



# An information entropy model on clinical assessment of patients based on the holographic field of meridian



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## HIGHLIGHTS

- In this paper, based on a novel informational perspective and a fundamental law of MIEP, we suggest an informational reality for meridian in TCM and deduce its evolutionary dynamic equation.
- By self-organizing artificial neural network as algorithm, we can resolve the dynamical equation of meridian to assess its properties and diagnose the healthy characteristics of human body.
- By three practical clinical cases, we use this theoretical model to assess the evolutionary properties of meridian systems and demonstrate that this model has its application value in practice. It is shown that by structural parameter  $\zeta_k$  and associated radar charts, the evolutionary process of human meridian can be well simulated and quantitative clinical regulations or predictions can be accordingly analyzed in multiple hierarchies, which may open a fresh door of instructing diagnosis and treatment in TCM.

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## ABSTRACT

Meridian system is not only the basis of traditional Chinese medicine (TCM) method (e.g. acupuncture, massage), but also the core of TCM's basic theory. This paper has introduced a new informational perspective to understand the reality and the holographic field of meridian. Based on maximum information entropy principle (MIEP), a dynamic equation for the holographic field has been deduced, which reflects the evolutionary characteristics of meridian. By using self-organizing artificial neural network as algorithm, the evolutionary dynamic equation of the holographic field can be resolved to assess properties of meridians and clinically diagnose the health characteristics of patients. Finally, through some cases from clinical patients (e.g. a 30-year-old male patient, an apoplectic patient, an epilepsy patient), we use this model to assess the evolutionary properties of meridians. It is proved that this model not only has significant implications in revealing the essence of meridian in TCM, but also may play a guiding role in clinical assessment of patients based on the holographic field of meridians.

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## 1. Introduction

Embracing a medical system originated from the idea of Yinyang and Wuxing over 2000 years ago, traditional Chinese medicine (TCM) has investigated human body as a whole rather than a set of relatively independent organs, largely different

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from western medicine. TCM has long believed human is in harmony with cosmos and has held the underlying unification of body and spirit (soul). She has ever annotated China's civilizations from oriental worldviews [1]. According to TCM theory, Qi (the vital energy) runs throughout the whole body but is primarily accessed through a network of pathways in the body called "meridian". Meridian spreads inside and outside of the whole body just as streams and rivers flowing under and across the surface of the earth so that the whole body is connected as one holistic system [2]. Within traditional Chinese medical thoughts, meridian represents a field of "Qi", a continuum of dynamic structures based on the physical structures of human body that in turn regulate it [3]. Meridian theory elaborates how meridian evolves with internal and external environmental changes of body and how meridian interacts mutually with both essence (Jing) and blood (Xue). As the core of TCM, meridian theory has played important roles in guiding diagnosis and clinical practice (e.g. acupuncture, massage) [4].

During past years, by paying attention to the anatomical basis and the physical entities of body, mainstream modern medicine has made great achievements along another avenue different from TCM. Standing on evidence-based modern medicine, researchers have overwhelmingly been interested in revisiting meridian theory invented thousands of years ago, and have been urgent for seeking for its physiological basis and working mechanisms. We could find numerous researches and models related to meridian of TCM. For example, structures such as primo-vessels (Bonghan ducts) [5–7], peripheral and central nerves, connective tissues, mast cells and fascia [8–11] were found to be able to represent the characteristics of meridian. Chemical substances such as  $\text{Ca}^{2+}$ ,  $\text{Na}^+$ , oxygen and nitric oxide along the meridian lines were also widely scrutinized [12]. Furthermore, some researches used thermal or radioactive tracer imaging techniques to identify that meridian might not be so reliable to some extents [13,14]. In addition, the mechanisms of meridian were explained by a series of phenomena such as propagated sensation along channels [15], low hydraulic resistance theory [16,17], and some others [18–21], to list only a few. Obviously, these available researches have largely enriched the understanding of meridian and its clinical applications. However, questions such as what shapes the meridian system, whether it exists, and how it evolves have still been in hot debates. In fact, since neither the anatomical method of mainstream western medicine based on modern science nor body induction experiment has succeeded in exactly showing the meridian system, the authenticity of meridian and the scientific rigorousness of TCM have ever been in dispute [22]. Why and how did we fall in muddle? During past years, scientists began to notice that, in most available researches, they always try to find an "objective stuff" to represent meridian. However, an objective material reality that is pre-existed and touchable has largely been challenged by quantum mechanics [23]. The logic of mechanical materialism that we invoked in meridian studies may be the crux of letting us be lost. Recently, to go out of muddle, beyond the view of objective stuff in mechanical materialism, quantum mechanics from modern physics is suggested as a new perspective to analyze meridian. David Bohm and Karl Pribram's pioneering works revealed that a quantum holographic field different from physical stuff may exist as a more underlying reality of our universe. Later, more and more experiments show strong evidence of the existence of a quantum holographic field linked to any physical objects [24]. These ideas were applied to life to naturally imply that a quantum holographic field is related to human body, and meridian should be understood as a holographic field reality [25]. Microtubules, neural network, acupuncture research also identified a connection between quantum holography, the physical body and meridian [26,27]. All these investigations mean that meridian is not a kind of pre-existed matter-particle-like stuff as commonly imaged by mechanical materialism tradition, but exists as a holographic field [28]. Obviously, these available researches have largely promoted the modern understanding of meridian. However, it is a pity that, up to today, no rigorous holographic field equation for meridian is derived and no quantitative descriptions can be provided. By absorbing good ideas from available works on holographic field of meridian or acupuncture, this paper tends to give a renewed effort. In Section 2, we state why it is possible to reveal the holographic field of meridian from perspective of maximum information entropy principle (MIEP). In Section 3, a dynamic equation for the holographic field of meridian is derived based on MIEP. A mechanistic quantitative model for assessing properties of meridians and clinically diagnose the health characteristics of patients is constructed accordingly. In Section 4, by some practical cases, we use the framework to assess the evolutionary properties of meridians. It is verified that the new model not only has important meanings in revealing the essence of meridian in TCM, but also may play a guiding role in clinical assessment of patients based on the holographic field of meridians.

## 2. Why is possible for the derivation of holographic field of meridian from MIEP

As stated in "Introduction part", trying to replace matter particle for wave function, quantum mechanics holds an object or reality is undoubtedly defined by its observer who observes it in the outside world as bystander, naturally implying a holographic view. Thus, by introducing quantum mechanics, it is revealed that there is a holographic field for meridian. This surely provides new understandings on meridian and acupuncture, being research fronts of meridians. However, being constantly frustrated by measurement or collapse, dark matter or dark energy, inability of unifying quantum and gravity, etc., quantum mechanics is itself still imperfect. Therefore, though quantum mechanics offer meridian a good idea of holographic field, we cannot yet well understand the essence of holographic field, and no rigorous holographic field equation for meridian is derived and no quantitative descriptions can be provided.

Anyway, we may need to invoke and transcend quantum mechanics to derive the holographic field of meridian and reveal its essence. We notice that, during recent decades, with the development of quantum mechanics, an information paradigm for quantum physics has prevailed: the universe consisted ultimately of information and interactions rather than matter-energy and fields [29]. Information paradigm may breach the bottleneck of quantum mechanics and help us to derive the holographic field of meridian and reveal its implications. Among all works on information physics, we notice

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