃), and moderate T_m (332~337 ℃), which is very acceptable for melt processing, and the copolymers with 25~30% mol BNOBN units exhibit excellent thermo stability at (350±10) ℃.

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Eventually Strong Wrpp Semigroups

Whose Idempotents Satisfy Permutation Identities

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Abatract

The aim of this paper is to study eventually strong wrpp semigroups whose idempotents satisfy permutation identities, that is, so-called PI-strong wrpp semigroups. After some properties are obtained, the structure of such semigroups are investigated. In particular, the structure of special cases are established.

Keywords: eventually strong wrpp, normal band, eventually PI-strong wrpp, spined product

1. Introduction and preliminaries

Let S be a semigroup, A a subset of S and let

$$\sigma = \begin{pmatrix} 1, & 2, & \dots, & n \\ \sigma(1), & \sigma(2), & \dots, & \sigma(n) \end{pmatrix} \qquad (*)$$

A non-identity permutation on n objects. Then A is said to satisfy the permutation identity determined by σ (in short, to satisfy a permutation identity if there is no ambiguity) if

$$(\forall x_1, x_2, \dots, x_n \in A) \quad x_1 x_2 \dots x_n = x_{\sigma(1)} x_{\sigma(2)} \dots x_{\sigma(n)},$$

Where $x_1 x_2 \dots x_n$ is the product of $x_1, x_2, \dots$ and x_n in S. If $A = S$, then S is called a PI-semigroup.

In connection with this, regular semigroup whose idempotents satisfy permutation identities were investigated by Yamada (1967, P.371). Strong wrpp semigroup whose idempotents satisfy permutation identities were investigated by Guo(1996, P.1947) Eventually strong wrpp semigroup whose idempotents satisfy permutation identities were studied by Du et al.(2001,P.424).

Du(2001, P.5)introduced the relation $L^{(**)}$ which generalizes the relation L^{**}, and the concept of eventually wrpp semigroup was introduced.

Let $a, b \in S$. Then $aL^{(**)}b \iff axRay$ if and only if $bxRby$ for all $x, y \in S$. we write as $L_a^{(**)}$ with respect to $L^{(**)}$- class containing a for any $a \in S$. Clearly, $L^{**} \subseteq L^{(**)}$. In particular, we have $L^{**} = L^{(**)}$ when $S = S^1$.

We denote

$$I_a = \{e \in E(S) \mid (\forall x \in S) eax = ax, \text{ and } xae = xa\}$$

for all $a \in E(S)$.

A semigroup is called eventually stong wrpp semigroup if each $L^{(**)}$-class of S contains an idempotent, and $|L_a^{(**)} \cap I_a| = 1$ for all $a \in S$. Here, denotes unique idempotent by a^+.

A eventually strong wrpp semigroup S is called eventually PI-strong wrpp semigroup if idempotents of S satisfy a permutation identity.

Throughout this paper, the terminologies and notations are not defined can be found in Howie(1976).

Lemma1.1 (Yammada, 1967, PP.371-392) let B be a band. Then the following conditions are equivalent:

(1) B Satisfy a permutation identity;

(2) B is a normal band;

(3) B is a strong semilattice of rectangular bands.

Lemma 1.2(Tang, 1997, PP.1499-1504) Let Y be a semilattice, and $S = [Y; S_a, \Phi_{\alpha,\beta}]$ a strong semilattice of semigroup S_α. If for any $a \in S_\alpha$, $b \in S_\beta, (a,b) \in R$, then $\alpha = \beta$.

Definition 1.3 A semigroup S is called R-cancellative monoids, if for any $a,b,c \in S$, $(ca,ab) \in R \Rightarrow (a,b) \in R$ and $(ac,bc) \in R \Rightarrow (a,b) \in R$.

2. Some lemma

In what follows S is always a eventually strong semigroup whose idempotents satisfy permutation identity(*). Let

$$k = min\{i \mid \sigma(i) \neq i\}, \ m = \sigma^{-1}(k),$$

then $\sigma(k) > k$. For any $e \in E(S)$, we let

$$S_e = \{a \in S \mid a^+ = e\}.$$

Lemma 2.1 The following conditions hold:

(1) A subsemigroups of S satisfy formula (*);

(2) $E(S)$ is a normal band;

(3) $L^+(S)|_T \subseteq L^+(T)$ for any a subsemigroup T of S;

(4) $ab = aa^+b = ab^+b = aba^+b^+ = a^+b^+ab$ For any $a,b \in S$.

