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A new interpretation of TCM pulse diagnosis based on quantum physical model of the human body

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ABSTRACT

Following the quantum theory-based physical model of the human body, a new interpretation of the traditional Chinese medicine (TCM) principle of "Cunkou reads viscera" is presented. Then, a Gaussian pulse wave model as a solution to the Schrodinger equation is shown to accurately describe 19 different pulse shapes, and to quantitatively capture the degree of Yin-Yang attributes of 13 pulse shapes. Furthermore, the model suggests using pulse depth and strength as leading-order quantity and pulse shape as first-order quantity, to characterize the hierarchical resonance between the human body and the environment. The future pulse informatics will focus on determining an individual's unique quantum human equilibrium state, and diagnose its health state according to the pulse deviation from its equilibrium state, to truly achieve the high level of TCM: "knowing the normal state and reaching the change".

1 Introduction

We established a new physical model of the human body: assuming that the human body is a quantum resonant cavity, which contains resonant quantum waves of various strengths and frequencies, carrying the internal movement of neural currents and blood flows. These phase waves form a multi-dimensional and multi-level composite phase field (CPF), which determines the energy distribution across five elements and twelve meridians in traditional Chinese medicine (TCM) theory. The main innovation of the present model is that the human body is described by a complex function having both real and imaginary parts, which may describe visible parts such as bio-molecular and cell tissue, as well as invisible parts such as mind, consciousness, and spirit. Qi is a gradient flow due to the inhomogeneity of CPF, driving the motion of the density field.

According to the human quantum resonance cavity model, a series of TCM concepts, including the theories of visceral manifestation and meridians, can be interpreted within the concept of the CPF for further in-depth studies. In this paper, the interpretation of the TCM pulse diagnosis is presented, and future applications are discussed.

1.1 The bottleneck of current pulse diagnosis study: lack of effective scientific model

The TCM pulse diagnosis obtains the pulse information relying on the doctor's finger sense, and yields the judgment and treatment plan lacking of uniform standars.

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This way of pulse diagnosis is especially dependent on the medical skill of TCM physician, and even their individual physiological and psychological states. The expression of pulse diagnosis is often abstract, and too general to be understood by patients receiving education in the modern era. Consequently, the traditional pulse diagnosis is difficult to widely spread in modern society, and a breakthrough in the understanding and interpretation of pulse diagnosis of TCM is urgently needed.

With the application of artificial intelligence technology in medicine, the TCM pulse diagnosis has made substantial progress in the objective collection of pulse data. In recent decades, several pulse collection instruments have been developed [1], which can achieve an all-round collection of the "Wei Shu Xing Shi" of Cunkou pulse [2-4]. By comparing the collected pulse wave data with the TCM diagnosis, different pulse types can be distinguished. Nevertheless, such distinction is insufficient to yield high-quality diagnoses in clinical applications. For instance, it is very frequent that no definite conclusion is reported on individual diagnosis, so the pulse instruments are mostly used for teaching and research only. Take "slippery pulse" for an example, the diagnosis result of it is measured, but it is difficult to distinguish the slippery pulse of ordinary people from that of a pregnant woman, or from that of phlegm. Therefore, the diagnosis in terms of pulse type is too incomplete for clinical applications, where the situation is so complicated that far more information is needed. In addition, mainstream medical studies mainly emphasize statistical results with a large number of cases, and such average characteristics are in general useless for determining individual pulse characteristics relevant to their health conditions. This is a methodology problem that requires lots of effort to achieve a breakthrough. Specifically, pulse characteristics of men and women, young and old, measured in summer and winter, for those living in the south and north, etc., would have different features, which are delicate but significant and need to be studied with a better method than current statistics. In other words, a more powerful system model needs to be developed for quantifying individual pulse characteristics relevant to their health conditions, and for revealing life science laws behind pulse diagnosis in TCM.

A high-level diagnosis of TCM is described by the ability of "knowing the normal state and recognizing the change". Only by understanding the "normal" health state can we define the change (i.e. deviation). However, the "normal state" of an individual involves many factors such as age, gender, season, and region, as stated in the *Yellow Emperor's Inner Classics* (*Huang Di Nei Jing*, 《黄帝内经》), "the changes of four (seasonal) movements are hiding in the pulse". Therefore, for the scientific and technological study of pulse diagnosis in TCM, what is urgently needed is to study the dynamic variation of the human pulse wave, to form a mathematical and physical model of pulse wave based on the principles of TCM, and gradually transform the syndrome differentiation from the mind of a skilled TCM doctor into an intelligent software.

