Perspectives:
Guest Editorial for Invited Special Section on Intelligent Control for Industrial Metaverses

The Metaverse of Mind: Perspectives on DeSci for DeEco and DeSoc

Fei-Yue Wang, *Fellow, IEEE*

First of all, I would like to take this opportunity to express my sincere and deep thanks to our Editor-in-Chief, Professor MengChu Zhou, who took over my position after I was drafted for rejuvenating *IEEE Transactions on Computational Social Systems* in 2017. During the past five years, MengChu's professional leadership and dedication has transformed *IEEE/CAA Journal of Automatica Sinica (JAS)* from its infancy to a young and high-impact publication in the world that is full of vitality and actively engaged by a group of talented and charged associate EiCs and editors, which is clearly demonstrated in MengChu's farewell editorial [1]. I am very glad that Professor Qing-Long Han, an influential and leading scientist of the world-class in AI, control, automation, and intelligent science and technology from Australia, as well as a staunch supporter and great leader of this journal from its beginning, will take over the EiC torch from MengChu next year, since I am extremely confident that our journal will reach a new high for its service and quality under his new leadership.

Right before this transition of leadership, three of us led the effort to establish a new column called *Perspectives* for *IEEE/CAA JAS* with the strong support from our editorial board, and select Metaverse as its launching topic for discussion. After my article for the inaugural issue of *Perspectives* last November on DAO (Decentralized Autonomous Organizations and Operations), MetaControl, MetaSystems, and Metaverses [2], we decided to invite researchers in my group in the *State Key Laboratory for Management and Control* at Chinese Academy of Sciences and their collaborators in other institutions to contribute a special section on *Intelligent Control for Industrial Metaverses* for *Perspectives*. To us and to *IEEE/CAA JAS*, metaverse, along with blockchain intelligence, DAO, digital twins in cyber-physical systems (CPS) and parallel intelligence in cyber-physical-social systems (CPSS), are emerging and important directions for investigation, research, development, and applications, perfectly fit the purpose of creating this column of *Perspectives*.

Citation: F.-Y. Wang, "The metaverse of mind: Perspectives on DeSci for DeEco and DeSoc," *IEEE/CAA J. Autom. Sinica*, vol. 9, no. 12, pp. 2043-2046, Dec. 2022.

F.-Y. Wang is with The State Key Laboratory for Management and Control of Complex Systems, Chinese Academy of Sciences, Beijing, 100190, China, and also the Macao Institute of Systems Engineering, Macau University of Science and Technology, Macao, 999078, China (e-mail:feiyue.wang@ia.ac.cn).

This work was supported by The Science and Technology Development Fund, Macau SAR (File no. 0050/2020/A1)

Digital Object Identifier: 10.1109/JAS.2022.106106

After almost 40 years since its publication, we need to move beyond *The Society of Mind* with agents as suggested by Marvin Minsky, *The Metaverse of Mind* with digital twins of parallel intelligence should be a good direction to try and explore, which is the inspiration and motivation for this special section. Here, I would like to thank my colleagues and other contributors to the special section for your great effort and scholar work to the topic. Hope this special section will inspire more investigation and research on control in or for metaverses, especially more applications along this direction.

In many senses, this invited special perspective section on *Control for Industrial Metaverses* is a result of an ambitious research agenda I made for myself almost 30 years ago after reading Karl Popper's ***The Open Society and its Enemies***. To me, the open society should have no enemies, we must find a way to build the bridge between Popper's utopian social engineering and piecemeal social engineering, perhaps through the *Cyber-enabled Social Movement Organizations and Operations* (**CeSMO**), and that would be my research for the rest of my professional career. I had promised myself to write a book entitled ***The Open Society and its Friends***, and even created a new name for my ambition, ***Bemonad***, for *Becoming* and *Being* Gottfried Leibniz's *Monad*, which was redefined as the atom of intelligence for Popper's Artificial World in the sense of ancient Greek philosopher Democritus' atom for matters in the Physical World. Of course, I realized very soon that it is simply a dream and a mission impossible. However, this had dramatically changed my career path from intelligent control for robotic systems to a mixture of science, technology, engineering, and social studies for complex intelligent systems, or an interdisciplinary approach by today's term, starting from my technical report at *NASA/UA Space Engineering Research Center* (SERC) on *Shadow Systems* in 1994 [3] and ending up with the creation of the *Program for Advanced Research in Complex Systems* (PARCS) at the University of Arizona, Tucson, Arizona in 1999.

