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# Systems Science and Traditional Chinese Medicine

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## Abstract

This paper will introduce the connection between Traditional Chinese Medicine (TCM) and Systems Science. In TCM there exist a lot of original system ideas, TCM looks human body as a holistic system including five Organ systems, which interconnect each with other, even more it deals with the disease connecting the human and the surrounding environment, such as weather and regions etc. We may find the similarity between TCM and Systems science., But from nowadays point of views we should push the TCM to more modern science, for example let the qualitative description of some theory to more quantitative description, to use advanced measurement technology to help TCM not only use the macroscopic description but also microscopic description, We also wish to use the IT technology to promote TCM in utilizing advanced computer and communication tool as hardware from one hand and from other hand software, such as different data mining, text mining, web mining and expert mining in digging more deep knowledge in TCM. Finally we wish also to find some original ideas and thoughts existed already in TCM which may obtain some useful impetus for formulizing new system methodologies for TCM. From last years we have engaged in a large project supported by Ministry of Science and Technology and Administration bureau of Traditional Chinese Medicine in China. This project had collected the academic thoughts and experiences from 100 Chinese masters in TCM based on IT technology and Data base. We just analyze these processed primary data further more and got some theoretical and experiment results.

**Keywords:** Systems Science, Traditional Chinese Medicine, Methodology, expert mining, Meta-synthesis system approach

## 1 Systems Science

### 1.1 Some basic concepts and theories in Systems Science

A lot of basic concepts of systems science are used in TCM, such as, holism, interrelation, hierarchy, openness, objective, stability, self-organization, evolution, similarity, autopoiesis [1, 11]

### 1.2 Systems techniques and methodologies

There are a lot of advanced system technologies, such as complex network techniques, modeling and simulation (e.g. multi-agent simulation), soft computing (e.g. genetic algorithm fuzzy mathematic) various mining techniques (data mining, text mining, web mining and expert mining), artificial intelligence etc used in the fields of TCM. Some special system methodologies, such as Soft system methodology, Viable system model, Meta-synthesis system approach etc. are being mentioned in TCM.

## 2 Traditional Chinese Medicine

**Traditional Chinese medicine** (also known as **TCM**), is a range of traditional medical practices originating in China that developed over several thousand years. The English phrase "TCM" was created in the 1950s by the PRC. TCM practices include theories, diagnosis and treatments such as herbal medicine, acupuncture and massage (tuina); Qigong is also strongly affiliated with TCM.

TCM theory asserts that processes of the human body are interrelated and in constant interaction with the environment. Signs of dis-

harmony help the TCM practitioner to understand, treat and prevent illness and disease.

TCM theory is based on a number of philosophical frameworks including the theory of Yin-yang, the Five Elements, the human body Meridian system, Zang Fu organ theory, and others. Diagnosis and treatment are conducted with reference to these concepts. TCM does not operate within a scientific paradigm but some practitioners make efforts to bring practices into a biomedical and evidence-based medicine framework [2].

## 2.1 Theory of TCM

The foundation principles of Chinese medicine are not necessarily uniform, and are based on several schools of thought. Received TCM can be shown to be most influenced by Taoism, Buddhism, and Neo-Confucianism.

Since 1200 BC, Chinese academics of various schools have focused on the observable natural laws of the universe and their implications for the practical characterization of humanity's place in the universe. In the I Ching and other Chinese literary and philosophical classics, they have described some general principles and their applications to health and healing:

There are observable principles of constant change by which the Universe is maintained. Humans are part of the universe and cannot be separated from the universal process of change.

As a result of these apparently inescapable primordial principles, the Universe (and every process therein) tends to eventually balance itself. Optimum health results from living harmoniously, allowing the spontaneous process of change to bring one closer to balance. If there is no change (stagnation), or too much change (catastrophism), balance is lost and illnesses can result.

Everything is ultimately interconnected. Always use a holistic ("systemic" or "system-wide") approach when addressing imbalance

### 2.1.1 Yin-Yang and Five elements [2, 5, 6]

Being a thought of Chinese ancient naive materialism and spontaneous dialectics, the theory of Yin—Yang and Five Elements (in Chinese Wu Xing) believed that world was material, and the material world was multiplied and developed by

Yin—Yang and *wood, fire, earth, metal and water*, five basic matters formed world were indispensable elements( see Figure 1). The five kinds of matters were interdependent and counterbalance each other, situated in continuous movement and change.

