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

空地协同无人系统的人机交互与共享控制

组织者

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个人简介

毕路拯：北京理工大学机械与车辆学院教授、博导、机电系统与装备研究所所长。主要研究领域包括脑机接口与脑控智能机器、多机器人协同与多模态智能感知与交互。担任中国人类工效学学会人机工程专委会副主任委员、中国脑机接口产业联盟专家委员会资深专家、数据与基础软件工作组副主席、中国计算机学会智能汽车分会专委会常务委员、中国人工智能学会脑机融合与生物机器智能专委会委员、世界机器人大赛专家组成员。主持国家级项目十余项等。第一著者出版学术专著和教材两部。在 IEEE TCYB, TBME, TITS, TSMCS, THMS, TNSRE, RA-L 以及 ESWA 等发表论文 120 余篇。获授权国家发明专利 30 余项。获教育部自然科学二等奖、北京市自然科学奖二等奖、中国仿真学会自然科学二等奖和中国电子学会科技进步二等奖。指导学生获第九届中国国际“互联网+”大学生创新创业大赛全国金奖。

Aberham Genetu Feleke：北京理工大学机械工程与车辆学院讲师、硕导。主要研究领域包括智能人机系统、脑机接口和脑控机器人。出版学术专著和教材两部。共发表学术论文 20 余篇。他获得了 2024 年中国仿真学会 2024 自然科学奖二等奖。他指导学生获得第十九届“挑战杯”全国大学生创新创业大赛全国银牌。

费炜杰：现任北京理工大学机械与车辆学院机电系统与装备所助理研究员，新加坡南洋理工大学脑计算研究中心research fellow。主要研究方向为自然场景下的脑机接口。担任人类工效学会人机工程专委会委员。主持国家自然科学基金等科研项目3项，参与多项国家级项目。获授权国家发明专利11项。第一作者或通讯作者在TBME，TITS，TNSRE等发表论文10余篇。2022年获得了世界机器人大赛BCI脑控机器人大赛青年优秀论文第一名。2023年入选国家级人才计划。2025年获北京市自然科学奖二等奖、2024年获中国仿真学会自然科学二等奖。

张佩瑜：北京理工大学机械与车辆学院助理研究员。主要研究领域包括智能网联车辆控制、鲁棒优化。第一作者在IEEE TITS，TVT，IJPR，ANOR等发表论文10余篇。2017年获河北省普通高等学校优秀毕业生称号，2012年获北京市第七届互联网+创业大赛二等奖，2024年获中国通信学会科技技术二等奖，2024年获中国智能交通协会科学技术创新团队奖。

王佳蓉：现任北京理工大学机械与车辆学院机电系统与装备所助理研究员、新加坡南洋理工大学脑计算研究中心research fellow。主要研究方向包括脑机接口、智能人机交互。第一作者在IEEE TBME，TSMCS，TNSRE等发表论文7篇，获授权/受理国家发明专利4项，获2024年北京市优秀毕业生、北京理工大学优秀博士学位论文。2024年入选国家级人才计划。

魏宇阳：北京理工大学教授、博士生导师（曾任牛津大学工程科学系博士后研究员），国家级青年人才。主要研究领域包括仿生触觉感知驱动的类人机器人、生物力学机理建模等。担任国际生物医学工程协会英国区学生分部主席；主持英国自然科学基金项目2项、英国国家工程院项目1项及UKRI项目1项（2021－2023，约12万英镑）；作为骨干参与英国内政部科研项目及欧盟地平线/EPSRC项目2项。迄今发表期刊论文20余篇，代表性成果发表于Nature

Communications、Advanced Materials 等期刊；并组织或参与组织 ICBE、InTouch Workshop 等国际会议与专题研讨。

特邀专题简介

空地协同无人系统是一种新型的高科技多机器人无人平台，它能够实现空中无人机、地面无人车和传统机器人的协同作业，可广泛应用于灾害救援、环境监测、安防巡逻、仓储物流等领域。在此平台中，异构多机器人之间的相互配合提高了无人系统的智能化水平和任务完成能力，从而有效完成更为复杂的实际任务。

