

Life Field Theory: An Objective Presentation of the Dynamic Evolution of Human Life

WELCOME to the fourth issue of IEEE TRANSACTIONS ON COMPUTATIONAL SOCIAL SYSTEMS (TCSS) in 2023. We are pleased to share some significant developments in our journal. In late June, Clarivate released the updated Impact Factor for all journals indexed by the esteemed Web of Science database. We are delighted to announce that according to the Journal Citation Reports, the 2022 Journal Impact Factor of IEEE TCSS has been determined as 5. Furthermore, we are proud to inform you that IEEE TCSS has achieved a remarkable position in the JCR Category of computer science, cybernetics, ranking in Q1. Thank you once again for your tremendous efforts and unwavering support, which have contributed to the continued success of IEEE TCSS.

In this issue, we are pleased to present a collection of scholarly works comprising nine regular papers and three special issues. The first Special Issue titled “AIoMT-Enabled Federated-Learning-Based Computing for Socially Implemented IoMT Systems: How Will Healthcare Systems Change?” delves into the realm of healthcare systems, exploring the transformative potential of socially implemented Internet-of-Medical-Things (IoMT) systems through the integration of artificial intelligence and federated learning techniques. This Special Issue features a comprehensive assortment of 24 articles, offering valuable insights and innovative approaches.

The second Special Issue, titled “Social Computing and Societies 5.0: Toward Social Intelligence via Cyber Movement Organizations,” sheds light on the paradigm of Societies 5.0 and its implications for social computing. By examining the role of Cyber Movement Organizations in fostering social intelligence, this collection of eight articles elucidates the opportunities and challenges in utilizing advanced computing techniques for societal advancement.

The third Special Issue, titled “Behavioral Modeling, Learning, and Adaptation in Cyber-Physical-Social Intelligence,” encompasses an array of 19 articles that investigate the intricate dynamics of cyber-physical systems and their influence on social intelligence. By exploring behavioral modeling, learning, and adaptation within this context, these articles provide valuable insights into the design and optimization of cyber-physical systems with a focus on enhancing social intelligence.

Furthermore, we are excited to present an engaging topic for discussion in this issue: “Life Field Theory: An Objective Presentation of the Dynamic Evolution of Human Life.” This topic delves into the realm of human life’s dynamic evolution

and aims to present the Life Field Theory as an objective framework for understanding this intricate phenomenon. We encourage readers to explore this thought-provoking subject, which promises to inspire new perspectives and avenues of research.

Scanning the Issue

1. “Attacking the Core Structure of Complex Network” by *Bo Zhou, Yuqian Lv, Jinhuan Wang, Jian Zhang, and Qi Xuan*

First, the authors give the general definition of the targeted k -core attack, map it to the set cover problem, which is NP-hard, and further introduce a series of evaluation metrics to measure the performance of attack methods. Then, the authors propose the Q -index theoretically as the probability that the terminal node of an edge does not belong to the innermost core, which is further used to guide the design of their heuristic attack methods, namely, COREATTACK and GreedyCOREATTACK. The experiments on a variety of real-world networks demonstrate that their methods behave much better than a series of baselines, in terms of much smaller edge change rate (ECR) and false attack rate (FAR), achieving state-of-the-art attack performance.

2. “Equilibrium Means Equity? An E-CARGO Perspective on the Golden Mean Principle” by *Qian Jiang, Dongning Liu, Haibin Zhu, Yan Qiao, and Baoying Huang*

When eliminating team disparities in the team allocation problem (TAP), few of the existing literature reasonably investigate the pros and cons of this principle from a computational perspective. With respect to the environments-classes, agents, roles, groups, and objects (E-CARGO) model and its role-based collaboration (RBC) methodology, this article formalizes and solves the TAP problem, from both the individual and team’s perspective. Based on the revised group role assignment (GRA), this article provides novel insight into the effectiveness of dynamically maintaining equilibrium.