Proof. Proof of (1) and (2) refer to Yammada(1967,PP.371-392). (3) is trivial. We only show that (4). According to $xaa^+ = xa, a^+ax = ax$ and $a^+a = aa^+$, we have $ab = aa^+b = ab^+b$.

By S satisfying equation (*), we have

$$ab = aa^+bb^+ = a(a^+)^k a^+ (a^+)^{(m-k)} bb^+ (b^+)^{(n-m)} b^+ = a(a^+)^k bb^+ a^+ b^+ = aba^+b^+.$$

Dually, we have $ab = a^+b^+ab$.

Lemma2.2 $(ab)^+ = a^+b^+$ holds for any $a,b \in S$.

Proof. Let all $x, y \in S$. Then

$$
\begin{aligned}
abxRaby &\Rightarrow a^+bb^+ Ra^+bb^+ \quad (aL^{(**)}a^+, a^+b = a^+bb^+) \\
&\Rightarrow b^+a^+bb^+xRb^+a^+bb^+y \quad (R \text{ is a left congruence}) \\
&\Rightarrow (b^+)^k a^+ (b^+)^{(m-k)} b(b^+)^{(n-m+1)} xR(b^+)^k a^+ (b^+)^{(m-k)} b(b^+)^{(n-m+1)} y \\
&\Rightarrow ba^+b^+x = b^+ba^+b^+xRb^+ba^+b^+y = ba^+b^+y \quad (S \text{ satisfies } (*)) \\
&\Rightarrow b^+a^+b^+xRb^+a^+b^+y \quad (bL^{(**)}b^+) \\
&\Rightarrow a^+b^+xRa^+b^+y \\
&\Rightarrow abxRaby \quad (aba^+b^+ = ab).
\end{aligned}
$$

Consequently, $a^+b^+ \in L^+_{ab} \bigcap E(S)$. By lemma 2.1(4), we know that $(ab)^+ = a^+b^+$.

Lemma 2.3 Let $e \in E(S)$. Then S_e is an inflation of commutative R-cancellative monoids.

Proof. According to lemma 2.2, we know that S_e is a subsemigroup of S. Noticed that

$$eS_e = S_e e \subseteq S_e^2 = \{ab \mid a,b \in S_e\} = \{abe \mid a,b \in S_e\} \subseteq S_e e.$$

Thus $eS_e = S_e e = S_e^2$, so S_e^2 contains a identity element e, and satisfies (*). For any $a,b \in S_e^2$, we have

$$ab = e^k ae^{m-k} be^{n-m+1} = ebae = ba,$$

That is, S_e^2 is commutative. For any $c \in S_e^2$ such that $caRcb$, by cL^+e, we have $a = ea \operatorname{Re} b = b$. Thus S_e^2 is R−left cancellative, so S_e^2 is a R-cancellative monoid. The mapping ϕ_e defined by the following rule:

$$\phi_e : S_e \to S_e^2, \ x \mapsto ex,$$

Then for any $x, y \in S_e$, we have $xy = exy = exey = x\phi_e y\phi_e$. So S_e is an inflation of commutative R-cancellative monoids S_e^2.

Lemma 2.4 Let B be a normal band, and η the least semilattice congruence on B. Then B is a eventually PI- strong wrpp semigroup and $L^+(B) = \eta$.

Proof. Let $[Y; E_\alpha, \xi_{\alpha,\beta}]$ be a strong semilattice decomposition of B with structure homomorphism $\xi_{\alpha,\beta}$, where Y is a semilattice, and $E_\alpha (\alpha \in Y)$ is a rectangular band. For any $a \in B$, we have $a \in L_a^{(**)} \bigcap I_a$. If $e \in L_a^{(**)} \bigcap I_a$, then we have $eax = ax \ xae = xa$ and $ea = ae$ for any $x \in B$. By $eL^{(**)}(B)a$ and $ae = ea = eaa = aa = a$, we have $e = ee \operatorname{Re} a = a$. Therefore, $e = ae = a$, so $a = a^+$. According to lemma 1.1, we know that B is a eventually PI- strong wrpp semigroup.

Let $a \in E_\alpha, b \in E_\beta (\alpha, \beta \in Y)$, and $aL^{(**)}b$. By $ab = a\bar{b}\xi_{\beta,\alpha\beta}$, we Have $b = bbR\bar{b}b\xi_{\beta,\alpha\beta}$. According to lemma1.2, $\beta = \alpha\beta$, similarly, $\alpha = \alpha\beta$. Therefore $L^{(**)}(B) \subseteq \eta$.

