

2024 第七届 IEEE 国际无人系统大会 特邀专题简介表

特邀专题名称

立体交通系统通信、感知与控制

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，研究员，滑铁卢大学
4. 盛正国，教授，萨塞克斯大学
5. 赵德宗，教授，格拉斯哥大学

个人简介



田大新，教授，博导，北京航空航天大学交通学院副院长，青年长江学者，国家自然科学基金委优秀青年基金和牛顿高级学者基金获得者，IEEE Senior Member，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、城市交通管理集成与优化技术公安部重点实验室车联网研究室主任，担任中国指挥与控制学会无人系统专业委员会副主任，是中国人工智能和大数据百人会专家。主持国家重点研发计划项目、国家自然科学基金重点支持项目等国家级项目 11 项，发表学术论文 200 余篇，出版著作 11 本，授权发明专利 51 项；获国家科技进步二等奖等科技奖 14 项；担任国际学术期刊《IEEE Transactions on Intelligent Vehicles》、《Complex System Modeling and Simulation》等的 Associate Editor。



周建山，副教授，北京航空航天大学十佳博士、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、小米青年学者，《无人系统技术》青年编委；长期从事车联网、空地协同系统、边缘计算研究，主持国家自然科学基金、国家重点研发计划子课题、博新计划等项目/课题 8 项，发表 SCI 论文 40 余篇，出版专著 2 部、

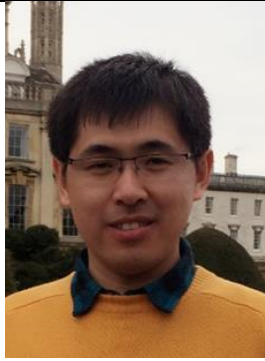
译著 1 部，授权发明专利 10 余项；获中国生产力促进中心协会生产力促进奖一等奖、中国智能交通协会科学技术奖一等奖、北京市科学技术进步奖二等奖等 10 余项荣誉奖励。



曲凯歌，加拿大滑铁卢大学副研究员，IEEE 会员。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。



赵德宗教授长期从事自主智能系统理论与技术研究，是英国工程与自然科学基金会（EPSRC）学者、英国皇家学会牛顿高级学者、Leverhulme 基金会学者，英国 EPSRC 基金和英国杰出青年基金（UKRI Future Leader Fellowship）评议专家。曾作为控制系统负责人成功研制出世界首台电涡轮增压器，实现产业化应用，拥有 2 项欧洲及美国专利；

在 IEEE Transactions 等汇刊和会议上发表学术论文 40 余篇，获英国 EPSRC 基础研究奖等十多项国际大会最佳论文奖，担任 EPSRC 项目首席科学家，是控制领域 6 个国际会议的程序委员会委员、2 个国际会议的分会主席。

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，为立体交通系统的发展和应用提供了新的契机。然而，现有针对立体交通中各种无人集群系统（如无人车、机器人、无人机等）的网联化信息交互与处理、感知决策与控制技术，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、传感噪声的不确定性严重制约无人集群系统的大规模部署应用。因此，为克服现有无人集群技术体制应对立体交通新需求、新挑战的性能限制，亟需研究具有自主智能特性的通信、感知和控制技术，以及面向立体交通系统的通信-感知-控制一体化架构，通过创新融合多种前沿理论方法和技术手段，包括深度强化学习、仿生群体智能、边缘计算等范式，促进立体交通无人集群实现通信-感知-控制智能协同、信息与物理深度融合等目标。

本特邀专题邀请以下与“立体交通系统通信、感知与控制”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。

- 无人集群系统自组织网络模型与高可靠、低时延通信机理
- 人工智能驱动的无人集群系统体系架构及其资源优化理论
- 无人集群系统多模态信息自主智能感知与分布式融合处理
- 数据/物理驱动的无人集群系统分布式协同决策与优化控制
- 面向物理信息安全的无人集群系统边缘计算与区块链应用

IEEE ICUS 2024

Invited Session Summary

Title of Session

Communication, Sensing and Control for Space-Air-Ground Integrated
Transportation Systems

Organizers

1. Prof. Daxin Tian

Beihang University, China

2. Assoc. Prof. Jianshan Zhou

Beihang University, China

3. Dr. Kaige Qu

University of Waterloo, Canada

4. Prof. Zhengguo Sheng

University of Sussex, United Kingdom

5. Prof. Dezong Zhao

University of Glasgow, United Kingdom

Biosketches of Organizers



Daxin Tian (Senior Member, IEEE) received the Ph.D. degree in Technology of Computer Application from Jilin University, China, in 2007. He is currently a Professor with the School of Transportation Science and Engineering, Beihang University, Beijing, China. His current research interests include mobile computing, intelligent transportation systems, vehicular ad hoc networks, and swarm intelligence. Prof. Tian leads about 11 research projects such as the projects funded by the National Natural Science Foundation and the National Key Research and Development Program. He has authored/co-authored more than 200 journal/conference papers, published 11 monographs, authorized 51 invention patents. He was the recipient of the Second Prize of the National Science and Technology Award in 2015 and 2018, the First Prize of the Technical Invention Award of the Ministry of Education in 2017, the First Prize of the Science and Technology Award from the China Intelligent Transportation Association in 2017, the First Prize of the Innovation and Development Award from the China Association of Productivity Promotion Centers in 2020, and seven other ministerial and provincial

science and technology awards. He also received the Changjiang Youth Scholars Program of China in 2018 and the Outstanding Youth Fund from the National Natural Science Foundation of China in 2019, the Forum Keynote Award from the 2019 Cyberspace Congress, the Outstanding Invited Speaker from the 2020 International Conference on Blockchain and Trustworthy Systems, and the Distinguished Young Investigator of China Frontiers of Engineering from Chinese Academy of Engineering in 2018. He was also awarded the Exemplary Reviewer for IEEE Wireless Communications Letters. He is a senior member of IEEE, CCF, and ITSC, and was or is the Editor-in-Chief of International Journal of Vehicular Telematics and Infotainment Systems, the Associate Editor of IEEE Transactions on Intelligent Vehicles, IEEE Internet of Things Journal, Complex System Modeling and Simulation, and Journal of Intelligent and Connected Vehicles.



