2026 第九届 IEEE 国际无人系统大会

特邀专题简介表

特邀专题名称

AI 赋能的自主运载系统交互、认知、决策与控制

组织者

1. 田大新，教授，北京航空航天大学

2. 周建山，副教授，北京航空航天大学

3. 曲凯歌，教授，北京航空航天大学

4. 盛正国，教授，萨塞克斯大学

个人简介

田大新，长江学者特聘教授、博导，IEEE Fellow，北京航空航天大学科研院副院长、前沿创新处处长，科学探索奖获得者、国家自然科学基金优秀青年基金和牛顿高级学者基金获得者，青年长江学者、中国工程院中国工程前沿杰出青年学者；担任车路协同与安全控制北京市重点实验室主任、运动型多用途乘用车节能与智能化京冀联合实验室主任，中国指挥与控制学会无人系统专业委员会主任委员，工信部“十五五”规划专家委员、交通部自动驾驶技术中心专家委员；主持国家重点研发计划“揭榜挂帅”项目、国家自然科学基金重点项目、国际合作项目等国家级项目 11 项、省部级项目 4 项，发表学术论文 200 余篇，出版著作 11 本，授权发明专利 50 余项；获国家科技进步二等奖等科技奖励 14 项；担任《IEEE Transactions on Intelligent Vehicles》、《Journal of Intelligent and Connected Vehicles》、《Complex System Modeling and Simulation》等多个国际学术期刊的 Associate Editor。

周建山，副教授，北京市科技新星、小米青年学者、中国汽车工程学会优秀博士学位论文获得者，入选中国博士后创新人才支持计划；《无人系统技术》青年编委、《人工智能》编委；长期从事低空智联网与自主智能系统研究，主持国家自然科学基金、北京市自然科学基金等项目/课题 10 项，发表 SCI 论文 50 余篇，出版中文著作 2 部、英文译著 1 部，授权发明专利 10 余项；获中国

生产力促进奖一等奖、中国智能交通协会科学技术奖一等奖、北京市科学技术进步奖二等奖等 10 余项科技奖励。

曲凯歌，教授、IEEE Member，国家级青年人才。2013 年获山东大学通信工程学士学位，2016 年获清华大学集成电路工程硕士学位、比利时鲁汶大学电子工程硕士学位，2021 年获加拿大滑铁卢大学电子与计算机工程博士学位。2021 年 2 月起，相继担任加拿大滑铁卢大学电子与计算机工程系博士后研究员、副研究员。2021 年 1 月至 4 月，担任加拿大滑铁卢大学电子与计算机工程系兼职讲师。2021 年起担任 IEEE Kitchener-Waterloo Section Vehicular Technology Chapter 主席秘书，并担任 IEEE Infocom’22 Workshop 宣传主席、IEEE VTC Spring’22, IEEE VTC Spring’23, IEEE BSC’23, IEEE PIMRC’23 技术程序委员会委员等。 研究方向包括：网联自动驾驶、智能车联网、网络虚拟化、数字孪生、网络自动化等。

盛正国教授长期致力于车载通信、车联网和物联网（IoT）领域的研究，主持欧盟 H2020 计划项目、英国皇家学会基金、英国自然科学基金、香港研究基金等多个项目/课题；已发表国际高水平期刊论文 130 余篇，参与出版学术专著 6 部；获萨塞克斯大学新兴研究奖、IEEE 优秀服务奖、IEEE SECON 会议的最佳论文奖等多个荣誉奖项；参与 2 项国际标准联盟组织的物联网标准制定，担任 IEEE Access、Ad Hoc Networks 等多个国际学术期刊编委，是 IEEE 车载技术委员会、ELSEVIER 计算机通信技术委员会委员，IEEE 通信委员会 IoT 标准研究组成员。