Conversely, let $a\eta b$. Then $\alpha = \beta$, and for any $x \in E_\gamma, y \in E_\lambda$, we have

$$
\begin{aligned}
axRay &\Leftrightarrow a\xi_{\alpha,\alpha\gamma} x\xi_{\gamma,\alpha\gamma} R a\xi_{\alpha,\alpha\lambda} y\xi_{\lambda,\alpha\lambda} \\
&\Leftrightarrow \alpha\gamma = \alpha\lambda \\
&\Leftrightarrow b\xi_{\beta,\beta\gamma} x\xi_{\gamma,\beta\gamma} R b\xi_{\beta,\beta\lambda} y\xi_{\lambda,\beta\lambda} \\
&\Leftrightarrow bxRby.
\end{aligned}
$$

Thus aL^+b, so $\eta \subseteq L^{(**)}(B)$.

Lemma 2.5 the following conditions are equivalent:

(1) $E(S)$ is a rectangular band;

(2) S is $L^{(**)}$-single;

(3) S is an inflation of the semidirect product of a commutative R-cancellative monoids and a rectangular band.

Proof. (1) $\Rightarrow$ (2). Let $E(S)$ be a rectangular band. For any $a, b \in S, x, y \in S$,

We have

$$
\begin{aligned}
axRay &\Leftrightarrow a^+xRa^+y \quad (aL^{(**)}a^+) \\
&\Leftrightarrow b^+a^+xRb^+a^+y \quad (R \text{ is a left congruence}) \\
&\Leftrightarrow b^+a^+x^+xRb^+a^+y^+y \quad (\text{by lemma } 2.1(4)) \\
&\Leftrightarrow b^+x^+xRb^+y^+y \quad (E(S) \text{ is a rectangular band}) \\
&\Leftrightarrow b^+xRb^+y \quad (\text{by lemma } 2.1(4)) \\
&\Leftrightarrow bxRby \quad (bL^{(**)}b^+).
\end{aligned}
$$

Therefore, $aL^{(**)}b$.

(2) $\Rightarrow$ (3). Let S is $L^{(**)}$-single. By lemma 2.1 (2) and (3), we know that $E(S)$

is a normal band, and $L^{(**)}|_{E(S)} = \omega|_{E(S)}$. So $E(S)$ is a rectangular band since $L^{(**)}|_{E(S)}$ is the least semilattice congruence on $E(S)$. According to lemma 2.1(4) and lemma 2.2, we have $S^2 = \bigcup_{e \in E(S)} S_e e$. The mapping defined by the following rule:

$$\varphi: S \to S^2, \quad x \mapsto xx^+,$$

By lamma 2.3 and its proof, we know that definition of φ is good. For any

$a, b \in S$, we have $ab = aa^+bb^+ = a\varphi b\varphi$. Thus S is an inflation of S^2. We select a fixed $e \in E(S)$, The mapping defined by the following rule:

$$\Psi: S^2 \to S_e^2 \times E(S), \quad x \mapsto (exe, x^+).$$

Let $x, y \in S^2$ such that $x\Psi = y\Psi$. Then $x^+ = y^+$, and $x = x^+ex^+xx^+ex^+$

$= x^+exex^+ = y^+eyey^+ = y$. Therefore Ψ is injective. For any $(x, f) \in S_e^2 \times E(S)$,

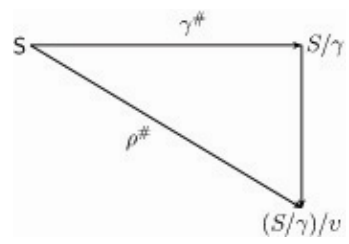We have $(fxf)\Psi = (x, f)\Psi$. Thus Ψ is surjective. On the other hand, for any

$x, y \in S^2$, we have

$$
\begin{aligned}
(xy)\Psi &= (exye, (xy)^+) = (exx^+ey^+ye, x^+y^+) \\
&= (exx^+eey^+ye, x^+y^+) \\
&= (exe\, eye, x^+y^+) \\
&= x\Psi\, y\Psi.
\end{aligned}
$$

Therefore, Ψ is a isomorphic mapping.

(3) $\Rightarrow$ (1). It is trivial.

