2025 第八届 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 通信感知计算一体化技术（ISAC²）及应用

组织者

1.侯华舟，副研究员，紫金山实验室

2.钟子果，研究员，紫金山实验室

3.黄永明，教授，紫金山实验室

个人简介

侯华舟，副研究员，紫金山实验室前沿交叉科学研究中心课题骨干，东南大学信息科学与工程学院校外博士生导师，入选江苏省高层次人才培养计划“333 工程”，江苏省卓越博士后人才计划。2013 年于北京理工大学获工学学士学位，2015 年及 2020 年于东北大学获工学硕士、工学博士学位，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科学研究中心，主要研究方向为 6G 通信感知计算一体化技术及其在无人系统中的应用。曾获 2024 年 IEEE ICSIDP 会议最佳论文奖，担任 IEEE Open Journal of Communications Society 客座编辑，担任中国通信标准化学会无线通信准（TC5）标工作委员会委员，中国指挥与控制学会低空产业委员会委员，南京市低空经济标准化技术委员会委员，未来移动通信论坛（FuTURE）数字低空测试与验证（TG8）工作组委员，牵头制定并发布数字低空相关白皮书 1 部。

钟子果，研究员，紫金山实验室普适通信研究中心首席研究员，分别于 2003 年和 2006 年在东南大学信息科学与工程学院获得学士和硕士学位，并于 2010 年在美国明尼苏达大学双城分校（University of Minnesota–Twin Cities）获得计算机科学博士学位。2024 年加入紫金山实验室普适通信研究中心，研究方向为 6G 通感一体和分布式高效计算等。此前，他曾在美国德州仪器（Texas Instruments）达拉斯总部的感知与分

析实验室（Perception and Analytics Lab）担任高级研究员，并曾任美国内布拉斯加大学林肯分校（University of Nebraska–Lincoln）计算机科学与工程系助理教授。他的研究聚焦于无线通信与网络，以及基于毫米波雷达、激光雷达和摄像头等多模态融合感知的机器视觉。他在经同行评议的重要国际学术期刊和会议上发表了 50 篇论文，并在美国和中国获得多项授权专利。他曾获得 2018 年 IS&T 国际电子成像会议（IS&T International Symposium on Electronic Imaging）最佳论文奖、德州仪器 2016 年 Jack Kilby 创新奖（纪念集成电路发明者）、内布拉斯加大学林肯分校 Maude Hammond Fling Faculty Fellowship 及计算机科学与工程系 2013 年度最佳教学奖。

黄永明，IEEE Fellow，国家杰出青年基金获得者，国家万人计划科技创新领军人才，东南大学首席教授，博导，紫金山实验室普适通信研究中心主任。主要研究 5G/6G 智能通信理论与技术，已在无线通信和信号处理领域具有重要国际影响力的 IEEE 核心期刊上发表 SCI 论文 150 余篇，获谷歌学术引用 16800 余次，已获授权国际/国家发明专利百余项；获国家技术发明二等奖、中国电子学会技术发明一等奖、教育部技术发明二等奖等奖项；获 IEEE 国际标准杰出贡献奖、日内瓦国际发明特别展金奖、IEEE GLOBECOM/WCNC 等国际会议最佳论文奖；获中国五四青年集体奖章。长期担任 IEEE Transactions on Signal Processing、IEEE Wireless Communications Letters 和 IEEE Open Journal of the Communications Society 等国际核心期刊的编委。

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、边缘智能计算成为可能，从而可以在一个系统中实现通信感知一体化（Integrated Sensing, Communication and Computing，ISAC^2），使通信与感知、计算功能相辅相成。通信感知计算一体化技术因在智能感知、高速计算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计算一体化技术的融合可充分发掘通信和感知以及高速计算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、计算性能的均衡普惠。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。感知同时可以为计算提供大量的数据来源，提升计算结果的准确性和可信度，同时高速准确的计算结果可以保障系统运行决策时的可靠性及最优性。通过对多节点感知信息的计算融合，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 通信感知计算一体化理论及技术”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^2 的信息理论极限
- 面向无人系统 ISAC^2 的智能数据处理理论、算法
- 面向无人系统 ISAC^2 的高速计算理论、架构、算法
- 面向无人系统 ISAC^2 的网络架构/帧结构/协议/波形设计
- 面向无人系统 ISAC^2 的干扰分析及管理
- 面向无人系统 ISAC^2 的隐私/安全/可靠问题
- 面向无人系统 ISAC^2 的系统资源管理分配及优化
- 面向无人系统 ISAC^2 的信号设计/智能信号处理
- 面向无人系统 ISAC^2 的数据驱动/人工智能/机器学习技术
- 面向无人系统 ISAC^2 的 MIMO/Massive MIMO/智能反射面（RIS）
- 面向无人系统 ISAC^2 的毫米波/太赫兹技术
- 面向无人系统 ISAC^2 的数字低空、低空经济应用
- 面向无人系统 ISAC^2 的环境感知及重构技术
- 面向无人系统 ISAC^2 的探测/定位/识别/导航
- 面向无人系统 ISAC^2 的 6G 通感一体化实验演示及原型设计
- 面向无人系统 ISAC^2 的样本集、数据集构建及发布