特邀专题简介

当前，以人工智能、大数据、5G 等为代表的新一代信息通信技术（ICT）及其产业正在全球范围内加速演进，为无人机、无人车、无人船等自主运载系统的发展和应用提供了新的契机。然而，现有针对自主运载系统的网联化信息交互与处理、认知、决策与控制技术，在复杂、随机、动态的实际应用场景下依旧面临巨大挑战，尤其是系统结构的复杂性和异构性、通信拓扑的时变性、

环境扰动的随机性、传感噪声和器件失效的不确定性严重制约自主运载系统的大规模部署应用。此外，实际开放环境存在机非混行、鬼探头、闯红灯等各种规则之外的交通行为，道路场景千变万化；基于规则设计或基于数据驱动的自动驾驶系统难以“穷尽”所有场景或“预判”复杂多变路况。现有基于深度学习的端到端自动驾驶系统尚未完全摆脱“数据换能力”的发展模式，缺乏类似人类对复杂动态场景的“理解”和“预判”能力，以及持续学习和认知的“进化”能力，依旧难以有效应对“长尾场景”的挑战，难以真正实现全场景、全天候落地应用。因此，为克服现有无人驾驶技术体制应对“长尾场景”及新需求、新挑战的性能限制，亟需深入探索脑认知、类脑智能与无人驾驶 AI 系统相融合的新机理、新方法，研究具有自主能力的交互、认知、决策和控制手段，发展出自主运载系统泛在传感、自主认知与决策智能技术体系，通过创新融合多种前沿理论方法和技术手段，包括视觉语言大模型、深度强化学习、仿生智能、类脑智能等范式，促进自主运载系统发展应用。

本特邀专题邀请以下与“AI 赋能的自主运载系统交互、认知、决策与控制”主题相关的包含创新思想、概念、新发现、改进以及新应用的原创论文。

- AI 赋能的自主运载集群组网模型与高可靠、低时延交互
- 自主运载系统多模态信息融合感知与 AI 决策算法
- 融合数据与物理的自主运载系统 AI 模型与控制架构
- AI 赋能的自主运载系统物理信息安全保障机制、方法和体系

IEEE ICUS 2026
Invited Session Summary

Title of Session

Interaction, Cognition, Decision-Making, and Control in AI-Enabled Autonomous Carrier Systems

Organizers

1. Prof. Daxin Tian
Beihang University, China
2. Prof. Jianshan Zhou
Beihang University, China
3. Prof. Kaige Qu
Beihang University, China
4. Prof. Zhengguo Sheng
University of Sussex, United Kingdom

Biosketches of Organizers

Daxin Tian is a distinguished professor and doctoral supervisor, a Changjiang Scholar, and an IEEE Fellow. He currently serves as the Deputy Director of the Research Institute and the Director of the Frontier Innovation Division at Beihang University (BUAA). He is also a recipient of the Scientific Exploration Award, the Excellent Young Scholars Fund from the National Natural Science Foundation, and the Newton Advanced Scholars Fund. Additionally, he has been honored as a Young Changjiang Scholar, an Outstanding Young Scholar in the Frontiers of Chinese Engineering by the Chinese Academy of Engineering. He holds the position of Director at the Beijing Key Laboratory of Vehicle-road Collaborative and Safety Control, as well as the Director of the Joint Laboratory of Energy Efficiency and Intelligence for Sports Utility Vehicles in Beijing and Hebei. He is the Chairman of the Unmanned Systems Committee of the Chinese Society of Command and Control, an Expert Member of the 14th Five-Year Plan Expert Committee of the Ministry of Industry and Information Technology, and an Expert Member of the Autonomous Driving Technology Center under the Ministry of Transport. Tian has led 11 national-level projects, including the "Challenge-oriented" project of the National Key R&D Program, key projects funded by the National Natural Science Foundation, and international cooperation projects, along with 4 provincial and ministerial-level projects. He has published over 200 academic papers, authored 11 books, and holds more than 50 patents for inventions. He has received 14 awards, including the Second

Prize of the National Science and Technology Progress Award. Tian serves as an Associate Editor for several international academic journals, including IEEE Transactions on Intelligent Vehicles, Journal of Intelligent and Connected Vehicles, and Complex System Modeling and Simulation.