The theory of Yin-Yang and Five Elements was applied to medical domain extensively to explain origin of mankind, physiological phenomenon, pathological change and to guide clinical diagnosis, prevention and treatment became an important part in Chinese medicinal theory and gave some deep influence at emerging and developing Chinese medicinal science.

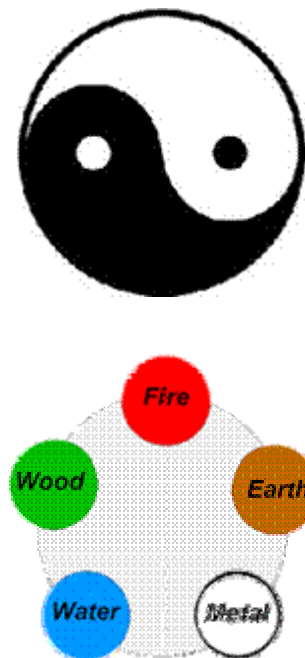


Figure 1. Yin-Yang and Five elements [3]

### 2.1.2 The Theory of Yin-Yang

The philosophical origins of Chinese medicine have grown out of the tenets of Taoism. Taoism bases much of its thinking on observing the natural world and manner in which it operates, so it is no surprise to find that the Chinese medical system draws extensively on natural metaphors. In Chinese medicine, the metaphoric views of the human body based on observations of nature are fully articulated in the theory of “Yin-Yang” and the system of “Five Elements”.

The direct meanings of yin and yang in Chinese are bright and dark sides of an object. Chinese philosophy uses yin and yang to represent a wider range of opposite properties in the universe: cold and hot, slow and fast, still and moving, masculine and feminine, lower and upper, etc. In general, anything that is moving, ascending, bright, progressing, hyperactive, including functional disease of the body, pertains to yang. The characteristics of stillness, descending, darkness, degeneration, hypo-activity, including organic disease, pertain to yin.

The function of yin and yang is guided by the law of unity of the opposites. In other words, yin and yang are in conflict but at the same time mutually dependent. The nature of yin and yang is relative, with neither being able to exist in isolation. Without "cold" there would be no "hot"; without "moving" there would be no "still"; without "dark", there would be no "light". The most illustrative example of yin-yang interdependence is the interrelationship between substance and function. Only with ample substance can the human body function in a healthy way; and only when the functional processes are in good condition, can the essential substances be appropriately refreshed.

The opposites in all objects and phenomena are in constant motion and change: The gain, growth and advance of the one mean the loss, decline and retreat of the other. For example, day is yang and night is yin, but morning is understood as being yang within yang, afternoon is yin within yang, evening before midnight is yin within yin and the time after midnight is yang within yin. The seed (Yin) grows into the plant (Yang), which itself dies back to the earth (Yin). This takes place within the changes of the seasons. Winter (Yin) transforms through Spring into Summer (Yang), which in turn transforms through Autumn into Winter again. Because natural phenomena are balanced in the constant flux of alternating yin and yang, the change and transformation of yin-yang has been taken as a universal law.

### 2.1.3 The theory of Five Elements

The theory of Five Elements also belongs to the thought of Chinese ancient materialist's dialectics. Ancient philosopher believes that nature consist of five basic elements: wood, fire, earth, metal and water, which are interdependent and

counterbalance each other in a situation of continuous movement and change, called Five Elements. they think that the development and change of every thing and phenomenon are results of evolution and interaction of Five Elements in universe .According that they condensate and explain the whole material world by abstracting and reasoning different attribute of anti-Five Elements step by step .The theory of Five Elements is used to explain the changes of physiology and pathology human body and relationship between human being and external environment, guided clinical diagnosis and treatment in Chinese medicine

Attribute and classify of Five Elements

Generation, restriction, subjugation and reverse restriction of five elements

Similar to the theory of yin-yang, the theory of five elements was an ancient philosophical concept used to explain the composition and phenomena of the physical universe. In TCM theory of five elements is used to interpret the relationship between the physiology and pathology of the human body and the natural environment. According to the theory, the five elements are in constant move and change, and the interdependence and mutual restraint of the five elements explain the complex connection between material objects as well as the unity between the human body and the natural world.

In TCM, the visceral organs, as well as other organs and tissues, have similar properties to the five elements; they interact physiologically and pathologically as the five elements do. Through similarity comparison, different phenomena are attributed to the categories of the five elements.

The five elements emerged from an observation of the various groups of dynamic processes, functions and characteristics observed in the natural world. The aspects involved in each of the five elements are follows:

•**Fire (F)**: draught, heat, flaring, ascendance, movement, etc.