3. “Being Polite: Modeling Politeness Variation in a Personalized Dialog Agent” by *Mauajama Firdaus, Arunav Shandilya, Asif Ekbal, and Pushpak Bhattacharyya*

This article proposes a novel task of generating polite personalized dialog responses in accordance with the user profile and consistent with the conversational history. They design a novel Polite Personalized Dialog Generation (PoPe-DG) framework that employs a reinforced deliberation network and create human-annotated politeness templates according to user profiles to induce politeness variation in the generated responses for the proposed task. Furthermore, the context modules and the annotated templates are appended to initialize the deliberation decoder. The proposed model outperforms the

existing and baseline models in generating polite responses in the personalized dialog dataset.

4. “Knowledge-Driven Industrial Intelligent System: Concept, Reference Model, and Application Direction” by *Poly Z. H. Sun, Yuguang Bao, Xinguo Ming, and Tongtong Zhou*

This article presents the concept and reference model of industrial intelligent systems (IISs) by analyzing the intelligentization requirement of the industrial systems. Different from academic research on general intelligent system capabilities, the reference model given emphasizes factors that need to be considered when implementing IIS in the industry. By analyzing the reference model, knowledge as the core driving force of IIS is recognized. Then, the four main forms of knowledge in IIS, as well as the role and key technologies of knowledge in different stages of IIS, are discussed in detail.

5. “VAM: An End-to-End Simulator for Time Series Regression and Temporal Link Prediction in Social Media Networks” by *Fred Mubang and Lawrence O. Hall*

This article presents a machine-learning-driven end-to-end simulator, called the Volume-Audience-Match (VAM) simulator. VAM’s purpose is to simulate future phenomena related to various topics of discussion in social media networks. VAM was applied to do time series forecasting to predict the future: 1) number of total activities; 2) number of active old users; and 3) number of newly active users over the span of 24 h from the start time of prediction. VAM then used these macroscopic volume predictions (VPs) to perform user link predictions. A user-user edge was assigned to each of the activities in the 24 future time steps.

6. “Understanding the Influence of Social Hubs in Diffusion Processes Driven by Incentivized Friend Invitation” by *Guozhen Zhang, Fengli Xu, Yuan Yuan, and Depeng Jin*

To bridge the gap between academic research and industrial practice, this article sets out to examine the influence of social hubs. Through a large-scale empirical data analysis, they found that under three different measures, the influence of social hubs on the growth of the diffusion process is saturated as their number of contacts increases. Following this observation, they further explored possible causes of this phenomenon by a mixed method that combines a large-scale empirical data analysis and a semi-structured interview to deepen our understanding of social hubs’ influence in the diffusion process.

7. “Cerberus: A Blockchain-Based Accreditation and Degree Verification System” by *Aamna Tariq, Hina Binte Haq, and Syed Taha Ali*

This article proposes a comprehensive blockchain-based credential verification solution, Cerberus, which is considerably more efficient, easy, and intuitive to use, and effectively mitigates widespread manifestations of credential fraud. Cerberus also improves significantly upon other blockchain-based solutions in the research literature: it adheres closely to the existing credential verification ecosystem and addresses real-world fraud scenarios. Moreover, Cerberus uses on-chain smart contracts for credential revocation. They prototype this solution and describe this attempt to design an online verification service with a rich feature set.

8. “Access Control and Privacy-Preserving Blockchain-Based System for Diseases Management” by *Kebira Azbeg, Ouail Ouchetto, and Said Jai Andaloussi*

This article describes a blockchain-based system for securing Internet-of-Things (IoT) healthcare devices. In addition to data encryption, they propose to use blockchain technology to enhance security and privacy in healthcare systems. Three important characteristics were taken into account: security, scalability, and processing time. The security concerns are ensured by using the re-encryption proxy in conjunction with blockchain to encrypt data and control access to it. To ensure blockchain scalability, data are stored in an inter planetary file system (IPFS) off-chain database. An ethereum blockchain is used based on proof of authority (PoA) to speed up the data storage.

