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
面向无人系统的 6G 通信感知智能一体化理论及技术

组织者
1.侯华舟，副研究员，紫金山实验室
2.刘智伟，教授，华中科技大学
3.刘凡，副研究员，南方科技大学
4.何东轩，副研究员，北京理工大学
5.杨杰，助理教授，东南大学

个人简介

侯华舟，紫金山实验室前沿交叉研究中心副研究员，博士生导师。2013 年在北京理工大学获工学学士学位，2015 年及 2020 年于东北大学控制理论与控制工程专业获工学博士学位。曾于 2017 年至 2019 年赴澳大利亚皇家墨尔本理工大学博士生联合培养，师从澳洲科学院院士，IEEE Fellow，余星火教授。2020-2023 年于东南大学自动化学院从事博士后研究员工作，2023 年加入紫金山实验室，前沿交叉研究中心，目前主要研究方向为 6G 通信感知一体化技术、智能决策技术及其在无人系统中的应用。已在国际期刊上发表包含 IEEE Transactions on Automatic Control, IEEE Transactions on Industrial Electronics 杂志在内的文章十余篇，包括 ESI 全球高被引论文 2 篇，主持包含国家自然科学基金青年项目、重点项目课题、科技部重大专项课题在内项目 7 项。

刘智伟，华中科技大学教授，博士生导师，教育部青年长江学者，湖北省杰出基金获得者。2004 年在西南交通大学获得信息管理与系统学士学位，2011 年在华中科技大学获得控制理论与应用博士学位。2012 年 12 月至 2013 年 2 月，担任香港城市大学机械与生物医学工程系高级研究助理。2014 年 9 月至 2015 年 9 月，担任澳大利亚皇家墨尔

本理工大学电气与计算机工程学校访问研究员。目前研究兴趣主要集中在分布式网络系统的学习、控制与优化及其在电力网络中的应用。已在国际期刊和会议上发表 100 多篇论文，包括 60 多篇 IEEE Transactions 论文。主持 20 余项科研项目，包括国家自然科学基金和国家电网重点研究项目。

刘凡，南方科技大学系统设计与智能制造学院助理教授（副研究员），博士生导师。中国科协青年托举人才，玛丽·居里学者，IEEE 高级会员，中国通信学会高级会员。2013 年于北京理工大学获工学学士学位，2018 年于北京理工大学获工学博士学位，师从国家最高科学技术奖获得者，"中国预警机之父"王小谟院士。曾于 2016 年—2018 年赴英国伦敦大学学院任访问学者，2018 年—2020 年在英国伦敦大学学院担任玛丽·居里学者（Marie Curie Research Fellow）。2020 年回国后全职加入南方科技大学。主要研究方向为通信感知一体化、车联网与智能交通。曾获得 2023 年 IEEE 通信学会莱斯奖（Stephan O. Rice Prize），2023 年 IEEE ICC 最佳论文奖，2023 年 IEEE/CIC ICCC 最佳论文奖，2022 年中国通信学会科技进步一等奖，2021 年 IEEE 信号处理学会青年作者最佳论文奖，2019 年中国电子学会优秀博士学位论文奖。

何东轩，北京理工大学信息与电子学院预聘助理教授、特聘副研究员。2013 年 6 月本科毕业于北京理工大学自动化专业，2019 年 6 月博士毕业于北京理工大学通信与信息系统专业，博士期间受留学基金委资助在新加坡科技设计大学进行联合培养博士学习，于 2019 年进入清华大学电子工程系进行博士后在站研究，主要研究方向包括通信感知一体化、太赫兹通信等。作为项目负责人承担国家自然科学基金 1 项、博士后基金面上项目 1 项，承担多项国家重大项目及企业合作项目。在 IEEE TCOM、WCL、CL、WCM 等高水平学术期刊以及 IEEE Globecom 等通信旗舰会议发表学术论文 30 余篇，申请专利 14 项。担任 Space: Science & Technology 期刊客座编辑，担任多个学术期刊、会议论文审稿人。荣获 2021 年 IEEE Wireless Communications Letters 期刊优秀审稿人。

杨杰，讲师，硕士生导师，东南大学至善青年学者，小米青年学者，入选第八届中国科协青年人才托举工程。主要从事面向 B5G/6G 的通信感知一体化理论与关键技术研究，在该研究领域已发表 IEEE Journal on Selected Areas in Communications、IEEE Transactions on Wireless Communication、IEEE Transactions on Communications、IEEE Internet of Things Journal 等 IEEE 核心刊物学术论文 20 余篇，授权国家发明专利 4 项，出版专著章节 1 部。主持 JKW 项目和省部级基金项目共 3 项、参与国家自然科学基金及企业合作项目 10 余项。担任 China Communications 客座编委、IEEE ISWCS 会议分会主席，参与 IMT-2030（6G）通感任务组标准化工作，提交提案 10 余项，并参与发布了世界首个《通信感知一体化技术报告》，获 2022 年江苏省科学技术一等奖。