•**Wood (Wo)**: germination, extension, softness, harmony, flexibility, etc.

•**Metal (M)**: strength, firmness, killing, cutting, cleaning up, etc.

•**Earth (E)**: growing, changing, nourishing, producing, etc.

•**Water (Wa)**: moisture, cold, descending, flowing, etc.

The following table 1 shows the categorization of phenomena according to the five elements:

Between the five elements there exist close interrelationships that can be classified as mutual promoting 生 (*generating G2*) and mutual restraining 克 (*restricting or controlling G4*) under physiological conditions, and mutual encroaching 反克或旺得 (*or reverse restraining G1*) and mutual violating 反生 (*subjugating G3*) under pathological conditions. By mutually promoting and restraining, functions of the various systems are coordinated and homeostasis maintained. By encroaching and violating, pathological changes can be explained and complications predicted.

Table 1. Five elements with the organs and other phenomena [3]

	Wood (Wo)	Fire (F)	Earth (E)	Metal (M)	Water (Wa)
<b>Flavor</b>	sour	bitter	sweet	pungent	salty
<b>Zang</b>	liver	heart	spleen	lung	kidney
<b>Fu</b>	gall bladder	s. intestine	stomach	l. intestine	urinary
<b>Sense</b>	eye	tongue	mouth	nose	ear
<b>Tissue</b>	tendon	vessel	muscle	hair/skin	bone
<b>Direction</b>	east	south	center	west	north
<b>Change</b>	germinate	grow	transform	reap	store
<b>Color</b>	green	red	yellow	white	black

The order of mutual promoting (G2) among the five elements is that wood promotes fire, fire promotes earth, earth promotes metal, metal promotes water, and water promotes generates wood. In this way each of the five elements has this type of mutual promoting relationship with the other, thus promoting is circular and endless.

According to the order of mutual restraining (G4), however, wood restrains earth, metal restrains wood, etc. Each of the five elements also shares this restraining relationship with the other. Mutual promoting and mutual restraining are two aspects that cannot be separated. If there is no promoting, then there is no birth and growth. If there is no restraining, then there is no change and development for maintaining normal harmonious relations. Thus the movement and change of all things exists through their mutual promoting and restraining relationships. These relationships are the basis of the circulation of natural elements.

Encroaching (G1) and violating (G3) are the pathological conditions of the normal mutual promoting and restraining relationships. Encroaching denotes that the restraining of one of the five elements to another surpasses the normal level, while violating means that one of the five elements restrains the other opposite to the normal mutual restraining order.

M-Wa-Wo-F-E ( generation( 生 promotion)~ Dong Zhongshu) *G2*

Metal generates water;  
Water generates wood;  
Wood generates fire;  
Fire generates earth;  
Earth generates metal  
and so on

M-Wo-E-Wa-F (restraint 克~ Zhou Yan) *G4*

Metal restrains wood  
Wood restrains earth,  
Earth restrains water  
Water restrains fire  
Fire restrains metal  
and so on. [7]

Table 2 the relationships between five elements [11]

	M	F	wa	E	Wo
M		<b>G1</b>	<b>G2</b>	<b>G3</b>	<b>G4</b>
F	<b>G4</b>		<b>G1</b>	<b>G2</b>	<b>G3</b>
Wa	<b>G3</b>	<b>G4</b>		<b>G1</b>	<b>G2</b>
E	<b>G2</b>	<b>G3</b>	<b>G4</b>		<b>G1</b>
Wo	<b>G1</b>	<b>G2</b>	<b>G3</b>	<b>G4</b>	

The Five-Element Theory gives a skilled TCM practitioner a range of options for addressing health problems. For instance, when a patient presents with skin problems, the TCM practitioner understands that the Organ System of

the Lung and Large Intestine are involved because the skin is the "tissue" of the Lung, according to the Five Elements. Therefore, doctors can decide to heal one or both Organs to treat the root cause, not just the symptom of the skin problem. [3]

TCM believes that the human body is a microcosm of the Universal macrocosm. Therefore, humans must follow the laws of the Universe to achieve harmony and total health. The Yin/Yang and Five-Element theories are actually observations and descriptions of Universal law, not concepts created by man. In ancient times, practitioners of TCM discovered these complex sets of interrelationships that exist on deep energetic levels below the material surface. Over time, these insights developed into a unified body of wisdom and knowledge—TCM theories—and were applied to a way of life and to healing the human body. Even today TCM practitioners use these essential theories to understand, diagnose and treat health problems.