9. “Leveraging Domain Knowledge to Improve Depression Detection on Chinese Social Media” by *Zhihua Guo, Nengneng Ding, Minyu Zhai, Zhenwen Zhang, and Zepeng Li*

To address the gap that few Chinese social media-based resources are used for depression research, this article presents the collection of a Chinese dataset for depression detection on social media. A depression lexicon is developed based on domain knowledge of depression and the Dalian University of Technology Sentiment Lexicon (DUT-SL) by including antidepressants and symptoms of depression. In addition, a metric is proposed to evaluate correlations between features, which is then used to fuse lexicon features. Experimental results indicate that the depression domain lexicon features improve classification performance and fusing these features based on their correlations can further enhance prediction effectiveness.

I. LIFE FIELD THEORY: AN OBJECTIVE PRESENTATION OF THE DYNAMIC EVOLUTION OF HUMAN LIFE

As the mainstream practice of medicine in ancient China, Traditional Chinese Medicine (TCM) has been through thousands of years of history and is ever-new. And now, with the latest development of science and technology, especially the advent of big data and artificial intelligence, TCM is gradually moving towards modernization and internationalization [1].

A. Why Is the Life Field Theory Proposed?

The holistic view is one of the essences of TCM, which has guided the formation and development of the entire TCM practice. Guided by the holistic view, TCM diagnoses and treats diseases through a personalized and dynamic therapy process based on temporal and spatial differences, highlighting the advantages of precise diagnosis and treatment. The holistic view of TCM believes that the human body and the universe are harmonious, and the body and mind are in synergy [2]. At the same time, it emphasizes that the human body undergoes dynamic changes over time and space. Therefore, it focuses on syndrome differentiation and treatment and forms a macroscopic theoretical system of the “diagnosis-treatment-feedback-treatment” dynamic loop.

However, since TCM is guided by concrete thinking and focuses on the functional studies of the human body’s organs,

with less research on the anatomical structure, the information obtained about diseases is influenced by the accuracy of subjective descriptions from observers. Therefore, the research results of TCM have characteristics that are difficult to compare and replicate, making it challenging to validate and reduce the data in TCM.

Guided by the holistic view, TCM believes that the evolution of human life occurs in a “harmony between human and nature” holistic system [3]. Various types of characteristic information do not exist independently but depend on each other. Each component in this system continuously exchanges energy, matter, and information, maintaining the dynamic balance of life evolution. This is consistent with the field theory view that things or phenomena are not simply collections of constituent elements but, as a whole, form a field with force and dynamic relationships among its components [4], [5]. Based on this, the “Life Field Theory” is proposed to objectively present the dynamic evolution of human life.

B. What Is the Life Field Theory?

Modern physics believes that there is a certain energy “field” around the “entity,” and the “entity” and the surrounding “field” exist in a spatial form of mutual independence and mutual correlation. Under certain conditions, these “fields” have material properties that can be measured and visualized [6], [7].

The Life Field Theory emphasizes the connection between the “entities” of various organs and tissues in the human body and the “fields.” The human body is also connected to the “fields” of the outside world. In this complex network relationship, the exchange of energy, matter, and information between “entities” is achieved through the interaction between “fields” to maintain dynamic balance. In addition, at various stages of life, the coordinated action between “entities” and “fields” maintains life’s functional completeness and structural integrity.

Therefore, under the guidance of the holistic concept of TCM, the measurement and visualization of various life fields in the human body through artificial intelligence technology may explore the laws of human life evolution and explain the complex network relationship in the human body, clarifying the scientific connotation of the evolution of life itself.

C. Why Does the Life Field Theory Works?

The human body is a carrier of life, and in the process of understanding life, modern medicine focuses on the “entity” structures that make up the various organs and tissues of the human body. However, as an organic whole, the human body cannot fully explain the phenomena of life, reproduce the process of life, or explore the laws of life solely based on objective “entity” structures if it is taken out of the living state.