During the late 1990s and entire 2000s, I spent all my energy and enthusiasm in building Sino-US research collaboration projects and programs for coming and future *Intelligent Science and Technology*, from the *US-China Joint Research Center on Intelligent Control and Systems* to *US-Sino Center for Advanced Research and Education* (US-CARE), including projects such as **FPGA** (*Foundational Platforms and Gateways for All*) to support start-ups and intelligent industries, **CASIA** (*Complex Adaptive Systems for Intelligence Analytics*)

for Academic Intelligence to be used for graduate students around the world for writing their theses and dissertations, and **PUREST** (*Parallel Universities for Research and Education in Science and Technology*) for helping future students in high schools and universities. Those efforts made me realize that we need to move fast and far beyond our conventional thinking on technology such as agents, robots or shadow systems, and far beyond our general desire for virtual, mixed or enhanced reality, we must develop digital human technology for our sustainability. My vision for future is simple and straight: The world population would be 5% biological human, 15% robotic human, and 80% digital human. To this mission, over the last two decades, our research has been focused on ***Artificial Societies, Computational Experiments, and Parallel Execution*** (ACP), ***Cyber-Physical-Social Systems*** (CPSS), as well as their derivatives such as *Parallel Intelligence*, *Parallel Systems*, *Parallel Management*, *Parallel Economics*, *Parallel Manufacturing*, *Parallel Control*, *Parallel Agriculture*, *Parallel Transportation*, *Parallel Services*, *Parallel Energy*, *Parallel Mining*, *Parallel Medicine*, *Parallel Ecology*,..., spanning over 100 fields and leading to the establishment of the *State Key Laboratory for Management and Control of Complex Systems* in 2011, which has grown into a conglomerate of research departments and start-ups and thousands of staff in many places and fields.

Today, our vision for the future is more closing than ever, and has been becoming the past in quite a few places in our industries and societies. Digital twins, foundational or Big AI models, metaverses, web 3.0 or web3, DAO for decentralized autonomous organizations or operations, DeSci, DeEco, or DeSoc for decentralized autonomous sciences, economies, or societies, are emerging fast and receiving tremendous attention from researchers and entrepreneurs around the world. Therefore, I think the time is ready for organizing an invited special perspective forum to discuss our research agenda on ACP-based parallel intelligence and CPSS in metaverses, we need more people to work and study in this field.

In what follows, I would like to give a brief introduction to each article of the special section.

***1*) Y. Shen, Y. H. Liu, Y. L. Tian, and X. X. Na, "Parallel sensing in Metaverses: Virtual-real interactive smart systems for "6S" sensing," *IEEE/CAA J. Autom. Sinica*, vol. 9, no. 12, pp. 2047-2054, Dec. 2022.**

A metaverse of no sensing is no verse at all. The use and design of mechatronic and optical sensors for deformation and vibration, and force/torque sensing for robotic manipulation and image acquisition for vision had been the major part of my research since early 1980s. In 2004, we launched our intelligent sensing and visualization project, called **CASID** for *Complex Adaptive Sensing for Identification and Display* for building devices and systems for true 3D display, which led to our parallel sensing research described in this paper for developing smart sensors by the technology of blockchain intelligence with "6S" sensing capacities: cognitive, parallel, crypto, federated, social, and ecological sensing. In parallel sensing, sensors are redefined as the pairing of real physical sensors and virtual software-defined sensors, or digital sensors. Parallel sensing allows physical sensors to operate in planned time periods for energy efficiency, while cloud-based descriptive, predictive, and prescriptive digital sensors compensate their functions for data and control. Digital sensors are constructed to perceive virtual scenes and then extend small real data to virtual big data by computational sensing experiments, which would be used to train and boost the performance of perception models. Our focus is on parallel optics of parallel light fields that could generate economically and massively images and point clouds for parallel learning in autonomous driving and other AI as well as metaverse applications [4]–[10].