1.2 Mechanical-based pulse wave study: difficult to cope with the holographic nature

Anatomy-based western medicine focuses on visible entities and interprets pulse waves as an oscillating movement of the blood vessel following the periodic cardiac ejection. An elastic chamber model of biomechanics is adapted to quantify the blood flow characteristics in the cardiovascular system [5]. This simplified model can help, to a certain extent, to understand the rules of cardiovascular system operation, but it cannot even explain why the heart can "press" blood into capillaries with such small power [6].

Certainly, facing complex life problems, classical biomechanics is seriously challenged. This mechanical model can hardly explain how TCM pulse diagnosis can describe the delicate functional state, and much less the mental state of human viscera through Cunkou pulse. To build a reliable mathematical and physical model of the pulse wave, inspired by the latest development of modern physics, we attempted to make great innovations in our understanding of human life dynamics utilizing complex system methodology.

1.3 Breakthrough: quantum cavity model of pulse wave empowered by complex system methodology

Modern quantum physics asserts that the basic interaction of matter is described by the gauge field, which is, according to YANG Chenning, just the phase field. The most familiar phase fields are electromagnetic and gravitational fields. From this perspective, we suggest a quantum resonant cavity model describing the movement of the essence, Qi, and spirit of TCM in the human body [7]. This model yields a new physical picture of human life: there is a multi-dimensional and multi-level CPF everywhere within a human body. This CPF is responsible for all internal and external resonance during the entire duration of life, for maintaining the life activity of the body fluid, viscera, skin, muscles, bones, etc. The CPF is also the force that pushes the blood into the end circulation. It is precise because of the existence of the CPF that the overall health state can be reflected through local human pulse waves (similar to laser holographic imaging technology).

We believe that a key step in the development of pulse diagnosis in TCM is to construct a reliable mathematical model capable of quantitatively describing the variation (for individual and in time) of the human pulse wave in

detail. This is what the quantum cavity model aims to achieve in the future under the complex system methodology. As previously explained before, the quantum cavity model with its particle-wave duality is fully consistent with the Yin-Yang philosophy of TCM, and its phase gradient flow offers an interpretation of Qi. This study aims to expand to a new area of life science that combines both the spirit and body, and interprets the principles and concepts of TCM.

2 Interpretation of TCM "Cunkou reads viscera"

2.1 The quantum resonance image of "Qi flows outside the pulse and blood flows inside the pulse"

Based on the human quantum resonant cavity model, we assert that the CPF waves of the five human zang-fu organs (i.e. lung, heart, spleen, liver, and kidney) propagate in the resonant cavity, and form standing waves after the reflection from the fingertips, toe tips, and head. Some important nodes of the human body correspond to the peak of the standing waves. Due to different wavelengths, the phase waves have different propagation patterns along different tissues. The five zang-fu organs form a three-dimensional quantum resonance system along the surface/horizontal and in the normal direction. Horizontally, the resonance system is connected to the three Yin meridians and three Yang meridians from the hand, and ends at the fingertip, while Cunkou is the standing wave peak point. The resonance system is composed of different body structures (skin, veins, muscles, and bones), which have a distribution in the normal direction at different depths, forming the so-called cun, guan, and chi pulse, which distributes gradually from shallow to deep. In other words, the different wave propagating along the skin, blood, muscle, and bone, has a correspondence to different TCM five zang-fu organs. This is the human quantum resonant model's interpretation of the famous TCM proposition that Cunkou reads the zang-fu system. Along this line of thinking, researchers may be able to carry out a series of in-depth studies on pulse diagnosis.

2.2 Gauss function description of pulse wave

Gaussian wave has a bell-shaped form, which constitutes a fundamental component for the pulse signal, and a superposition can describe a variety of relatively complicated pulse waveforms. Therefore, it is a promising way to describe the pulse wave with the combination of Gaussian wave packets [8]. However, we presently adopted an alternative view for the interpretation. Specifically, we proposed that the cell chain along the blood vessel oscillated under the action of the CPF field. Consequently, the harmonic oscillator motion of this cell chain satisfies the Schrodinger equation,

$$i\frac{\partial\psi}{\partial t}=\left(-\frac{\hbar^2}{2m}\nabla^2+U\right)\psi \tag{1}$$

The wave function form of this cell chain is:

$$\psi=f\mathrm{e}^{i\theta} \tag{2}$$

f represents the amplitude of the blood vessel cell in a quantum field, θ represents the phase of the wave function. Hamiltonian is divided into kinetic energy term $-\frac{\hbar^2}{2m}\nabla^2$ and potential energy term U, while the former describes the blood's motion, and the latter is driven by the CPF, including the influence of the internal zang-fu and the external environment. That is, the potential energy of pulse at different locations (such as cun, guan, and chi) is different, and will be affected by the external five movements and six climates (quantum coupling with the external field).