Dr. Jianshan Zhou is currently an Associate Professor and Deputy Director at the School of Transportation Science and Engineering, Beihang University. He has extensive experience in international collaborative research. From 2017 to 2018, he was a Visiting Research Fellow at the School of Informatics and Engineering, University of Sussex, UK. From 2020 to 2022, he held a Postdoctoral Research Fellow position, supported by Beihang University's Zhuoyue Program and the National Postdoctoral Program for Innovative Talents. His research interests include the modeling and optimization of vehicular communication networks, air-ground cooperative networks, analysis and control of connected autonomous vehicles (CAVs), and intelligent transportation systems. Dr. Zhou has served as Technical Program Session Chair or Co-Chair for events such as IEEE EDGE 2020, IEEE ICUS 2022–2024, and ICAUS 2022. He has also been a Technical Program Committee (TPC) member for IEEE VTC 2021-Fall and a Youth Editorial Board Member for journals such as Unmanned Systems Technology and Artificial Intelligence View. He has authored or co-authored over 50 international scientific publications and more than 10 patents. His contributions have been recognized with numerous awards, reflecting both academic and societal significance. The significant awards include the First Prize in the Science and Technology Award from the China Intelligent Transportation Systems Association (2017), the First Prize in the Innovation and Development Award from the China Association of Productivity Promotion Centers (2020 and 2021), the Second Prize in the Beijing Science and Technology Progress Award (2022), the National Scholarship (2017 and 2019), the Outstanding Top-Ten Ph.D. Candidate Prize from Beihang University (2018), the Outstanding China-SAE Doctoral Dissertation Award (2020), and the Excellent Doctoral Dissertation Award from Beihang University (2021). Additionally, he received the First Prize in the 2023 China Highway Society Science and Technology Award, the First Prize in the 2024 China Communications Society Science and Technology Invention Award, and his team was recognized with the 2024 China Intelligent Transportation Association Science and Technology Innovation Team title. He was also honored with the title of Xiaomi Young Scholar for his contributions to the field of advanced vehicular networking and communications.

Kaige Qu is currently an Associate Professor and Deputy Director at the School of Transportation Science and Engineering, Beihang University. She received her B.Eng. and M.Eng. degrees from Shandong University, Jinan, China, and Tsinghua University, Beijing, China, in 2013 and 2016, respectively, all in Electrical Engineering. She also received a dual master's degree from Katholieke Universiteit Leuven (KU Leuven), Leuven, Belgium, in 2016. She received her Ph.D. degree in Electrical and Computer Engineering from the University of Waterloo, Waterloo, Canada, in 2021. Since February 2021, she has been a Post-doctoral Research Fellow and then a Research Associate with the Department of Electrical and Computer Engineering, University of Waterloo, Waterloo, Canada, where she was a sessional instructor from January 2021 to April 2021. She is a member of IEEE and serves as the chair secretary of the IEEE Kitchener-Waterloo Section Vehicular Technology Chapter from 2021. She was the publicity co-chair for IEEE Infocom'22 Workshop, and the technical program committee member for IEEE VTC Spring'22, IEEE VTC Spring'23, IEEE BSC'23, IEEE PIMRC'23. Her research interests include connected and autonomous vehicles, intelligent vehicular networks, network virtualization, and digital twin assisted network automation.