Jianshan Zhou received the B.Sc., M.Sc., and Ph.D. degrees in traffic information engineering and control from Beihang University, Beijing, China, in 2013, 2016, and 2020, respectively. He is an associate professor with the school of transportation science and engineering at Beihang University. From 2017 to 2018, he was a Visiting Research Fellow with the School of Informatics and Engineering, University of Sussex, Brighton, U.K. He was a Postdoctoral Research Fellow supported by the Zhuoyue Program of Beihang University and the National Postdoctoral Program for Innovative Talents from 2020 to 2022. He is or was the Technical Program Session Chair with the IEEE EDGE 2020, the IEEE ICUS 2022, the ICAUS 2022, the TPC member with the IEEE VTC2021-Fall track, and the Youth Editorial Board Member of the Unmanned Systems Technology. He is the author or co-author of more than 30 international scientific publications. His research interests include the modeling and optimization of vehicular communication networks and air-ground cooperative networks, the analysis and control of connected autonomous vehicles, and intelligent transportation systems. He was the recipient of the First Prize in the Science and Technology Award from the China Intelligent Transportation Systems Association in 2017, the First Prize in the Innovation and Development Award from the China Association of Productivity Promotion Centers in 2020, the Second Prize in the Beijing Science and Technology Progress Award in 2022, the National Scholarships in 2017 and 2019, the Outstanding Top-Ten Ph.D. Candidate Prize from Beihang University in 2018,

the Outstanding China-SAE Doctoral Dissertation Award in 2020, and the Excellent Doctoral Dissertation Award from Beihang University in 2021.

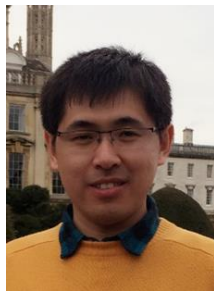


Kaige Qu received her B.Eng. and M.Eng. degrees from Shandong University, Jinan, China, and Tsinghua University, Beijing, China, in 2013 and 2016, respectively, all in Electrical Engineering. She also received a dual master's degree from Katholieke Universiteit Leuven (KU Leuven), Leuven, Belgium, in 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).



Dezong Zhao (Senior Member, IEEE) received the B.Eng. and M.S. degrees in control engineering from Shandong University in 2003 and 2006, respectively, and the Ph.D. degree in control engineering from Tsinghua University in 2010. Since 2020, he has been a Senior Lecturer in autonomous systems with the University of Glasgow. His research interests include connected and autonomous vehicles, robotics, machine learning, and control engineering. He has been an EPSRC Innovation Fellow since 2018 and a Royal Society-Newton Advanced Fellow since 2020.

Details of Session

The deployment of next-generation information communication technologies (ICT) and related sectors, such as artificial intelligence, big data, and 5G, has been accelerated worldwide. The advanced ICTs spawn new opportunities for the development and applications of autonomous intelligent swarms in space-air-ground integrated transportation systems. However, there are some significant challenges for traditional networking, information processing, perception, decision-making, and control paradigms when they are applied to complex, stochastic, and dynamic environments in reality. In particular, complexity and heterogeneity in the architecture of large-scale swarm systems, time-varying communication topologies, unpredictable environmental disturbances, and uncertainties in sensor data bring significant challenges and limit the actual performance of existing swarm systems. Hence, it requires novel designs and technical paradigms incorporating the autonomy and intelligence of swarms in terms of communication, sensing, and control to cope with emerging technical demands and challenges on unmanned swarm systems. More focus and research efforts should be made to transform the current paradigm of unmanned swarm systems to the communication-sensing-control-integrated

autonomous intelligent one. In this point of view, we need to join various state-of-the-art technical paradigms in computer, information, and communication domains into a unified framework, including deep reinforcement learning, bio-inspired swarm intelligence, and edge computing. Integrating emerging methodologies and technologies can promise the joint realization of autonomous intelligent communication, sensing, and control for unmanned swarms in space-air-ground integrated transportation systems. This direction may bring the autonomy and intelligence of cyber-physical systems into our actual society.

The invited session calls for original papers presenting innovative ideas and concepts, discoveries and improvements, and novel applications. The selected topics of communication, sensing, and control for autonomous intelligent swarm systems include but are not limited to

- Ad-hoc networks and highly reliable and low-latency communications for unmanned swarm systems;
- AI-driven architectures and resource optimization theories for unmanned swarm systems;
- Multi-mode information perception and distributed information fusion for unmanned swarm systems;
- Data-physics-driven distributed cooperative decision-making and optimal control for unmanned swarm systems;
- Cyber security-oriented edge computing for unmanned swarm systems and blockchain applications.