Here we introduced four Gaussian wave packets to describe a single cycle pulse wave, which achieves a better description than three Gaussian functions [9], with the equation in the following

$$V_l=\sum_{i=1,2,3,4}\mathrm{a}_i\exp\left\{-\frac{(t-t_i)^2}{W_i^2}\right\} \tag{3}$$

in which, a_i indicates the peak intensity/height of the Gaussian wave packet, W_i width at the half height, and t_i the location of the peak. In the past, V_1 denotes main wave, V_2 tidal wave, V_3 dicrotic wave, and V_4 atrial contraction wave, but their physiological origins remain unclear and need further examination.

The four Gaussian wave packets form the four basic structures of the human pulse, rather like ATGC – the four basic bases of DNA, which can build different types of pulse patterns. From a practical point of view, determining the four sets of Gaussian parameters yields a quantitative description of the pulse, which forms a high-dimensional phase space to depict human health. This would yield a therapeutic evaluation index based on the principles of TCM.

2.3 Quantitative description of pulse diagnosis under TCM theory

We selected 14 kinds of pulse conditions from the book *Pulse Diagnosis of Traditional Chinese Medicine* [10], including 19 representative pulse diagrams: floating pulse (浮脉), sinking pulse (沉脉), deficient pulse (虚脉), excess pulse (实脉), normal pulse (平脉), slippery pulse (滑脉), hesitant pulse (涩脉), hollow pulse (芤脉), wiry pulse (弦脉), tight pulse (紧脉), tympanic pulse (革脉), firm pulse (牢脉), soft pulse (濡脉), and feeble pulse (微脉). Table 1 shows the accuracy of using four Gaussian wave packets to depict 19 characteristic pulse types, with an error of less than 6%. It has been verified that the

combination of the four Gaussian functions can capture the key information in the complex pulse and realize the parametric description of various pulse waves (including the healthy and sick) (Figure 1).

Next, we interpreted the "Wei Shu Xing Shi" theory of TCM pulse diagnosis. The above 19 pulse types can be divided into four categories: class A refers to hollow pulse, floating pulse, and sinking pulse (according to pulse position), class B to deficient pulse, normal pulse and excess pulse (according to pulse strength), class C to soft pulse, wiry pulse, tympanic pulse, firm pulse, tight pulse (according to pulse tension), and class D to slippery pulse and hesitant pulse (according to pulse fluency).

Table 1 Accuracy of Gaussian function description of 19 characteristic pulse maps

Pulse condition	Class	Matching relative error (%)
Hollow pulse	A	3.9
Floating pulse	A	2.9
Sinking pulse	A	2.9
Feeble pulse	B	4.3
Deficient pulse	B	4.5
Normal pulse	B	2.9
Excess pulse	B	3.0
Soft pulse	C	1.4
Tympanic pulse	C	2.9
Firm pulse	C	4.3
Tight pulse	C	6.6
Wiry pulse I	C	2.3
Wiry pulse II	C	2.6
Wiry pulse III	C	5.1
Wiry pulse IV	C	3.1
Slippery pulse	D	1.7
Hesitant pulse C	D	5.0
Hesitant pulse B	D	3.4
Hesitant pulse A	D	3.5