Lemma 2.6 Let $\rho = \{(a, b) \in S \times S \mid a^+\eta b^+\}$. Then ρ is a semilattice congruence on S, and each ρ-class of S is a

Noticed that for any $a \in S_\alpha, b \in S_\beta, \alpha, \beta \in Y$, we have

$$ab = aa^+b^+a^+b^+bb^+a^+b^+ = aa^+b^+a^+b^+bb^+a^+b^+$$
$$= aa^+\xi_{\alpha,\,\alpha\beta}b^+\xi_{\beta,\,\alpha\beta}a^+\xi_{\alpha,\,\alpha\beta}bb^+\xi_{\beta,\,\alpha\beta}a^+\xi_{\alpha,\,\alpha\beta}b^+\xi_{\beta,\,\alpha\beta}$$
$$= (aa^+\xi_{\alpha,\,\alpha\beta})(bb^+\xi_{\beta,\,\alpha\beta})$$
$$= a\Phi_{\alpha,\,\alpha\beta}\, b\Phi_{\beta,\,\alpha\beta}\,.$$

Thus $\Phi_{\alpha,\,\beta}$ is a structure homomorphism, where $\alpha, \beta \in Y$, and $\alpha \geq \beta$.

$(2) \Rightarrow (3)$. Let $S = [Y; S_\alpha, \Phi_{\alpha,\beta}]$ is a strong semilattice of S_α, where $\alpha, \beta \in Y, S_\alpha$ is an inflation of the direct product of a commutative R – cancellative monoid M_α and a rectangular band E_α with respect to the mapping φ_α. Then $S_\alpha^2 = M_\alpha \times E_\alpha$, and for $\beta \leq \alpha$, we have

$$(M_\alpha \times E_\alpha)\Phi_{\alpha,\beta} = S_\alpha^2 \Phi_{\alpha,\beta} \subseteq M_\beta \times E_\beta.$$

Therefore, $M = \bigcup_{\alpha \in Y} M_\alpha \times E_\alpha$ forms a subsemigroup of S, and

$$M = [Y; M_\alpha, \Phi_{\alpha,\beta}|_{M_\alpha \times E_\alpha}] \quad (\alpha, \beta \in Y).$$

Let $\phi_{\alpha,\beta}$ and $\psi_{\alpha,\beta}$ denote the mapping which M_α onto M_β elicited by $\Phi_{\alpha,\beta}|_{M_\alpha \times E_\alpha}$ and the mapping E_α onto E_β, respectively, identity element of M_α write as e_α, and $M' = [Y; M_\alpha, \phi_{\alpha,\beta}], B = [Y; E_\alpha, \psi_{\alpha,\beta}]$. According to lemma 9, $M = M' \times B$. For any $x \in S_\alpha(\alpha \in Y)$ such that $x\varphi_\alpha = (a,e) \in M_\alpha \times E_\alpha$. Then let $x^* = (e_\alpha, e)$. For any $\gamma \in Y$, and $\gamma < \alpha$, then $(x\Phi_{\alpha,\gamma})^* = x^*\Phi_{\alpha,\gamma}$. If not, then

$$(x\Phi_{\alpha,\gamma})^* = (e_\gamma, f) \neq (e_\alpha\phi_{\alpha,\gamma}, e\psi_{\alpha,\gamma}) = (e_\gamma, e\psi_{\alpha,\gamma}) = x^*\Phi_{\alpha,\gamma}.$$

So

$$((xx^*)\Phi_{\alpha,\gamma})^* = (x\Phi_{\alpha,\gamma}x^*\Phi_{\alpha,\gamma})^* = (x\Phi_{\alpha,\gamma})^*x^*\Phi_{\alpha,\gamma} = (e_\gamma, fe\psi_{\alpha,\gamma})$$
$$\neq (e_\gamma, e\psi_{\alpha,\gamma}f) = x^*\Phi_{\alpha,\gamma}(x\Phi_{\alpha,\gamma}) = ((x^*x)\Phi_{\alpha,\gamma})^*.$$

This is contrary to $x^*x = x^*x\varphi_\alpha = x\varphi_\alpha = x\varphi_\alpha x^* = xx^*$. For any $y \in S_\beta(\beta \in Y)$,
We have

$$xy = x\Phi_{\alpha,\alpha\beta}y\Phi_{\beta,\alpha\beta} = x\Phi_{\alpha,\alpha\beta}(x\Phi_{\alpha,\alpha\beta})^*y\Phi_{\beta,\alpha\beta}(y\Phi_{\beta,\alpha\beta})^* = (xx^*)\Phi_{\alpha,\alpha\beta}(yy^*)\Phi_{\beta,\alpha\beta}.$$

Therefore, S is an inflation of M with respect to the mapping $\theta: S \to M, x \mapsto xx^*$.