The Five-Element theory is the bedrock of TCM. It evolved as a way of naming and systematizing patterns of perceived related phenomena, ranging from something as tangible as the weather to more rarified realms such as emotion and capacities of character, into five major groups named for the universal elements. The Five-Element Theory states that the five major Organ Systems (Liver/Gallbladder, Heart/Small Intestine, Spleen/Stomach, Lung/Large Intestine, and Kidney/Urinary Bladder) are each related to a particular element and therefore to a broad category of correspondences or classifications: from a season of the year to a time of day, to particular colors and foods, etc. Both the Yin/Yang Theory and the Five-Element theory reflect the entire Universal law in one complete, comprehensive system of related categories.

#### **2.1.4 The relationship between Yin-Yang and Five Elements**

The theory of Yin-Yang mainly explain the relationship of interdependent, inter-growth and decline, and inter-transform between opposite both sides in things ; but the theory of Five Elements explain property and interrelation in things by classifying of Five Elements and law of generation, restriction, subjugation and reverse restriction in property of things. In Chinese medicine both of them consider that the material bases of

them are and viscera, meridian, Qi, blood and fluid; both of them analyze study and explain physiological activity of human body, pathological change and various reference in and out of body guides clinical pattern identification and treatment from macroscopically natural phenomenon including the law of human body's change in analogy.

## **2.2 Diagnostics**

Following the macro philosophy of disease, traditional Chinese diagnostics are based on overall observation of human symptoms rather than "micro" level laboratory tests. There are four types of TCM diagnostic methods: observe (望), hear and smell (聞), ask about background (問) and touching (切). The pulse-reading component of the touching examination is so important that Chinese patients may refer to going to the doctor as "Going to have my pulse felt". Modern practitioners in China often use a traditional system in combination with Western methods. TCM is considered to require considerable diagnostic skill. This often depends on the ability to observe what are described as subtle differences. This may be contrasted with a straightforward laboratory test, which indicates an unambiguous cause. A training period of years or decades is said to be necessary for TCM practitioners to understand the full complexity of symptoms and dynamic balances.

### **Techniques**

- Palpation of the patient's radial artery pulse (Pulse diagnosis) in six positions
- Observation of the appearance of the patient's tongue
- Observation of the patient's face
- Palpation of the patient's body (especially the abdomen) for tenderness
- Observation of the sound of the patient's voice
- Observation of the surface of the ear
- Observation of the vein on the index finger on small children
- Comparisons of the relative warmth or coolness of different parts of the body
- Observation of the patient's various odors
- Asking the patient about the effects of his problem
- Anything else that can be observed without instruments and without harming the patient.

## 2.3 Mechanism of action

The basic mechanism of TCM is akin to treating the body as a black box, recording and classifying changes and observations of the patient using a traditional philosophy. In contrast to many alternative and complementary medicines such as homeopathy, practically all techniques of TCM have explanations for why they may be more effective than a placebo, which Western medicine can find plausible. Most doctors of Western medicine would not find implausible claims that qigong preserves health by encouraging relaxation and movement, that acupuncture relieves

pain by stimulating the production of neurotransmitters, or those Chinese herbal medicines may contain powerful biochemical agents. However, the largest barriers to describing the mechanisms of TCM in scientific terms are the difference of language and lack of research. TCM concepts such as qi and yin and yang are used to describe specific biological processes but are difficult to translate into scientific terms. Some research is now beginning to emerge explaining possible scientific mechanisms behind these TCM concepts.