Zhengguo Sheng received his Ph.D. and M.S. with distinction at Imperial College London in 2011 and 2007, respectively, and his B.Sc. from the University of Electronic Science and Technology of China (UESTC) in 2006. From 2013 to 2014, he was a research associate in the Department of Electrical and Computer Engineering at University of British Columbia (UBC), Canada. From 2011 to 2013, he was with France Telecom Orange Labs as the senior researcher and project manager in M2M/IoT. During 2009, he also worked as a research intern with IBM T. J. Watson Research Center, USA, and U.S. Army Research Labs. His current research interests cover connected vehicles, Internet-of-Things (IoT), and cloud/edge computing. He has published over 140 journal and conference papers, 5 books, 1 patent and 2 standards contribution in OneM2M and OMA LWM2M, and has served as Co-Editors-in-Chief for Intl. Journal of Veh. Telematics and Infotainment Syst. (IJVTIS); technical committee member for ELSEVIER COMCOM; editorial board of IEEE Access, IEEE/VTS connected vehicle initiative and AD HOC NETWORKS (ELSEVIER); member of IoT Standardization Research Groups at IEEE ComSoc Communities. He has also served as the technical reviewer for IEEE Trans. on Communications, Wireless Communications, and Vehicular Technology, etc. His current research works are

funded by H2020, EPSRC, Royal Society and University of Sussex. He is also the receipt of Royal Society Kan Tong Po International Fellowship 2020, Emerging research award 2017 from University of Sussex. Senior Member of IEEE, IET, Fellow of of The Higher Education Academy (HEA).

Details of Session

The rapid evolution of next-generation information and communication technologies (ICT), represented by artificial intelligence, big data, 5G, and other innovations, is providing new opportunities for the development and application of autonomous systems such as drones, autonomous vehicles, and unmanned ships. However, existing technologies for information interaction and processing, cognition, decision-making, and control in autonomous systems still face significant challenges in complex, random, and dynamic real-world scenarios. These challenges are particularly pronounced in areas such as the complexity and heterogeneity of system structures, the time-varying nature of communication topologies, the randomness of environmental disturbances, and the uncertainty caused by sensor noise and device failures, all of which severely restrict the large-scale deployment and application of autonomous systems.

Furthermore, real-world open environments are characterized by unpredictable traffic behaviors outside of established rules, such as mixed traffic with non-motorized vehicles, "ghost" vehicles appearing at intersections, and red-light running. Roadway scenarios are constantly changing, making it difficult for rule-based or data-driven autonomous driving systems to "cover" all possible situations or "predict" complex and dynamic road conditions. Current end-to-end autonomous driving systems based on deep learning have not fully overcome the "data-for-ability" development model. They lack human-like capabilities for understanding and predicting complex dynamic scenarios, as well as the ability to continuously learn and adapt, making it challenging to effectively address the "long-tail scenarios" problem. As a result, these systems still struggle to achieve full deployment across all scenarios and in all weather conditions.

To overcome the limitations of existing autonomous driving technologies in addressing "long-tail scenarios" and responding to new demands and challenges, it is crucial to explore new mechanisms and methods that integrate brain cognition, brain-like intelligence, and autonomous driving AI systems. Research should focus on developing interactive, cognitive, decision-making, and control techniques with autonomous capabilities. A new paradigm is needed for the development of a ubiquitous sensing, autonomous cognition, and decision-making intelligence system for autonomous vehicles. This should involve the innovative integration of various cutting-edge theories, methods, and technologies, including visual-language large

models, deep reinforcement learning, bionic intelligence, and brain-like intelligence, to promote the advancement and application of autonomous driving systems.

This special issue invites original papers that introduce innovative ideas, concepts, new findings, improvements, and novel applications related to the theme of "Interaction, Cognition, Decision-Making, and Control in AI-Enabled Autonomous Carrier Systems".

- AI-enabled networking models and highly reliable, low-latency interaction for autonomous carrier clusters
- Multimodal information fusion, perception, and AI-based decision-making algorithms for autonomous carrier systems
- Data-physics integrated AI models and control architectures for autonomous carrier systems
- Security mechanisms, methods, and frameworks for protecting cyber-physical security in AI-enabled autonomous carrier systems4. Data/Physics-Driven Intelligent Decision-Making and Optimized Control for Autonomous Systems
- Physical Information Security Protection Mechanisms, Methods, and Systems for Autonomous Systems