Guided by the holistic perspective, TCM not only emphasizes the independence of the “entity” of the human body’s organs, blood, and other body fluids but also emphasizes the functional and dynamic relationship between the human body’s internal and external environment. From the holistic

perspective, TCM’s explanation of various macroscopic phenomena of life is essentially an explanation of the complex dynamic network relationship between humans and the outside world, which is more in line with the nature and internal laws of life.

However, due to the lack of objective “entity” researches in TCM, its theory is somewhat abstract. Therefore, the key breakthrough in exploring the nature of life is how to use modern technology to interpret and reduce the complex dynamic network relationship of life. The application of the Life Field Theory provides the possibility for achieving this goal.

The flourishing development of artificial intelligence and big data makes quantifying and objectifying subjectively descriptive language, images, and text possible. Therefore, the deep integration of TCM with artificial intelligence technology can achieve the quantification and objectification of differentiated clinical data in TCM, improve the interpretability of TCM theories, and break through the “black box” problem of clinical data in TCM.

In particular, as the integration of medical practice and engineering gradually deepens, guided by the holistic perspective of TCM, the combination of feature information and disease information mapping has been achieved with the help of artificial intelligence technology and further research in conjunction with the Life Field Theory will help TCM to transform into an objective, precise, and intelligent form.

D. Conclusion

In summary, a human being is an organic whole composed of many interconnected and mutually constrained subsystems. It has both an objectively independent “entity” structure and characteristics of a “field.” The exchange of energy, matter, and information takes place within the context of the holistic environment of “Harmony between human and nature,” which constitutes the dynamic evolution process of human life [8]. In this process, life exhibits both temporal dynamics and spatial unity. Therefore, the Life Field Theory was proposed, with the aim of elucidating the dynamic evolution of life from a holistic and systemic perspective and revealing the harmonious unity of life with the universe.

XINYI LI
Dongzhimen Hospital
Beijing University of Chinese Medicine
Beijing 100700, China

HANSHU CAI
School of Information Science and Engineering
Lanzhou University
Lanzhou 730000, China

GUIHUA TIAN
Dongzhimen Hospital
Beijing University of Chinese Medicine
Beijing 100700, China

BIN HU, *Editor-in-Chief*
School of Medical Technology
Beijing Institute of Technology
Beijing 100081, China

REFERENCES

- [1] X. Li et al., "Current status and future prospects of artificial intelligence in traditional Chinese medicine," *Biomed. Transformation*, vol. 3, no. 3, pp. 69–73, 2022.
- [2] Z. Chen et al., "Basic characteristics of concept of holism of Chinese medicine," *J. Basic Chin. Med.*, vol. 27, no. 9, pp. 1348–1351, 2021.
- [3] X. Cai and W. Jin, "Holistic view and science—The practical significance of the holistic view of Chinese traditional thinking," *Stud. Dialectics Nature*, vol. 26, no. 1, pp. 115–119, 2010.
- [4] K. Lewin, *Resolving Social Conflicts*. New York, NY, USA: Harpper and Brother Publishers, 1948, p. 11.
- [5] K. Lewin, *Field Theory in Social Science*. New York, NY, USA: Harpper and Brother Publishers, 1951, pp. 239–240.
- [6] X. Ma and Y. Shi, "Qi-monism: The field quantum theory in the traditional Chinese philosophy," *J. Henan Univ. Sci. Technol., Social Sci.*, vol. 37, no. 5, pp. 40–43, 2019.
- [7] Z. Xiao and C. Lv, *Introduction to Particle Physics*. 2016, p. 16.
- [8] L. Jia, Q. Li, and Y. Xu, "Re-discussion 'heaven-human integration': The paradigm shift from quantitative method to qualitative method," *Shanghai Manag. Sci.*, vol. 44, no. 2, pp. 11–15, 2022.