$(4) \Rightarrow (5)$. Let S is an inflation of spined product of a strong semilattice of a commutative R – cancelative monoid M and a normal band B with respect to it's the common greatest homomorphism image under the mapping φ. Then S is also an inflation of a strong semilattice M' of commutative R – cancelative monoids and a normal band B with respect to the mapping φ. Let the greatest semilattice decomposition of M and B be

$$M = [Y; M_\alpha, \phi_{\alpha,\beta}], B = [Y; E_\alpha, \psi_{\alpha,\beta}].$$

Let $a, b, x, y \in S$, and such that $a\varphi = (k,e) \in M_\alpha \times E_\alpha, x\varphi = (l,f) \in M_\beta \times E_\beta, b\varphi = (m,g) \in M_\gamma \times E_\gamma, y\varphi = (n.h) \in M_\delta \times E_\delta, e_\alpha$ is an identity element of M_α. Then

$$axRay \Leftrightarrow (kl, ef)R(kn, eh)$$
$$\Leftrightarrow (ke, ef)R(ke_\alpha n, eh)$$
$$\Leftrightarrow (e_\alpha l, ef)R(e_\alpha n, eh), \alpha\beta = \alpha\gamma \quad (M_\alpha \text{ is a } R\text{-cancellative moniod})$$
$$\Leftrightarrow (e_\alpha, e)xR(e_\alpha, e)y.$$

Thus $aL^+(e_\alpha, e)$. Clearly, $xa(e_\alpha, e) = xa, (e_\alpha, e)ax = ax$. Let $(e_\lambda, u) \in M_\lambda \times E_\lambda(\lambda \in Y)$

Such that $(e_\lambda, u)L^+a$, and $xa(e_\lambda, u) = xa; (e_\lambda, u)ax = ax$. Then we imply that $\beta\alpha\lambda = \beta\alpha$ by $xa(e_\lambda, u) = xa$. Let $\beta = \alpha$. Then $\alpha\lambda = \alpha$. So $\lambda \geq \alpha$. Again $(e_\lambda, u)\Phi_{\lambda,\alpha}a\varphi = (e_\lambda, u)a = a(e_\lambda, u) = a\varphi(e_\lambda, u)\Phi_{\lambda,\alpha}$ u), where $\Phi_{\alpha,\beta}$ is a structure homomorphism of a strong semilattice M' of a commutative R – commutative monoid and a rectangular band, so $(e_\lambda, u)\Phi_{\lambda,\alpha}$ is an identity element of $a\varphi$ in $M_\alpha \times E_\alpha$. Thus $(e_\lambda, u)\Phi_{\lambda,\alpha} = (e_\alpha, e)$. Noticed that $(e_\alpha, e) = (e_\alpha, e)(e_\alpha, e) = (e_\lambda, u)(e_\alpha, e)$,

so $(e_\alpha, e) = (e_\lambda, u)(e_\alpha, e) = (e_\lambda, u)(e_\lambda, u) = (e_\lambda, u)$, consequently, $(e_\alpha, e) = a^+$, S is an eventually strong wrpp semigroup. According to M is a commutative

R – cancellative monoid and B is a normal band, we obtain

$$axyb = (klnm, efgh) = (knlm, egfh) = ayxb \cdot$$

Therefore, (5) holds.

Definition 3.2 A wrpp semigroup S is called to satisfy conditions (L).if there exist a unique $e \in L^{**} \bigcap E(S)$ such that $eae = a$ for all $a \in S$.

Corollary3.3 an eventually PI-strong semigroup S is a semigroup with satisfying the conditions (L) and satisfying the permutation identity (*)

If and only if $S^2 = S$.

Proof. Let S be an eventually PI-strong wrpp semigroup. By theorem 3.1, we know that S is an inflation of the spined product of a commutative R – cancellative monoid M and a normal band B with respect to its common greatest semilattcice homomorphism image Y. If $S^2 = S$, then $S = M \times_Y B$. According to the proof of theorem 3.1, for any $(k,e) \in M_\alpha \times E_\alpha \subseteq S, (k,e)^+ = (e_\alpha, e)$ and $(k,e)^+(k,e)(k,e)^+ = (k,e)$, we can imply that S is a semigroup with satisfying the conditions (L) and satisfying the permutation identity (*). Conversely, if S is a semigroup with satisfying the conditions (L) and satisfying the permutation identity (*), then we have $a^+ a = a$ for any $a \in S$. Therefore $S^2 = S$.