***2*) X. J. Wang, M. Z. Kang, H. Q. Sun, P. de Reffye, and F.-Y. Wang, "DeCASA in agriVerse: parallel agriculture for smart villages in Metaverses," *IEEE/CAA J. Autom. Sinica*, vol. 9, no. 12, pp.2055-2062, Dec. 2022.**

I have a deep interest and lifelong passion in botany, largely due to the fact that I spent a significant part of my childhood in an experimental plantation for hops and many other research plants. In the middle of 1990s, I started my research of using linguistic dynamic systems for modeling plant growth in Arizona's Biosphere 2 at the Sonoran desert and Experimental Center for Controlled Environment Agriculture (CEA) on the bank of Rillito River in Tucson. In the process, we installed the first webcam in the world for monitoring CEA remotely by Internet in a course project in my class SIE 485/585: Robotics and Automation. In 2002, I started my research in growing virtual plants on computers and that will grow simultaneously with real plants in the lab, which led to my friendship and collaboration with Dr. Bao-Gang Hu and Professor Philippe de Reffye in the middle of 2000s, and then Dr. Mengzhen Kang, and our project on Complex Adaptive Systems for Agriculture (CASA) in 2005 [11]. Subsequently, at the system level, we proposed a framework, called DiCASA for distributed CASA for parallel agriculture in 2017 [12] following the ACP approach [13], and then we put forward the agricultural CPSS in 2018 [14], and finally the current work on DeCASA in AgriVerse that introduces our effort on developing metaverses for agriculture and plantations. I believe this effort would be critical for our sustainable development now and in the future, especially for the construction and operations of intelligent villages and smart cities. This article provides the system architecture, operating processes, and the role of agricultural foundational models for DeCASA and AgriVerse, as well as the potentials and significance of DAO, DeSci, and CPSS for such effort [2], [6], [7].

***3*) J. Yang, X. X. Wang, and Y. D. Zhao, "Parallel manufacturing for industrial Metaverses: A new paradigm in smart manufacturing," *IEEE/CAA J. Autom. Sinica*, vol. 9, no. 12, pp. 2063-2070, Dec. 2022.**

I started my manufacturing research on using Petri nets for the formal process specification and analysis of computer integrated manufacturing (CIM) in 1987, specifically for task coordination in automated factories and protocol analysis for manufacturing message specification (MMS), and got my first industrial job at the New York State Center for Manufacturing Productivity and Technology Transfer in 1988, as well as my friendship and collaboration with MengChu for 35 years, which was followed by a manufacturing career in CIM, flex-

ible automation, rapid prototyping (3D printing), networked design, unmanned plants until early 2000s. We launched our research and applications of parallel manufacturing in 2005 under the strong support from Chinese Academy of Sciences and SINOPEC in 2005, and then social manufacturing in 2012 [15] with applications in apparel and footwear industries. I still remembered vividly the ambitious demo projects and vision presentations presented to me by Shapeways and Quirky when I visited their New York offices in 2013. Afterward, our research on smart and intelligent manufacturing has been focused on parallel and social manufacturing, especially their relationship to social computing, computational marketing and parallel services. This article introduces our effort of integrating parallel and social manufacturing with metaverse-based open manufacturing for ecologically smart production.

Parallel manufacturing systems are constructed to achieve virtual-real co-evolution, double closed-loop feedback, and collaborative optimization of a series of manufacturing processes such as production planning, real-time scheduling, and task coordination/execution. Social intelligence is collected, analyzed and extracted for meeting social demands more precisely, and collective wisdom is gathered to design products, contribute to the consideration of individual requirements for achieving on-demand production and avoiding potential wastes caused by aesthetic discrepancies from the consumer side. Digital workers and robotic workers constantly perform most of the routine physical and mental loads instead of using human workers, resulting in higher efficiency, fewer employees and lower costs. By taking the workflow of customized shoes in SANBODY Technology Company as an example, where the unmanned production line named FlexVega has been built, the effectiveness of parallel manufacturing is verified. In comparison with other manufacturing patterns [16]–[18], parallel manufacturing can break up the barriers imposed by the constraints of resource and capacity, as well as spatio-temporal limitations, and facilitate the realization of low-cost, high-efficiency and zero-inventory flexible manufacturing.