Xinyi Li is currently pursuing the Ph.D. degree with the Dongzhimen Hospital, Beijing University of Chinese Medicine, Beijing, China.

She has participated in one National Key Research and Development Program of China and one project of the National Natural Science Foundation of China. She has coauthored 15 publications in journals, participated in the compilation of Generality of Intelligent Traditional Chinese Medicine as an editorial board member, and authorized three invention patents. Her research interests include clinical efficacy evaluation of Traditional Chinese Medicine (TCM) and intelligent diagnosis and treatment of TCM.



Hanshu Cai (Member, IEEE) received the bachelor's degree in computer mathematics from Carleton University, Ottawa, ON, Canada, in 2006, and the Ph.D. degree in computer engineering from Lanzhou University, Lanzhou, China, in 2018.

He is currently an Associate Professor with the Gansu Provincial Key Laboratory of Wearable Computing, School of Information Science and Engineering, Lanzhou University. His research interests include artificial intelligence, affective computing, big data analysis, semantic web, automated reasoning, bio-feedback, and computerized cognitive behavioral therapy.



Guihua Tian was born in January 1983. She received the bachelor's degree in acupuncture and tuina from Xinjiang Medical University, Urumqi, China, and the Ph.D. degree (joint training) from the Beijing University of Chinese Medicine, Beijing, China, and the School of Medicine, Peking University, Beijing, in 2006 and 2012, respectively.

She is currently a Chief Physician/Researcher and a Doctoral Supervisor. She is a Post-Doctoral Fellow at the West China School of Clinical Medicine, Sichuan University, Chengdu, China, and a Visiting Scholar at the University of Toronto, Toronto, ON, Canada. In 2012, she joined the Dongzhimen Hospital, Beijing University of Chinese Medicine, where she is the Director of the Science and Technology Department, and in 2018, she was promoted to Chief Physician, and in 2019, she was promoted to Research Fellow.

Dr. Tian has been awarded the eighth batch of outstanding cadres of the Ministry of Organization of the CPC Central Committee, the National Ten Thousand Talents Program for Top Young Talents Award, the 17th China Youth Science and Technology Award, the Talents of

Young Qihuang Scholar, the Outstanding Youth of the National Higher Institute of Traditional Chinese Medicine, the Beijing Young Talent, the Beijing New Star of Science and Technology, and the Young Innovation Talent of the Chinese Society of Traditional Chinese Medicine.



Bin Hu (Fellow, IEEE) received the Ph.D. degree in computer science from the Institute of Computing Technology, Chinese Academy of Sciences, Beijing, China, in 1998.

He is currently a Full Professor and the Dean of the School of Medical Technology, Beijing Institute of Technology, Beijing. He is a National Distinguished Expert and the Chief Scientist of the 973 Program, and was the National Advanced Worker in 2020. He has coauthored more than 400 publications (more than 10k citations, H-index: 51).

Dr. Hu is a fellow of the Institution of Engineering and Technology (IET). He is a member of the Steering Council of the ACM China Council and the Vice-Chair of the China Committee of the International Society for Social Neuroscience. He serves as the Editor-in-Chief for IEEE TRANSACTIONS ON COMPUTATIONAL SOCIAL SYSTEMS. He is also the TC Co-Chair of computational psychophysiology and cognitive computing in the IEEE Systems, Man, and Cybernetics Society (SMC). He is a member of the Computer Science Teaching and Steering Committee as well as the Science and Technology Committee. His awards include the 2014

China Overseas Innovation Talent Award, the 2016 Chinese Ministry of Education Technology Invention Award, the 2018 Chinese National Technology Invention Award, and the 2019 WIPO-CNIPA Award for Chinese Outstanding Patented Invention. He is a Principal Investigator for large grants such as the National Transformative Technology “Early Recognition and Intervention Technology of Mental Disorders Based on Psychophysiological Multimodal Information,” which have greatly promoted the development of objective, quantitative diagnosis, and nondrug interventions for mental disorders.