Corollary3.4 the following conditions are equivalent:

(1) S is a semigroup with satisfying the conditions (L) and satisfying the permutation identity (*);

(2) S is an eventually PI-strong wrpp semigroup, and $S^2 = S$;

(3) S is a strong semilattice of the direct product of a commutative R – cancellative monoid and a rectangular band;

(4) S is a spined product of a strong semilattice of commutative R – cancellative monoid and a normal band;

(5) S is a semigroup with satisfying the conditions (L) and satisfying a permutation identity $x_1 x_2 x_3 x_4 = x_1 x_3 x_2 x_4 \cdot$

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Reconstruction of Video Electromagnetic Leakage from Computer

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Abstract

TEMPEST technology has been concerned much more in recent years. Video Displayer Unit, which is one of the most import parts that may result in computer information leakage, offers the interface for man-machine conversation directly and its video electromagnetic radiation contains the displaying information. The interception and recovery system of video electromagnetic information leakage of the computer is designed. After the electromagnetic leakage is intercepted, the method to recover the word image is presented using the reconstruction techniques such as synchronization, related filtering, phase lock on etc. This means that the original useful information can be reconstructed by the electromagnetic leakage under certain conditions, and this will menace information security. It is one of the most important factors that should be concerned in information security and electronic antagonism fields.

Keywords: TEMPEST, Electromagnetic Radiation, Electromagnetic leakage, Filtering, Information Reconstruction

1. Introduction

Electronic equipments deal with data information by controlling the changes of electric current (or voltage). But the time-variant electric current will bring electromagnetic radiation which contains abundant frequency spectrum and information that can be unscrambled.

According to the investigation and analysis from the domestic and aboard if the radioactive electromagnetic wave is detected and intercepted the digit signal can be abstracted. As a result, it will cause information leaking by means of reproduce the original information. Therefore, it is one of the key technologies to reduce or remove the problem of information leaking caused by electromagnetic radiation .The video information radiation from electromagnetic radiation coming with the working computer can received the transmitting signals can be monitored .The emission of electromagnetism has two main influences on the information technologic equipment: the first one is the electromagnetic disturbing and information leaking caused by the electromagnetic emission of their own ,the other the disturbing and destroying from outside. The two kinds of influences have not only the problem of electromagnetic disturbing but also the problem of information leaking. TEMPEST, advanced during 1980s is a technology based on computer information leaking. It is a new technique developed from the field of electromagnetic annexation bringing great threaten to the information safety. Acquiring the intelligence from the leakage from TEMPEST is one of important methods used by ELINT to get information .In the Bay-War happened in 1991, America used the most advanced TEMPEST technique to intercept and capture the intelligence about politics ,military affairs and economy of Iraq and Bay area. Although the TEMPEST technique is based on the principle of electromagnetic radiation, it pays more attention to abstract useful information handling and identifying to deal with this useful information. The computer system is the most important component of various information technique devices, so it is the primary research objective among all the TEMPEST technique problems. The computer's make up circuits are complex and contain many kinds of clock information, all of which exist electromagnetic radiation to a certain degree. The sources of radiation can be divided into CPU, communication circuits, and transform equipments, output devices and so on...All of them will lead to information leaking phenomenon. These leakages contain synchronism signal, clock signal, digit signal, being processing and information being displayed on the screen.

From the middle age of 1980s, our country has begun to research on TEMPEST. In the early age of 1990s, several internal units researched some key-pointing problems of TEMPEST technique and got many important achievements on many subjects, for example: computer information leakage and principle of protection from it, the technique of

receiving and receiving and restoring micro-mini computer radioactive information, safety evaluation, the test of technical production, laboratory and scene testing, distinguishing from red and black signals, the technique of electromagnetic leakage protection in micro-mini computer system, and so on. In 1980s in the nationwide exhibition of computer application, the department of public security demonstrated that they reappeared the showing content of micro-mini computer's screen on TV's screen by using TV receiving antenna to aim at the computer. Xi'an electronic technique university and so on used black-and-white television to receive screen information. Changchun light machine office of Chinese Academy of Science carried out the interception and reappearance about the video leaking information of the computer whose showing method is CGA. The receiving scope is usually limited to about 3 meters for reappearing display text information by means of black-and-white television structure. But Van.Eck came up in his thesis that it can receive and deoxidize the video frequency information among 1000 meters. During 1990s, English reported that they can receive and deoxidize information in 1600m.In comparison, Beijing Postal and label services university carried out a receiving machine which realized the reappearance of computer word leakage and got word reseen picture located at far range. In 2004, the university completed a simulation platform, which was used to reappearance computer video electro magnetic linking information and realize the ration evaluation about the leaking threshold of information and the reinforcing function of computer.