而面对复杂的实际环境，无人系统往往难以通过独立的自主算法和传统手动操作同时完成无人机和无人车的控制和配合。因此人机交互和共享控制是非常重要的一环。

在人机交互方面，空地协同无人系统需要考虑如何完善人类操作员和 UAV（无人机）、UGV（无人车）等智能设备进行交互，让操作员能够更有效地监控、指挥和调度无人设备。因此需要设计和创新友好的人机界面，便于操作员查看设备实时运行状态，收集运行数据，完成对无人设备的运行检测和协同配合。此外，还需要考虑如何在紧急情况下让操作员能够及时干预决策，确保设备的安全运行。

在共享控制方面，空地协同无人系统不仅需要实现设备之间的协同作业，以提高效率和减小运行成本，而且需要保证设备运行时的安全。这就需要探索如何实现设备之间的信息共享、任务分配以及安全保障，并保证设备之间的协同工作顺畅、高效和安全。因此需要通过设计合适的自适应控制算法，实现设备之间的智能协调，并且在保证设备安全运行的前提下，尽可能满足操作员控制需求。

本特邀专题邀请以下与“空地协同无人系统的人机交互与共享控制”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。

- 人机交互设计与优化
- 协同控制策略
- 智能控制算法
- 分布式控制

- 多机器人协同控制技术
- 移动机器辅助控制器
- 数据共享与处理技术

IEEE ICUS 2026
Invited Session Summary

Title of Session

Human-Machine Interaction and Shared Control of Aerial-Ground Collaborative Unmanned Systems

Organizers

1. Prof. Luzheng Bi

Beijing Institute of Technology, China

2. Dr. Aberham Genetu Feleke

Beijing Institute of Technology, China

3. Dr. Weijie Fei

Beijing Institute of Technology, China

4. Dr. Peiyu Zhang

Beijing Institute of Technology, China

5. Dr. Jiarong Wang

Beijing Institute of Technology, China

Biosketches of Organizers

Luzheng Bi: Professor and Doctoral Supervisor at the School of Mechanical and Vehicle Engineering, Beijing Institute of Technology, Director of the Institute of Mechatronic Systems and Equipment. His main research areas include brain-computer interfaces and brain-controlled intelligent machines, multi-robot collaboration and multimodal intelligent perception, and human-computer intelligent interaction. He serves as a senior expert on the Expert Committee of the China Brain-Computer Interface Industry Alliance, Vice Chairman of the Data and Basic Software Working Group, Standing Committee Member of the Intelligent Vehicle Branch of the Chinese Computer Federation, Member of the Brain-Computer Integration, and a member of the expert group for the World Robot Contest. He has obtained many grants and contracts,such as the National Natural Science Foundation of China. As the first author, he has published two academic monographs and textbooks. He has published over 100 papers as the first or corresponding author in journals such as IEEE TCYB, TBME, TITS, TSMCS, THMS, and TNSRE. He has been granted more than 30 national invention patents and has received the Second Prize in Natural Science from the Ministry of Education and the Second Prize in Science and Technology Progress from the China Electronics Society. He has guided students to win the national gold award in the 9th China International "Internet+" College Students Innovation and Entrepreneurship Competition , the first prize for

outstanding young paper in the BCI Brain Control Robot Competition at the 2022 World Robot Conference and the special prize for outstanding young paper in the BCI Brain Control Robot Competition at the 2024 World Robot Conference.

Aberham Genetu Feleke: Lecturer and Master's Supervisor at the School of Mechanical Engineering and Vehicle Engineering, Beijing Institute of Technology. Main research areas include intelligent human-machine systems, brain-computer interfaces, and brain-controlled robots. He is a co-author of a published academic monograph and has published over 20 academic papers. He received the second prize of the Natural Science Award from the Chinese Simulation Society in 2024. He also guided students to win the national silver medal in the 19th "Challenge Cup" National College Students Innovation and Entrepreneurship Competition.

Weijie Fei: Assistant Researcher at the Institute of Mechatronic Systems and Equipment, School of Mechanical and Vehicle Engineering, Beijing Institute of Technology, and Research Fellow at the Brain Computing Research Center, Nanyang Technological University, Singapore. His main research direction is brain-computer interfaces in natural scenes. He serves as a member of the Human Factors and Ergonomics Society's Human-Machine Engineering Committee. He has presided over 2 scientific research projects and participated in multiple national-level projects. He has been granted 11 national invention patents. As the first author or corresponding author, he has published more than 10 papers in journals such as TBME, TITS, and TNSRE. In 2022, he won the first prize for outstanding youth papers in the BCI Brain-Controlled Robot Competition at the World Robot Conference. In 2023, he was selected for a national talent program. In 2024, he received the second prize of the Natural Science Award from the Chinese Simulation Society.