特邀专题简介

在 6G 移动通信系统中，更高的频段（毫米波乃至太赫兹）、更宽的带宽、更大规模天线阵列使高精度、高分辨感知成为可能，从而可以在一个系统中实现通信感知一体化（Integrated Sensing and Communication, ISAC）， 使通信与感知功能相辅相成。通信感知一体化技术因在智能感知和高效无线传输方面的巨大潜力，已被认为是 6G 的重要特征和关键性赋能技术。

无人系统与通信感知一体化技术的融合可充分发掘通信和感知技术各自带来的优势。首先，通过新的波形设计，利用同一无线信号同时完成通信和感知功能，可提高资源利用率，实现通信、感知性能的均衡普惠。利用感知信息可以实现更精确的波束成形和波束跟踪设计，减少导频资源的开销，提升波束成形增益，辅助无人系统通信，扩大通信服务覆盖的范围，提升通信的可靠性。同时，通过对多节点感知信息的融合，可以进一步提高系统的感知精度和范围，减少感知盲区，扩大感知的范围，实现广域感知。

本特邀专题邀请以下与"面向无人系统的 6G 通信感知智能一体化理论及技术"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。

- 面向无人系统 ISAC 的信息理论极限
- 面向无人系统 ISAC 的网络架构/帧结构/协议/波形设计

- 面向无人系统 ISAC 的干扰分析及管理

- 面向无人系统 ISAC 的隐私/安全/可靠问题

- 面向无人系统 ISAC 的系统资源管理分配及优化

- 面向无人系统 ISAC 的信号设计/智能信号处理

- 面向无人系统 ISAC 的数据驱动/人工智能/机器学习技术

- 面向无人系统 ISAC 的 MIMO/Massive MIMO/智能反射面（RIS）

- 面向无人系统 ISAC 的毫米波/太赫兹技术

- 面向无人系统 ISAC 的无人机/电动垂直起降飞行器/车联网应用

- 面向无人系统 ISAC 的环境感知及重构技术

- 基于无人系统 ISAC 的无人系统控制调度/轨迹规划

- 基于 6G ISAC 的无人系统探测/定位/导航

- 面向无人系统 ISAC 的 6G 通感一体化实验演示及原型设计

IEEE ICUS 2024
Invited Session Summary

Title of Session

Integrated Sensing and Communication (ISAC) for Unmanned Systems in 6G Era

Organizers

1. Assoc. Prof. Huazhou Hou

Purple Mountain Laboratories, China

2. Prof. Zhiwei Liu

Huazhong University of Science and Technology, China

3. Assoc. Prof. Fan Liu

Southern University of Science and Technology, China

4. Assoc. Prof. Dongxuan He

Beijing Institute of Technology, China

5. Asst. Prof. Jie Yang

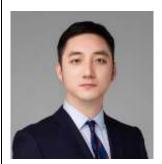Southeast University, China

Biosketches of Organizers

Huazhou Hou received the B.S. degree from Beijing Institute of Technology (BIT) in 2013, the M. S. degree and the Ph.D. degree from Northeast University (NEU) in 2015 and 2020, respectively. From 2017 to 2019, he was a Joint Ph. D. student at RMIT university, Melbourne, Australia. From 2020 to 2023, he was a Post-Doctoral at Southeast University (SEU). He is currently an Associate Professor with the Purple Mountain Laborites (PML), Nanjing, China. His research interests include Integrated Sensing and Communication (ISAC) and Signal Processing, Intelligent Decision and their applications in Unmanned Systems.

Prof. Liu Zhiwei, Ph.D. supervisor at Huazhong University of Science and Technology. He received a Bachelor of Science degree in Information Management and Systems from Southwest Jiaotong University in 2004, and a Ph.D. in Control Theory and Applications from HUST in 2011. From December 2012 to February 2013, he was a Senior Research Associate in the Department of Mechanical and Biomedical Engineering at

City University of Hong Kong. From September 2014 to September 2015, he was a Visiting Research Fellow at the School of Electrical and Computer Engineering, RMIT University. His research interests include learning, control, and optimization of distributed network systems and their applications in power networks. He has published over 100 papers in international journals and conferences, including more than 60 in IEEE Transactions. In 2020, he was awarded the Chang Jiang Scholars Programme for Young Scholars and received the Hubei Province Outstanding Young Scientist Fund. He has led over 20 scientific research projects, including the National Natural Science Foundation of China and Key Research Projects of the State Grid.