Through the video frequency channel we can realize the communication between man and computer directly. The reason why the video frequency signal is a main scores of information leakage is that the electromagnetic leakage caused by video signal radiation including useful information that can be recognized an abstract easily. Regarding the character information, they are random digit signal can produce electromagnetic radiation easily an take on wide frequency spectrum area owning to there are more causes and components caused information leakage this article have design the system method for the computer electromagnetic leakage. Dealing with the real data use many technique like synchronism, related filtering, phase lock and so on to obtain the word and image reappearance from electromagnetic leakage.

From the research we can discovery the electromagnetism radiation caused by digit pulse video frequency signal processing a wide frequency spectrum area. In addition, owning to the effect of muti-patches effect will be neglected under strong noise when transmitting through the wireless channel. At the same time the signal has been deformed. Because the received video signal radiation has low S/N, wide spectrum and will be deformed, so to capture and deal with the electromagnetism leakage information is different from to receive and do with the classical communication signal either in theory or in technique. In this article, when the electromagnetic leakage from computer captured, the technique of abstracting the filed synchronism signal and row synchronism signal, phase clock, related filtering, be used to reappear the word image of common song-character displaying on the computer screen away from 10 miters. It's a breakthrough to the recorder of the distance researched about the leakage information.

2. The Distill of the Synchronous Signal in Electromagnetic Leakage

The references [21,22] gave the metrical results of the Electromagnetic Leakage. In this paper, we designed the frame of interception and rebuild of the Electromagnetic Leakage information. After the interception with the help of the wide-band antenna, the information was transferred into digital. The signal processing was finished by software applications. The sample rate of the system is 60M.

In the near filed, to output though amplify, demodulation and detector after digital sampling, we could get the character signal of Electromagnetic Leakage when computer display character information near the receive center frequency. Which sketch 2(a)(b) is field synchronous information and row synchronous information of Electromagnetic Leakage information separately, sketch 2(c)(d) is field synchronous signals and row synchronous signals which is abstracted by Electromagnetic Leakage information. Sketch 2(e) is one row of the video signal of Electromagnetic Leakage information; sketch 2(f) is the abstracting video signal after signal processing. corresponding to sketch 2(e) which vertical is relative amplitude of the Electromagnetic Leakage information after signal processing, horizontal is the number of sampling point corresponding to the time is 16.7 ns.
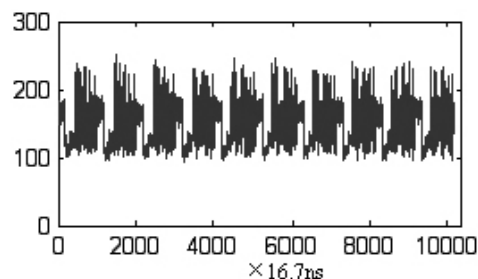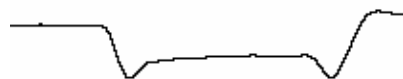

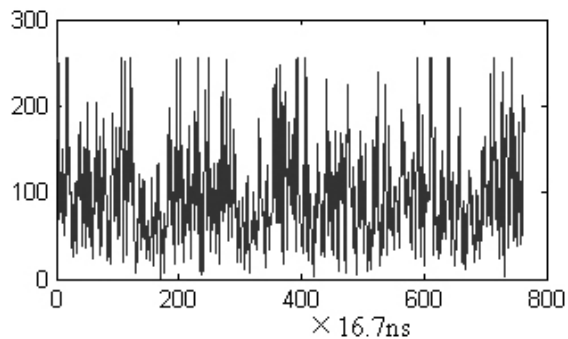the row synchronous character information of the Electromagnetic Leakage information.
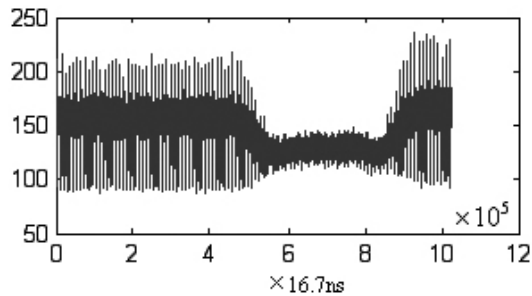
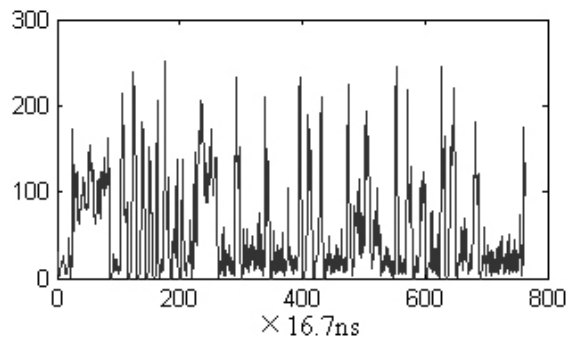the filed synchronous character information of the Electromagnetic Leakage information.
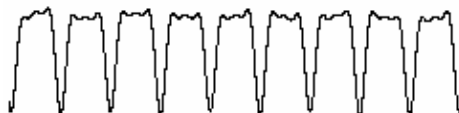
the row synchronous signal abstracted from Electromagnetic Leakage information.