Peiyu Zhang: Assistant Researcher at the School of Mechanical and Vehicle Engineering, Beijing Institute of Technology. Main research areas include intelligent connected vehicle control and robust optimization. As the first author, she has published more than 10 papers in journals such as IEEE TITS, TVT, IJPR, and ANOR. In 2017, she was awarded the title of Outstanding Graduate from Hebei Province's ordinary colleges and universities. In 2022, she won the second prize in the 7th Beijing Internet+ Entrepreneurship Competition. In 2024, she received the second prize of the Science and Technology Award from the China Communications Society and the Science and Technology Innovation Team Award

from the China Intelligent Transportation Systems Association.

Jiarong Wang: Assistant Researcher at the Institute of Mechatronic Systems and Equipment, School of Mechanical and Vehicle Engineering, Beijing Institute of Technology, and Research Fellow at the Brain Computing Research Center, Nanyang Technological University, Singapore. Main research directions include brain-computer interfaces and intelligent human-machine interaction. As the first author, she has published 7 papers in journals such as IEEE TBME, TSMCS, and TNSRE, and has been granted or applied for 4 national invention patents. In 2024, she was awarded the title of Outstanding Graduate in Beijing and the Outstanding Doctoral Dissertation Award from Beijing Institute of Technology. In 2024, she was selected for a national talent program.

Yuyang Wei: Professor and PhD supervisor at Beijing Institute of Technology (formerly a Postdoctoral Researcher in the Department of Engineering Science, University of Oxford), and a nationally funded young talent. His research focuses on biomimetic tactile-perception–driven humanoid robotics and biomechanics-informed mechanistic modelling. He served as Chair of the UK Student Chapter of the Biomedical Engineering Society (BMES). He has led two UK Natural Environment Research Council projects, one Royal Academy of Engineering project, and one UKRI project (2021–2023; ~£120k), and has been a key contributor to a UK Home Office research project and two Horizon Europe/EPSRC projects. He has published 20+ journal papers, with representative work in Nature Communications and Advanced Materials, and has organised or co-organised international conferences and focused workshops such as ICBE and the InTouch Workshop.

Details of Session

The Air Ground Collaborative Unmanned System is a new high-tech unmanned platform that integrates aerial drones, ground unmanned vehicles, and traditional robots to conduct collaborative operations. It can be used in disaster rescue, environmental monitoring, security patrols, warehouse logistics, and other fields. The mutual cooperation between these multiple robots enhances the intelligence level and task completion ability of unmanned systems, which enables them to complete more complex practical tasks.

However, with complex practical environments, unmanned systems may face difficulties in controlling and coordinating the drones and unmanned vehicles simultaneously through independent unmanned algorithms or traditional manual operations. Therefore, human-computer interaction and shared control become vital

parts.

Regarding human-machine interaction, the Air Ground Collaborative Unmanned System should consider how to improve the interaction between human operators and intelligent devices such as UAVs and UGVs so that operators can more effectively monitor, command, and dispatch unmanned devices. Designing user-friendly human-machine interfaces facilitates operators to view real-time equipment operation status, collect operation data, and complete operation detection and collaborate with unmanned equipment. It is also necessary to enable operators to intervene in decision-making during emergency situations and ensure the safe operation of the equipment.

In terms of shared control, the Air Ground Collaborative Unmanned System not only needs to achieve collaborative operations to improve efficiency and reduce operating costs but also to ensure the safety of equipment operation. This requires exploring how to achieve information sharing, task allocation, and security between devices to ensure smooth, efficient, and secure collaborative work. Therefore, appropriate adaptive control algorithms must be designed to achieve intelligent coordination between devices while meeting the operator's control needs and ensuring the safe operation of the equipment.

This special invitation invites original papers related to the theme of "human-machine interaction and shared control of air-ground collaborative unmanned systems." The papers should include innovative ideas, concepts, new discoveries, improvements, and new applications.

- Human-computer interaction design and optimization
- Collaborative control strategy
- Intelligent control algorithm
- Distributed control
- Multi-robot collaborative control technology
- Mobile robot assistant controller
- Data sharing and processing techniques