IEEE ICUS 2025
Invited Session Summary

Title of Session

Integrated Sensing, Communication and Computing Technology (ISAC^2) for Unmanned Systems in 6G Era

Organizers

1. Prof. Huazhou Hou

Purple Mountain Laboratories, China

2. Prof. Ziguo Zhong

Purple Mountain Laboratories, China

3. Prof. Yongming Huang

Purple Mountain Laboratories, China

Biosketches of Organizers

Huazhou Hou received his bachelor's degree of engineering from Beijing Institute of Technology in 2013, received his M.S. and Ph.D. degrees from Northeastern University in 2015 and 2020. He is currently an Associate Professor with the Purple Mountain Laboratories (PML), Nanjing, China. His research interests include 6G Integrated Sensing, Communication and Computing Technology (ISAC^2) for Unmanned Systems. He was selected for Jiangsu Province High-level Talent Cultivation Program, Jiangsu Province Excellent Postdoctoral Talent Program. He was awarded the best paper award in the 2024 IEEE ICSIDP conference, served as guest editor of IEEE Open Journal of Communications Society, member of Wireless Communications Quasi (TC5) Standard Working Committee of the CCSA, member of Low Altitude Industry Committee of the CICC, member of Nanjing Low Altitude Economic He is also a member of Nanjing Low Altitude Economy Standardization Technical Committee, a member of Future Mobile Communications Forum (FuTURE) Digital Low Altitude Testing and Verification (TG8) Working Group.

Ziguo Zhong received his B.E. and M.E. degrees in radio engineering from Southeast University in China in 2003 and 2006, respectively, and his Ph.D. degree in computer science from the University of Minnesota – Twin Cities in 2010. He is currently a Principal Researcher at Purple Mountain Laboratories in Nanjing, China. Prior to this, he served as a Senior Member of Technical Staff in the Perception and Analytics Lab at Texas Instruments (Dallas, USA) and as an Assistant Professor in the Department of Computer Science and Engineering at the University of Nebraska – Lincoln. His research interests focus on wireless communication/networking and machine perception using multi-modal sensing platforms such as radar, LiDAR, and cameras. He has published 50 papers in leading peer-reviewed journals and conferences, along with multiple granted patents in the U.S. and China. He was the recipient of the Best Paper Award at the 2018 IS&T International Symposium on Electronic Imaging, the 2016 Jack Kilby Innovation Award from Texas Instruments, and the Maude Hammond Fling Faculty Fellowship and Computer Science & Engineering 2013 Best Teaching Award at the University of Nebraska – Lincoln.

Yongming Huang, IEEE Fellow, received the B.S. and M.S. degrees from Nanjing University, Nanjing, China, in 2000 and 2003, respectively, and the Ph.D. degree in electrical engineering from Southeast University, Nanjing, in 2007. Since March 2007 he has been a faculty in the School of Information Science and Engineering, Southeast University, China, where he is currently a full professor. He has also been the Director of the Pervasive Communication Research Center, Purple Mountain Laboratories, since 2019. During 2008-2009, Dr. Huang visited the Signal Processing Lab, Royal Institute of Technology (KTH), Stockholm, Sweden. His current research interests include intelligent 5G/6G mobile communications and millimeter wave wireless communications. He has published over 200 peer-reviewed papers, hold over 80 invention patents. He submitted around 20 technical contributions to IEEE standards, and was awarded a certificate of appreciation for outstanding contribution to the development of IEEE standard 802.11aj. He served as an Associate Editor for the IEEE Transactions on Signal Processing and a Guest Editor for the IEEE Journal

Selected Areas in Communications. He is currently an Editor-at-Large for the IEEE Open Journal of the Communications Society and an Associate Editor for the IEEE Wireless Communications Letters.

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, Communication and Computing ($ISAC^2$) 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 beam-forming and beam tracking design, reduce the overhead of guide frequency resources, improve beam-forming 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 Communication and Computing ($ISAC^2$) for Unmanned Systems in 6G Era"

- Information-theoretic limits of $ISAC^2$ for unmanned systems
- Intelligent data processing theory, algorithms for unmanned systems $ISAC^2$
- High-speed computing theory, architecture, algorithms for unmanned systems $ISAC^2$

- Network architecture/frame structure/protocols/Beam forming of ISAC^2 for unmanned systems
- Interference analysis and management of ISAC^2 for unmanned systems
- Privacy/Security/Reliability Issues for Unmanned Systems ISAC^2
- System Resource Management Allocation and Optimization for ISAC^2 of Unmanned Systems
- Signal Design for Unmanned Systems ISAC^2 / Intelligent Signal Processing
- Data-Driven/Artificial Intelligence/Machine Learning Techniques for Unmanned Systems ISAC^2
- MIMO/Massive MIMO/Reflecting Surface with Intelligence (RIS) for Unmanned Systems ISAC^2
- Millimetre Wave/Terahertz Technologies for Unmanned Systems ISAC^2
- UAV/eVTOL/V2X Networking Applications for Unmanned Systems ISAC^2
- Environment Sensing and Reconfiguration Techniques for Unmanned Systems ISAC^2
- 6G ISAC^2-based detection/location/identification/navigation of unmanned systems
- Experimental Demonstration and Prototyping for Unmanned Systems ISAC^2
- Sample set, data-set construction and publishing for Unmanned Systems ISAC^2