the filled synchronous signal abstracted from Electromagnetic Leakage information.

The video signal leaked from character information and picture information.

The video signal abstracted after signal processing.

3. The Technology of Signal Processing

3.1 The principle of phase lock on

The recovery technology of get field synchronous signals and row synchronous signals though signal processing of

the collected Electromagnetic Leakage from Computer is one of the key technology of Electromagnetic Leakage's Reconstruction. To make the field synchronous signals and row synchronous signals steady ,we adopt the digital phase lock on: technology, make use of phase lock on loop circuit accurate fix the output synchronous signals position. The basic of the structure of phase lock on such as the sketch 3.It consist of 3 base component part:

comparer, LPF, and synchronous signals producer (synchronous circuit), the input signals is the field synchronous signals and row synchronous signals which is picked up by receiver. The comparer compare the input signals Si(t)and the output synchronous signals So(t) which pass the circuit. Product error voltage Se(t) corresponding to two signals. The function of LPF is filter the high frequency component and noise of the error voltage Se(t), the purpose is to ensure the functions which is needed by the loop, and enhance the stability of system. The synchronous circuit is controlled by the control voltage Sd(t). make the synchronous signals approach to the input signals, until clearing the error to lock on.
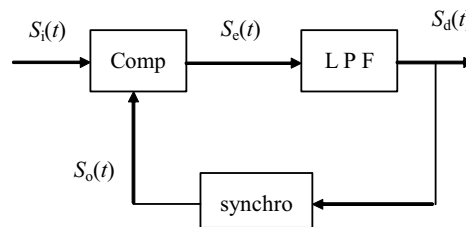
Sketch 3 digital look on principle

3.2 correlate filter wave

We could adopt the measure called shifting of function enhance the SNR to reduce noise. Assume the signal include noise is

$$x(t) = s(t) + n(t) \qquad (1)$$

Which s(t) is the signal whose circle is T, n(t) is the independent white noise whose average value is 0, square different is   .The input signal SNR is :

$$SNR_i = W / \delta^2 \qquad (2)$$

Assume the frame frequency of monitor is M, so the output of the system after following operation as following:

$$y(t) = \frac{1}{M} \sum_{k=1}^{M} x(t+kT) = s(t) + \sum_{k=1}^{M} n(t+kT) = s(t) + N(t) \qquad (3)$$

Which N(t) is measure err   Its average value is obvious 0.its square err is

$$\sigma = D[N(t)] = \frac{1}{M} \sum_{k=1}^{M} E[n(t+T)^2] = \frac{\delta^2}{M} \qquad (4)$$

Now, the processed SNR is

$$SNR_o = \frac{W}{\sigma} = M \cdot SNR_i \qquad (5)$$

It is thus clear that SNR increase M times. It is easy to protect the pass function is

$$|H(\omega)| = \frac{1}{M} \left| \frac{1 - e^{-jNM\omega\Delta t}}{1 - e^{-jN\omega\Delta t}} \right| = \frac{1}{M} \left| \frac{\sin(\pi M \omega / \omega_0)}{\sin(\pi \omega / \omega_0)} \right| \qquad (6)$$

it is thus clear that the gain of pass function of the filter when w=kw0,This process is equal to comb filter whose central frequency is w=kw0, called correlate filter.

3.3 matching filter

Matching filter could be considered one correlate device which accurate input signals correlate function. The shape of wave become autocorrelation integral shape after passing match filter, and it is symmetrical about point t=t0.

t0   is also the maximum point of the output signal. Consider the output signal is so(t) :

$$s_0(t) = \int_{-\infty}^{\infty} s(t-u) Ks(t_0 - u) du \qquad (7)$$

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