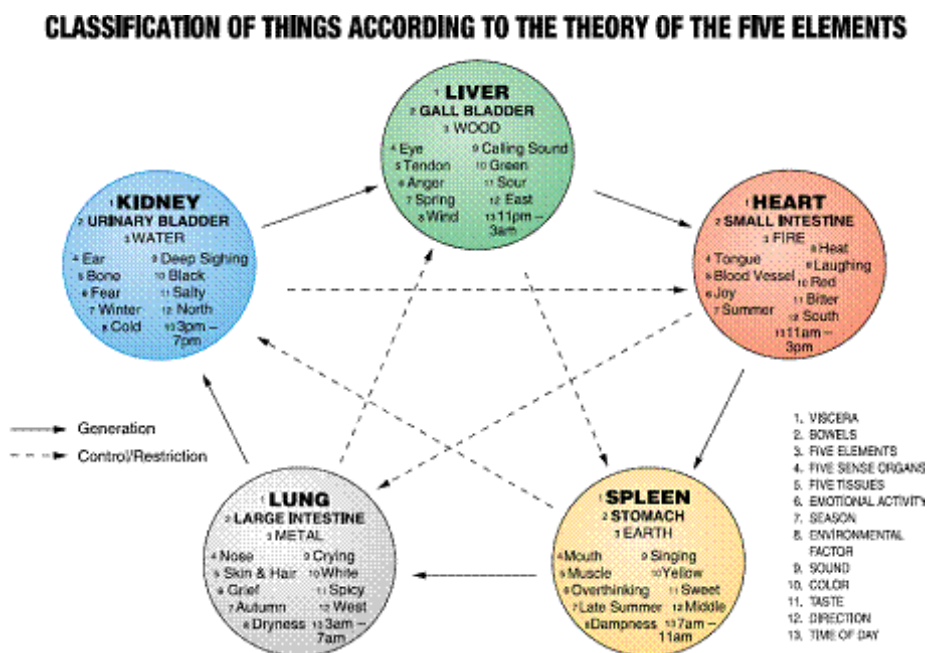


Figure 2 Classification of things according to the theory of the five elements [from TCM World Foundation] [4]

## 2.4 Characteristic features of TCM

In the methods of observation and analysis of something TCM mainly took whole observation of analogism and analysis of appearance of things to seek its inner mechanism. So the unique theoretical system of TCM has two basic features: the concept of holism and Bianzheng Lunzhi. The unity between man and the natural world. Mankind lives in the natural world and there are essential conditions on which persons depend for existence in the natural world. And the changes of the natural world (such as, seasons and

climate, day and night, morning and dusk, regions and area, etc) can affect the human body directly and indirectly, then organism showed response correspondingly.

The response is physiological adaptability, if it is within the physiological limit, otherwise pathological response. So persons must adapt themselves to circumstance initiatively. The treatment in accordance with climate, environment and individual is the important principle in the treatment of TCM.



### 3 Methodologies for TCM

#### 3.1 Holism [15]

#### 3.2 Bianzheng Lunzhi (辩证论治 treatment according to the differentiation of syndromes) [15]

#### 3.3 Phenomenological method; metaphor

#### 3.4 Deduction method

Mentioned four methodologies have been used often in TCM from ancient time [2-7]

#### 3.5 Integrated Autopoises [8]

Chinese doctor Ling Feng had suggested so called Integrated Autopoises approach during healing a patient Ms.Liu H, R. This approach is based on second order cybernetics. Dr. Ling stands for combination of west medicine and TCM.

#### 3.6 Meta-synthesis system approach

Qian et al proposed the Meta-synthesis system approach (MSA approach) for solving the open complex giant system problems, including the human body system problems [9], as a main tool for realizing the MSA approach Qian proposed the Hall of Workshop for Metasynthetic Engineering (HWNMSE) see Figure 3.

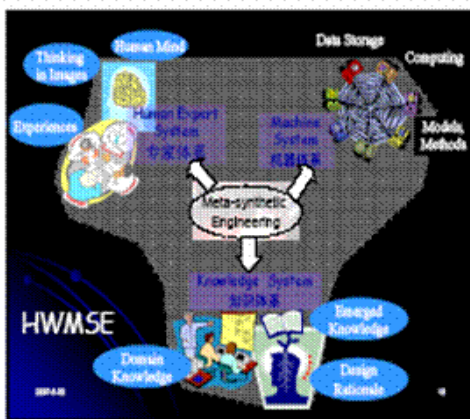


Figure 3 HWNME by Tang X.J, Zhang W, Wang Z

#### 3.7 Complex system theory

Zhu Qingshi points out the connection between the complex system theory and TCM. He tries to compare the concepts used in dissipative system theory and five elements in TCM. [10](Table 3 is based on Zhu's idea).