***4*) Y. T. Wang, Y. L. Tian, J. G. Wang, Y. S. Cao, S. X. Li, and B. Tian, "Integrated inspection of QoM, QoP, and QoS for AOI industries in Metaverses," *IEEE/CAA J. Autom. Sinica*, vol. 9, no. 12, pp. 2071–2078, Dec. 2022.**

Reliability and Quality Engineering (RQE) has been my favorited topics but no real research until 2000s. However, I had hand-on experience as a child with the use of statistical and probabilistic methods at the hop research plantation before I knew anything about theories of statistics and probability, and that made me a staunch supporter of the RQE program at the University of Arizona since 1990, which had faced the pressure and likelihood of downsizing or even outright eliminating several times during my 21 year tenure there. In 2007, I was invited to visit several institutes and companies in Hangzhou, Zhejiang, and asked to head their proposed new alliance for industrial monitoring and inspecting devices, mainly field cameras and laser detectors for security surveillance, fault detection, and quality of products (QoP) and services (QoS). I was very interested in the effort but declined the offer due to my time constraint. But the trip made me aware the emerging importance of this old yet quite new industry, and I am so glad that today our lab has two leading startups on automated optical inspection (AOI) based on AI in China. This article describes our new effort in developing metaverse-based systems with blockchain intelligence and DAO in CPSS for Automated Quality Inspection (AutoQI), particularly for application in semiconductor industry, partly due to my personal experience with systems on programmable chips, FPGA/BGA/CSP in 1980s and 1990s at RPI/UA and a small company for automation in semiconductor, called Vanguard Automation in Oro Valley, Arizona [19]. I hope soon we would have a strong research program on Complex Adaptive Systems for Inspection and Insurance of Quality (CASIIQ) and the associated federation of CASIIQ on blockchains, our DeCASIIQ based on DAO and DeSci.

***5*) J. W. Lu, X. X. Wang, X. Cheng, J. Yang, O. Kwan, and X. Wang, "Parallel factories for smart industrial operations: From big AI models to field foundational models and scenarios engineering," *IEEE/CAA J. Autom. Sinica*, vol. 9, no. 12, pp. 2079–2086, Dec. 2022.**

Last but not least, it is our effort of developing industrial field foundational models and scenarios engineering for parallel factories and parallel organizations, aiming at building new knowledge workshops, assembly lines, and machines for knowledge workers with knowledge automation based on shadow systems, digital twins, metaverses, and parallel intelligence. I am happy to see Oliver Kwan, the first "official" graduate student under my name in 1990, join us in this endeavor, and that bring me back to the old memories of long driving for visiting Silicon Valley in 1992 for organizing and helping the first **AAAI** Robotic Competition as well as experiencing start-up companies in San Jose. In 2013, we established *QAII* in Qingdao, China, to speed up the implementation for our vision of future intelligent industries or Industries 5.0 with demo projects and prototype systems, and made the concept of parallel factories a popular model and emerging paradigm for intelligent enterprises [20]–[23]. Clearly, metaverses, parallel systems, and foundational models will be gradually integrated into actual production activities in factories, we hope that parallel factories would emerge as a scientific approach to effectively and efficiently, relate, analyze, design, integrate and deploy those new intelligent technologies. In this paper, preliminary investigation and discussion on integrating field foundational models and scenarios engineering into parallel factories are introduced with *QAII-1.0*, which incorporates complex social and human factors into the design and analysis of industrial operations based on CPSS, and is capable of enabling parallel industrial operations to achieve "6S" production, safe in the physical space, secure in cyberspace, sustainable in ecological world, sensitive to privacy and individual rights, service to all, and smart comprehensively. In *QAII-1.0*, a field foundational model called EuArtisan is developed for achieving high-level machine intelligence while ensuring industrial interpretability and reliability. The design, certification, and verification of EuArtisan are carried out based on scenarios engineering and DAO principle. A case study of parallel oil fields in metaverses is presented to illustrate the potentials and significance of *QAII-1.0* types of future industrial platforms.

I have talked a lot about our old research history, but this special perspective section is about the future that will define our new history. At this critical moment for the formation and development of Intelligent Science and Technology, we need new thinking and new philosophy for intelligent industries and smart societies of tomorrow, digital twins, metaverses, parallel intelligence have offered us new technologies and tools for control and automation in dealing with complex and intelligent systems, we need metasystems, metaorganizations, metaeconomies, metasocieties, and the corresponding DeSci and DeTech for their healthy and sustainable evolution (not revolution, I hope sincerely) for bettering our human benefit as a whole [24], [25]. This special section on intelligent control for industrial metaverses is preliminary and a first call for more and fruitful discussions, we hope you will join us in this endeavor at the coming sections of *IEEE/CAA JAS* with your own insight and research.

REFERENCES

[1] M. Zhou, "Editorial: Evolution from AI, IoT and big data analytics to metaverse," *IEEE/CAA J. Autom. Sinica*, vol. 9, no. 12, pp. 2041−2042, Dec. 2022.