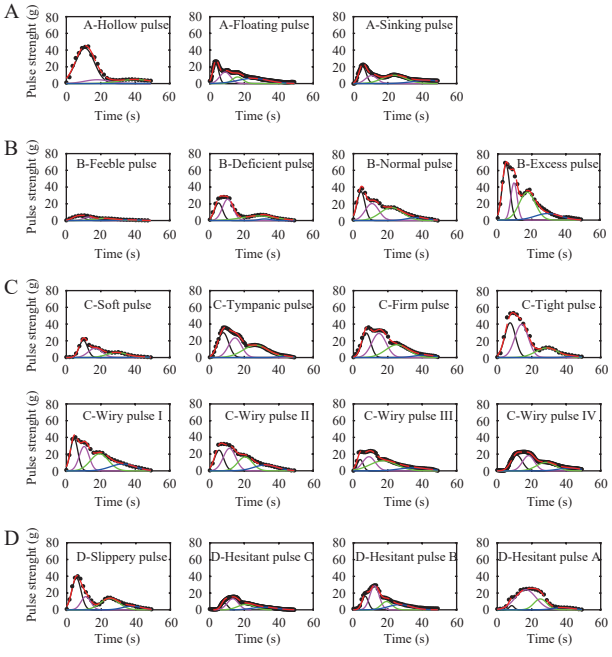

Figure 1 Nineteen typical pulse maps

A – D, class A – D. Black dots are data from *Pulse Diagnosis of Traditional Chinese Medicine* [10]. The red lines are fitting curves with the model of four Gaussian wave packets. The relative errors of the fitting are mostly less than 5% (see Table 1).

The Gaussian wave packet model yielded a clear interpretation of the features of different classes. Class A can be quantified by the pulse pressure, but more detailed features can also be described by the relative heights of subsequent Gaussian wave packets. For instance, a floating pulse's first Gaussian wave packet is relatively higher than the second packet, and a sinking pulse has typically a bigger third Gaussian wave packet. Class B pulses can be quantified by its highest Gaussian wave packet. Class C is the most diversified, and its increasing tension can be described by faster growth of the second than the first Gaussian wave packet, which can then be quantified by a1/w1 and a1/a2 (see below). Finally, class D's fluency can be quantified by a1/a2. The above features lay the foundation for developing a phase space description of pulse diagnosis so that clinically relevant diagnosis can be made possible with artifical intelligence (AI) machine learning techniques.

In the following, we made an analysis of 13 class C and D pulses using Gaussian parameters, which achieved quantitative expressions of TCM pulse diagnosis with clear physiological and pathological meanings. Interestingly, we found that different class C and D pulses can be described by the intensity ratio of the first (main wave) to the second (tidal wave) Gaussian wave packet (a1/a2), which quantifies the extent of Yang and Yin within an individual's body. We speculated that the main wave is related to the upper energizer (corresponding to the heart and lung) resonance of the human quantum resonant cavity, it becomes too large when one is in a Yang prevailing state (or insufficient Yin of convergence), while it becomes too small when one is in a Yin prevailing state (or insufficient Yang of divergence).

In Table 2, we presented the variations of the parameter ratio a1/a2 and a1/w1 for different pulse shapes, consistent with the principle of TCM. As seen from Table 2, the hollow pulse, the slippery pulse, and the normal pulse have decreased a1/a2, ranging from 9.3 to 1.8. On the other hand, wiry pulse I-IV, tight pulse, tympanic pulse, and firm pulse have a1/a2 around 1. The hesitant pulses have the smallest a1/a2, ranging from 0.6 to 0.2. Since the main wave (a1) is related to the upper energizer, the decrease of a1/a2 corresponds to decreasing power of the human heart and lung system, which, according to TCM, implies a decreasing Yang versus Yin. As shown in Figure 2, we displayed these 13 pulses in the phase diagram, log (a1/a2) versus a1/w1. Thus, through the Gaussian parameter a2/a1, we can see that the five major pulses, namely, hollow pulse, slippery pulse, normal pulse, wiry pulse, and hesitant pulse, gradually move

Table 2 The Gaussian characteristic parameters of 13 class C and D pulses

Pulse condition	a1/a2	a1/w1
Hollow pulse	9.3	5.5
Slippery pulse	2.6	2.8
Normal pulse	1.8	4.8
Wiry pulse I	1.5	3.8
Wiry pulse II	1.3	3.3
Wiry pulse IV	1.0	4.1
Tympanic pulse	1.3	6.7
Firm pulse	1.0	7.9
Tight pulse	1.1	9.4
Wiry pulse III	0.8	8.0
Hesitant pulse C	0.6	2.8
Hesitant pulse A	0.2	4.5
Hesitant pulse B	0.6	7.7

a1/a2 is ratio of the height of the first and second Gaussian wave packet; a1/w1 is the ratio of height and width at the half height of the first Gaussian wave packet.