Table 3

Dissipative system	openness	nonlinearity	Resistance	Clear	Growth
TCM	Earth	Fire	Metal	water	Wood

A project titled in “Study on mining methods for analyzing the academic thoughts and collective regular pattern within TCM Masters” attached to “Ten-Five” National Scientific Gong guan Program Project “Study on academic thoughts and dissemination of famous and old master in TCM” run by Xi Yuan Hospital, Chinese Academy of Chinese Medicine Sciences and Institute of Systems Science, Chinese Academy of Sciences. This project had collected the academic thoughts and experiences from 100 Chinese masters in TCM based on IT technology and Data base. We just analyze these processed primary data further more and got some theoretical and experiment results by some mining techniques, such as social network. analysis, Group Argumentation Environment and PathMaker, [11, 12, 13] (see Figure 5, 7). Tang X J et al had developed a special TCM Master Miner to mining Masters knowledge [14] (see Figure 4, 6)

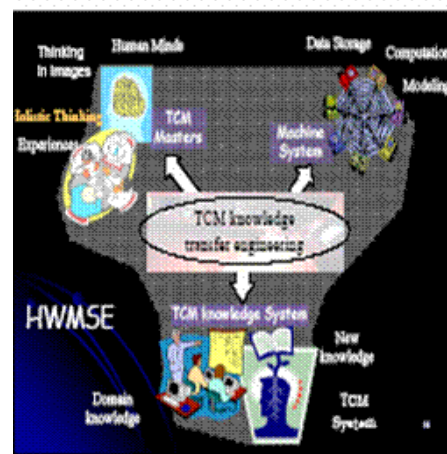


Figure 4 TCM knowledge transfer engineering by Tang X.J, Zhang W, Wang Z





## Conclusion

TCM is a system of ancient Chinese medicine knowledge, which has been used by many Chinese doctors in practice. But it is difficult to understand and learn by nowadays young TCM doctors and some of them are being mined deeper and transformed properly by using contemporary science. Especially we find that there are a lot of similarities between TCM thought and system thought. This paper is based on the survey of some papers and project supported by Ministry of Science and Technology and Administration bureau of TCM. We have obtained only a few results and will continue this work in the next project from this year

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## References

- [1]. Autopoiesis, <http://www.christianhubert.com/hypertext/Autopoiesis.html>
- [2]. TCM from Wikipedia, the free encyclopedia, [http://en.wikipedia.org/wiki/Traditional\\_Chinese\\_medicine](http://en.wikipedia.org/wiki/Traditional_Chinese_medicine)
- [3]. TCM information page, [http://www.tcmpage.com/about\\_us.html](http://www.tcmpage.com/about_us.html)
- [4]. What Is Traditional Chinese Medicine? Traditional Chinese Medicine World Foundation <http://www.tcmworld.org/>
- [5]. Making sense of traditional Chinese medicine, Mind, <http://www.mind.org.uk/About+Mind/website.htm>
- [6]. Eu Y.S., Yin—Yang and Five Elements, [http://www.euyansang.com/index.php?option=com\\_content&task=view&id=206&Itemid=260](http://www.euyansang.com/index.php?option=com_content&task=view&id=206&Itemid=260)
- [7]. Philosophical Basis of Traditional Chinese Medicine *Practical Traditional Chinese Medicine*, Foreign Languages Press, 2000, <http://www.china.org.cn/english/MATERIAL/185381.htm#31>
- [8]. Ling Feng., Exploration on the application of integrated autopoiesis in medical practice, *Science and Technology China*, 2005, No.4
- [9]. Qian X.S., Yuan J.Y., Dai R.W., A new discipline of science—the study of open complex giant system and its methodology. *Nature Magazine* 1990.13 (1), 3–10 (in Chinese, an English translation is published in *Chinese Journal of Systems Engineering and Electronics* 4 (2) 2–12, 1993).
- [10]. Zhu Q.S., The Chinese Traditional Medicine: A modern scientific point of view, *Chinese journal of nature*, 2005 Vol.27 No.5 .249-253
- [11]. Gu J.F. Song W.Q, Liu Y.J., View on TCM methodologies from systems science, Technical report III, Xi Yuan Hospital, Chinese Academy of Chinese Medicine Sciences and Institute of Systems Science, Chinese Academy of Sciences, January 2007
- [12]. Song W.Q., Liu Y.J, Gu J.F. Mining TCM experiences of TCM masters based on the medical cases data, Technical report III, Xi Yuan Hospital, Chinese Academy of Chinese Medicine Sciences and Institute of Systems Science, Chinese Academy of Sciences, January 2007
- [13]. Gu J.F., Song W.Q, Liu Y.J., System, Knowledge and Traditional Chinese Medicine, ISSS2007 Tokyo – Conference 148
- [14]. Tang X.J. N. Zhang N. and Wang. Z., [Exploration of TCM Masters Knowledge Mining](#), in *Computational Science – ICCS2007* (proceedings, Part IV, Y. Shi, et al eds.), Lecture Notes in Computer Science, Vol. 4490, Springer-Verlag, 2007, 35-42. Characteristic features of traditional Chinese medicine,