[2] F.-Y. Wang,"The DAO to MetaControl for MetaSystems in Metaverses: The system of parallel control systems for knowledge automation and control intelligence in CPSS," *IEEE/CAA J. Autom. Sinica*, vol. 9, no.11, pp.1899−1908, Nov. 2022.

[3] F.-Y. Wang,"Shadow systems: A new concept for nested and embedded co-simulation for intelligent systems," Univ. Arizona, Tucson, AZ, USA, RAL Rep., 1994.

[4] F.-Y. Wang and Y. Shen, "Parallel light field: A perspective and a framework," *IEEE/CAA J. Autom. Sinica*, vol. 9, no. 12, pp. 1871−1873, Dec. 2022.

[5] F.-Y. Wang et al., "Parallel light field: the framework and processes," *Chin. J. Intell. Sci. Technol.*, vol. 3, no. 1, pp.110−122, Mar. 2021.

[6] L. Li, Y. L. Lin et al., "Parallel learning: a perspective and a framework," *IEEE/CAA J. Autom. Sinica*, vol. 4, no. 3, pp. 389−395, Jul. 2017.

[7] L. Li, Y. L. Lin et al., "Parallel learning–a new framework for machine learning," *IEEE/CAA J. Autom. Sinica*, vol. 43, no. 1, pp. 1−8, Jan. 2017.

[8] C. X. Zhou, Y. Z. Liu, Q. S. Sun, and P. S. Lasang, "Vehicle detection and disparity estimation using blended stereo images," *IEEE Trans. Intell. Veh.*, vol. 6, no. 4, pp. 690−698, Dec. 2021

[9] M. Ghahramani, M. C. Zhou, and G. Wang, "Urban sensing based on mobile phone data: approaches, applications, and challenges," *IEEE/CAA J. Autom. Sinica*, vol. 7, no. 3, pp. 627−637, May 2020.

[10] F.-Y. Wang, "MetaVehicles in the Metaverse: Moving to a new phase for intelligent vehicles and smart mobility," *IEEE Trans. Intell. Veh.*, vol. 7, no. 1, pp. 1−5, Mar. 2022.

[11] F.-Y. Wang, "Digital agriculture and parallel intelligence: Towards complex adaptive systems for smart agriculture," CASIA, CASKL-CSIS Tech Report, Oct. 2005.

[12] M. Kang and F.-Y. Wang, "From parallel plants to smart plants: Intelligent control and management for plant growth," *IEEE/CAA J. Autom. Sinica*, vol. 4, no. 2, pp. 161−166, Apr. 2017.

[13] F.-Y. Wang, "On the modeling, analysis, control and management of complex systems," *Complex Sys. and Complex. Sci.*, vol. 3, no. 2, pp. 26−34, Jun. 2006.

[14] M. Kang, X.-R. Fan, et al., "Managing traditional solar greenhouse with CPSS: A just-for-fit philosophy," *IEEE Trans. Cybern.*, vol. 48, no. 12, pp. 3371−3380, Dec. 2018.

[15] F.-Y. Wang, "From social computing to social manufacturing: The coming industrial revolution and new frontier in cyber-physical-social space," *Bull. Chin. Acad. Sci.*, vol. 27, no. 6, pp. 658−669, Dec. 2012.

[16] M. Ghahramani, Y. Qiao, M. C. Zhou, A. O'Hagan, and J. Sweeney, "AI-based modeling and data-driven evaluation for smart manufacturing processes," *IEEE/CAA J. Autom. Sinica*, vol. 7, no. 4, pp. 1026−1037, Jul. 2020.

[17] J. C. Luo, Z. Q. Liu, S. G. Wang, and K. Y. Xing, "Robust deadlock avoidance policy for automated manufacturing system with multiple unreliable resources," *IEEE/CAA J. Autom. Sinica*, vol. 7, no. 3, pp. 812−821, May 2020.

[18] B. Huang, M. C. Zhou, C. Wang, A. Abusorrah, and Y. Al-Turki, "Deadlock-free supervisor design for robotic manufacturing cells with uncontrollable and unobservable events," *IEEE/CAA J. Autom. Sinica*, vol. 8, no. 3, pp. 597−605, Mar. 2021.