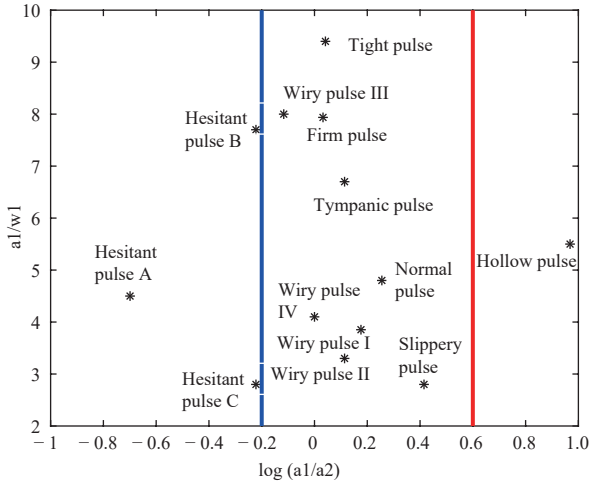

Figure 2 The Gaussian characteristic parameters phase diagram of 13 class C and D pulse conditions

from Yang to Yin, corresponding to the fluency of human Qi and blood, and can be quantitatively depicted.

Next, we discussed more specifically the Gaussian parameter log (a1/a2) in correspondence with the Yin and Yang attributes in the *Binhu's Sphygmology* (*Bin Hu Mai Xue*, 《濒湖脉学》), by dividing the class C and D pulses into three sub-categories:

The abscissa is log (a1/a2) and the ordinate is a1/w1.

(i) The hollow pulse belongs to Yang, log (a1/a2) $\in$ [0.6, 1].

The hollow pulse is formed due to massive blood loss, causing a deficiency of blood, so that the individual has insufficient Yin with Yang floating outward, forming a Yang pulse.

(ii) Slippery and wiry pulses are Yin in Yang, log (a1/a2) $\in$ [– 0.2, 0.6].

Slippery pulses are formed either due to phlegm disease or indigestion, or inflammation. Note that healthy people also typically have a slippery pulse, with vigorous Qi and blood.

Wiry pulses are formed due to cold, pain, spasm, and other diseases, causing tension of the sinews, which can be further specified by the Gaussian parameter a1/w1: decreasing a1/w1 describes the decreasing tension, which is consistent with TCM theories since the tight pulse is tenser than other wiry pulses.

(iii) Hesitant pulse belongs to Yin, log (a1/a2) $\in$ [– 0.8, – 0.2].

The hesitant pulse is formed due to the obstruction of Qi and blood by more severe blood deficiency or injury of essence and Qi; this corresponds to a more extreme Yin state, consistent with TCM theories.

From the above analyses, it is shown that the Gaussian parameters have the potential to be used to quantify the pattern differentiation by the eight principles of TCM. This would, to some extent, break through the dilemma that the current pulse diagnostic instrument cannot be used clinically for its ambiguity. The Gaussian parameters and their combination can form a quantitative framework of pulse conditions, that is, the Gaussian parameters can be employed to build a high-dimensional phase diagram for human health state analyses, and further form different subcategories based on the principles of TCM syndrome differentiation.

3 Disscusion

ZHOU Xuehai in the late Qing Dynasty put forward four attributes of pulse diagnosis, namely "position, rate, shape, and potential", which laid the foundation for modern pulse diagnosis studies [11]. These four attributes correspond to different levels, as we will explain below. Rate is an important indicator, which will be discussed elsewhere. Complex system methodology [7] yields a two-step strategy for pulse diagnosis.

(i) Pulse position and force are leading (zeroth) order quantities, which yields diagnosis by eight principal syndromes.

CUI Jiayan of the Southern Song Dynasty put forward the idea of taking "floating or sinking, slow or rapid" as the key, combined with "deficiency or excess", to yield a recognition of 27 different pulse conditions. The selection of these three parameters corresponds to the three pairs of eight principal syndromes differentiation of TCM: "exterior and interior, deficiency and excess, cold and heat", which are easier to measure and yield the first classification of illness.

(ii) Pulse shape and pulse potential are the first-order small quantity, which depicts the subtle characteristics of individuality.

The changes in pulse shape and potential are very sensitive to external fields (including nature and society). For example, ZHU et al. [12] observed the diurnal pulse changes in 63 normal subjects and found the pulse condition changes to a wiry pulse from 11 p.m. to 0 a.m., which corresponds to daily changes in Yin and Yang. The human quantum model holds that the pulse shape quantifies the subtle changes due to internal and external resonance characteristics, and Gaussian parameters can effectively describe an individual's subtle changes in pulse shape, in line with the principle of TCM pulse diagnosis. This will yield a personalized and dynamic health diagnosis.