Fan Liu (Member, IEEE) received the B.Eng. and Ph.D. degrees from the Beijing Institute of Technology (BIT), Beijing, China, in 2013 and 2018, respectively. He is currently an Assistant Professor with the Department of Electrical and Electronic Engineering, Southern University of Science and Technology (SUSTech), Shenzhen, China.He has previously held academic positions with the University College London (UCL), London, U.K. From 2016 to 2018, he was a Visiting Researcher and then from 2018 to 2020, a Marie Curie Research Fellow. He was listed in the World's Top 2% Scientists by Stanford University for citation impact in 2021. He was the recipient of the IEEE Signal Processing Society Young Author Best Paper Award of 2021, the Best Ph.D. Thesis Award of Chinese Institute of Electronics of 2019.

Dongxuan He (IEEE Member) received the B.S. degree in automation and the Ph.D. degree in information and communication systems from the Beijing Institute of Technology (BIT) in 2013 and 2019, respectively. From 2017 to 2018, he was a Visiting Student at the Singapore University of Technology and Design (SUTD). From 2019 to 2022, he was a Post-Doctoral Researcher at the Department of Electronic Engineering, Tsinghua University. He is currently an Assistant Professor with the School of Information and Electronics, BIT. His current research interests include terahertz communication, AI empowered wireless communications, and physical layer security. He was also an Exemplary Reviewer of IEEE Wireless Communications Letters.

Jie Yang (Member, IEEE) received the B.S. degree in communication engineering from Nanjing University of Science and Technology, Nanjing, China, in 2015, the M.S. and Ph.D. degrees in information and communications engineering from Southeast University, Nanjing, China, in 2018 and 2022, respectively. In 2022, she joined the School of Automation, Southeast University, Nanjing, China, where she is currently an Assistant Professor. Her current research interests include signal processing for wireless communications, massive MIMO, millimeter-wave wireless communications, and integrated sensing and communication

Details of Session

In 6G mobile communication systems, higher frequency bands (millimetre wave and even terahertz), wider bandwidths, and larger antenna arrays enable high-precision and high-resolution sensing, thus enabling Integrated Sensing and Communication (ISAC) in a system, where communication and sensing functions are complementary. ISAC is considered to be an important feature and key enabling technology for 6G due to its great potential for intelligent sensing and efficient wireless transmission.

The integration of unmanned systems with communication and perception integration technologies can fully exploit the advantages that communication and perception technologies each bring. Firstly, through the new waveform design, the same wireless signal can be used to complete communication and perception functions simultaneously, which can improve the resource utilization rate and achieve a balanced and universal benefit of communication and perception performance. The use of sensing information can achieve more accurate beamforming and beam tracking design, reduce the overhead of guide frequency resources, improve beamforming gain, assist unmanned system communication, expand the range of communication service coverage, and improve the reliability of communication. At the same time, through the fusion of multi-node sensing information, the sensing accuracy and range of the system can be further improved, reducing the sensing blind area, expanding the range of sensing, and realizing wide-area sensing.

The invited session invites original papers of innovative ideas and concepts, new discoveries and improvements, and novel applications relevant to the following

selected topics of "Integrated Sensing and Communication (ISAC) for Unmanned Systems in 6G Era".

- Information-theoretic limits of ISAC for unmanned systems
- Network architecture/frame structure/protocols/Beam forming of ISAC for unmanned systems
- Interference analysis and management of ISAC for unmanned systems
- Privacy/Security/Reliability Issues for Unmanned Systems ISACs
- System Resource Management Allocation and Optimisation for ISACs of Unmanned Systems
- Signal Design for Unmanned Systems ISAC / Intelligent Signal Processing
- Data-Driven/Artificial Intelligence/Machine Learning Techniques for Unmanned Systems ISACs
- MIMO/Massive MIMO/Reflecting Surface with Intelligence (RIS) for Unmanned Systems ISACs
- Millimetre Wave/Terahertz Technologies for Unmanned Systems ISACs
- UAV/eVTOL/V2X Networking Applications for Unmanned Systems ISACs
- Environment Sensing and Reconfiguration Techniques for Unmanned Systems ISACs
- Control /Trajectory Planning/SLAM based on Unmanned Systems ISAC
- 6G ISAC-based detection/location/navigation of unmanned systems
- Experimental Demonstration and Prototyping for Unmanned Systems ISACs