[19] F.-Y. Wang and M. Liu, "The coming of CPS: automated assembly processes for high-volume chip scale packaging," *IEEE Robot. & Autom. Mag.*, vol. 11, no. 1, pp. 59−69, Mar. 2004.

[20] F.-Y. Wang, "Parallel control and digital twins: Control theory revisited and reshaped," *Chin. J. Intell. Sci. Technol.*, vol. 2, no. 3, pp. 293−300, Sep. 2020.

[21] J. J. Zhang, F.-Y. Wang, X. Wang et al., "Cyber-physical-social systems: The state of the art and perspectives," *IEEE Trans. Comput. Soc. Syst.*, vol. 5, no. 3, pp. 829−840, Sep. 2018.

[22] G. Xiong, X. S. Dong, H. Lu et al., "Research progress of parallel control and management," *IEEE/CAA J. Autom. Sinica*, vol. 7, no. 2, pp. 355−367, Mar. 2020.

[23] Q. Wei, H. Li et al., "Parallel control for continuous-time linear systems: A case study," *IEEE/CAA J. Autom. Sinica*, vol. 7, no. 4, pp. 919−926, Jul. 2020.

[24] F.-Y. Wang, R. Qin, X. Wang, and B. Hu, "MetaSocieties in Metaverse: MetaEconomics and MetaManagement for MetaEnterprises and MetaCities," *IEEE Trans. Comput. Soc. Sys.*, vol. 9, no. 1, pp. 2−7, Feb. 2022.

[25] X. Li et al., "From features engineering to scenarios engineering for trustworthy AI: I&I, C&C, and V&V," *IEEE Intell. Sys.*, vol. 37, no. 4, pp. 18−26, Sep. 2022.

Fei-Yue Wang (Fellow, IEEE) received his Ph.D. degree in computer and systems engineering from the Rensselaer Polytechnic Institute, Troy, NY, USA, in 1990. He joined The University of Arizona in 1990 and became a Professor and the Director of the Robotics and Automation Laboratory and the Program in Advanced Research for Complex Systems. In 1999, he founded the Intelligent Control and Systems Engineering Center at the Institute of Automation, Chinese Academy of Sciences (CAS), Beijing, China, under the support of the Outstanding Chinese Talents Program from the State Planning Council, and in 2002, was appointed as the Director of the Key Laboratory of Complex Systems and Intelligence Science, CAS, and Vice President of Institute of Automation, CAS in 2006. He found CAS Center for Social Computing and Parallel Management in 2008, and became the State Specially Appointed Expert and the Founding Director of the State Key Laboratory for Management and Control of Complex Systems in 2011.

His current research focuses on methods and applications for parallel intelligence, social computing, and knowledge automation. He is a Fellow of INCOSE, IFAC, ASME, and AAAS. In 2007, he received the National Prize in Natural Sciences of China, numerous best papers awards from IEEE Transactions, and became an Outstanding Scientist of ACM for his work in intelligent control and social computing. He received the IEEE ITS Outstanding Application and Research Awards in 2009, 2011, and 2015, respectively, the IEEE SMC Norbert Wiener Award in 2014, and became the IFAC Pavel J. Nowacki Distinguished Lecturer in 2021.

Since 1997, he has been serving as the General or Program Chair of over 30 IEEE, INFORMS, IFAC, ACM, and ASME conferences. He was the President of the IEEE ITS Society from 2005 to 2007, the IEEE Council of RFID from 2019 to 2021, the Chinese Association for Science and Technology, USA, in 2005, the American Zhu Kezhen Education Foundation from 2007 to 2008, the Vice President of the ACM China Council from 2010 to 2011, the Vice President and the Secretary General of the Chinese Association of Automation from 2008 to 2018, the Vice President of IEEE Systems, Man, and Cybernetics Society from 2019 to 2021. He was the Founding Editor-in-Chief (EiC) of the International Journal of Intelligent Control and Systems from 1995 to 2000, IEEE ITS Magazine from 2006 to 2007, IEEE/CAA Journal of Automatica Sinica from 2014-2017, China's Journal of Command and Control from 2015-2021, and China's Journal of Intelligent Science and Technology from 2019 to 2021. He was the EiC of the IEEE Intelligent Systems from 2009 to 2012, IEEE Transactions on Intelligent Transportation Systems from 2009 to 2016, IEEE Transactions on Computational Social Systems from 2017 to 2020. Currently, he is the President of CAA's Supervision Council, and the EiC of IEEE Transactions on Intelligent Vehicles.