According to the human quantum cavity view, the pulse wave contains rich information about the interactions within the human body and between the body and the external environment, which are reflected in the changes in Gaussian parameters. A health state corresponds to a harmonious resonance state both internally and externally. Each individual has its own unique quantum coupling equilibrium state that dynamically changes with the external environment. Through the study of pulse wave parameters, we can set the basic points of pulse parameters and mark the floating range of the equilibrium state. The final results will be integrated into an intelligent TCM expert system with individuality, holography, and full-time pulse diagnosis analysis, which will help the modernization of TCM [13].

4 Conclusion

In this paper, under the quantum resonance cavity view of the human body, a Gaussian function model of pulse wave was constructed, yielding a quantitatively accurate description of various pulse signals and Yin-Yang interpretation, which were in line with TCM principles. Not only that "Cunkou reads viscera" in TCM pulse diagnosis can now be understood, but also a new foundation has been laid out for interpreting clinical pulse signal data in assessing an individual's health condition. Evidence indicates that the Gaussian function model of pulse waves has two characteristics: stability and sensitivity, which should be firmly established in future studies, with clinical pulse data of complex shapes.

Furthermore, it is possible to extract key order parameters (including countable functional combination classes) based on a certain amount of physiological and psychological data, so as to achieve personalized parameter description of the human health state.

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Competing interests

The authors declare no conflict of interest.

References

[1] ROSEMARIE V. An objective review of the technological developments for radial pulse diagnosis in traditional Chinese medicine. European Joural of Interative Medicine, 2015, 7(4): 321–331.

[2] ZHU QW. Methodology approach of pulse diagnosis research based on complexity science theory. China Journal of Traditional Chinese Medicine and Pharmacy, 2007, (5): 265–268.

[3] YANG J, NIU X. Ultrasound-videotex detection on three dimensional movement of radial artery on cunkou. China Journal of Traditional Chinese Medicine and Pharmacy, 2006, (5): 264–266.

[4] XU YJ, NIU X. Exploration of detecting character of digital phase in TCM pulse-diagnosis. Chinese Journal of Integrated Traditional and Western Medicine, 2003, (6): 467–470.

[5] CHANDRAN KB, RITTGERS SE, YOGANATHAN AP. Biofluid mechanics the human circulation. Beijing: China Machine Press, 2015: 137–140.

[6] WANG WG. The movement of Qi. Beijing: China Renmin University Press, 2006: 9.

[7] SHE ZS. A New Framework of Complex Systematics - Knowledge System Combining Quantum and Tao. Beijing: Science Press, 2012: 63–79.

[8] WANG L, XU L, FENG S, et al. Multi-gaussian fitting for pulse waveform using weighted least squares and multi-criteria decision making method. Computers in Biology and Medicine, 2013, 43(11): 1661–1672.

[9] LIU CY, ZHENG DC, MURRAY A, et al. Modeling carotid and radial artery pulse pressure waveforms by curve fitting with Gaussian functions. Biomedical Signal Processing and Control, 2013, 8: 449–454.

[10] ZHAO EJ. Pulse Diagnosis of Traditional Chinese Medicine, Tianjin Science and Technology Press, 1990.

[11] ZHANG GZ, YANG J. On the relationships between pulse tracing and position, rate, shape and force attributes. China Journal of Traditional Chinese Medicine and Pharmacy, 2009, 24(9): 1123–1127.

[12] ZHU CX, LI BX, LI SZ, et al. Preliminary observation of pulse changes in four seasons and day and night in normal people. Journal of Hunan College of Traditional Chinese Medicine, 1991, (1): 36–39.

[13] LEUNG YLA, GUAN BH, CHEN S, et al. Artificial intelligence meets traditional Chinese medicine: a bridge to opening the magic box of sphygmopalpation for pulse pattern recognition. Digital Chinese Medicine, 2021, 4(1): 1–8.

基于量子观的中医人体物理模型解读脉搏波

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【摘要】在本团队提出的人体量子物理的模型下, 对“寸口分候脏腑”这一中医原理进行了现代解读, 并构建了基于薛定谔方程的高斯脉搏波模型, 实现了对中医 19 种脉形的准确描述。高斯参数对 13 种脉形成功实现了对阴阳属性的定量展示。人体量子模型进一步提出, 脉搏波是人体内部与环境共振的体现, 基于脉位脉力的零阶量与基于脉形的一阶小量, 构成对人体健康态的多层次辨析。人体量子模型指导下的脉象信息学将实现对人体平衡态的个性化刻画, 根据其偏离度来精准评估其健康态, 从而真正实现传统中医的“知常达变”。

【关键词】量子谐振腔; 中医; 脉诊; 高斯脉搏波模型; 阴阳