

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 无人集群系统的自主控制与智能运维方法与应用
组织者 1. 许涛，助理研究员，北京理工大学 2. 伊泉剑，教授，北京理工大学
个人简介  <p>许涛，北京理工大学助理研究员，南洋理工大学访问博士后。2022 年获北京大学博士学位，曾赴香港城市大学开展访问交流。主要从事智能无人集群、多智能体网络与动态协同控制等方向的研究工作。近五年来，以第一作者或通讯作者在 Automatica、IEEE TAC 等国际权威期刊及会议发表论文 20 余篇；授权国家发明专利 4 项，参与制定团体标准 1 项。主持国家自然科学基金项目及中国博士后科学基金项目共 3 项。入选北京市“高创计划”青年人才托举工程及中国指挥与控制学会博士学位论文激励计划，荣获学术会议最佳论文奖 2 项。现任中国现场统计研究会智能运维分会理事、北京自动化学会理事、中国指挥与控制学会具身智能专业委员会委员及青年工作委员会委员。</p>  <p>伊泉剑，北京理工大学教授，国防 DF 青年人才，长期从事系统可靠性与装备运维决策技术与工程应用，在基础研究方面，在领域顶级/知名期刊以一作/通讯发表 SCI 论文 40 余篇，入选斯坦福大学人工智能领域发布的“全球前 2% 顶尖科学家榜单”，出版专著 2 部、译著 2 部，授权发明专利 40 余项，转化 2 项；在卡脖子技术攻关与工程应用方面，先后担任了某国家重大工程健康管理技术副总设计师、维修性提升技术副总设计师，主持研制了 4 型国产组网装备健康管理系统。获国防科技进步一等奖（排 1）、日内瓦国际发明金奖（排 1）、辽宁省创新团队（负责人）、军队科技进步二等奖（排 7）等奖励与荣誉。</p>

特邀专题简介

随着空中、地面及水域无人集群系统的快速发展，无人集群系统在环境监测、智能交通、协同巡检、应急响应及国防安全等领域展现出广阔的应用前景。相比单体无人系统，集群系统具有规模大、交互复杂、通信受限及动态性强等显著特点，使其在复杂不确定环境中的自主运行能力与长期稳定性面临更高挑战。为实现高可靠、高自主性的集群运行能力，不仅需要先进的分布式协同控制与自主决策方法，还需要融合智能感知、健康管理与预测性维护的智能运维机制，以保障系统在任务执行过程中的持续性与鲁棒性。然而，传统集中式控制与依赖人工干预的运维方式已难以适应大规模网络化集群系统的发展需求，自主控制与智能运维的深度融合已成为当前研究的重要前沿方向。近年来，随着分布式控制理论、数据驱动方法、机器学习技术及事件触发机制的发展，无人集群系统在协同控制、状态估计、故障诊断与资源优化等方面取得了重要进展。本邀请组旨在围绕无人集群系统自主控制与智能运维中的关键理论与工程问题开展深入交流，促进方法创新与应用融合，提升系统在复杂动态环境中的自主性、可靠性与长期运行能力。

本特邀专题邀请以下与“无人集群系统的自主控制与智能运维方法与应用”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。

- 无人集群系统的分布式自主控制方法
- 基于学习的集群决策与优化方法
- 事件触发与资源受限控制策略
- 集群系统状态估计与信息融合
- 故障诊断与容错控制方法
- 健康管理与预测性维护技术
- 数字孪生驱动的智能运维方法
- 感知—控制—运维一体化方法
- 多无人系统协同任务规划与调度
- 无人机、无人车及无人船集群应用

IEEE ICUS 2026
Invited Session Summary

Title of Session

Autonomous Control and Intelligent Maintenance for Unmanned Swarm Systems:
Methods and Applications

Organizers

1. Dr. Tao Xu

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Biosketches of Organizers



Tao Xu received the Ph.D. degree in dynamical systems and control from Peking University, Beijing, China, in 2022. He is currently a Postdoctoral Researcher with the School of Mechatronical Engineering, Beijing Institute of Technology, Beijing, China, and the School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore. From June 2021 to September 2021, he was a Research Assistant with the City University of Hong Kong, Hong Kong, China. His current research interests include intelligent unmanned swarms, multi-agent networks, and distributed dynamic cooperative control. Dr. Xu was a recipient of the Young Elite Scientists Sponsorship Program of the Beijing High Innovation Plan and the Excellent Doctoral Dissertation Award from the Chinese Institute of Command and Control. He also received the Best Paper Awards at IAI 2025 and IEEE ICUS 2025.



Xiaojian Yi is a Professor at Beijing Institute of Technology and a recipient of the National Defense Young Talent Program. He has long been engaged in research and engineering applications in system reliability and equipment maintenance decision-making technologies. He has published over 40 SCI papers in leading international journals as first or corresponding author, including 7 ESI Highly Cited Papers. He has been listed among the World's Top 2% Scientists in the field of Artificial Intelligence released by Stanford University. He has authored 2 monographs and 2 translated books, and has been granted more than 40 invention patents, with 2 successfully commercialized. He has received numerous honors and awards, including First Prize of the National Defense Science and Technology Progress Award (Ranked 1st), Gold Medal of the Geneva International Exhibition of

Inventions (Ranked 1st), Leader of a Liaoning Provincial Innovation Team, and Second Prize of Military Science and Technology Progress Award (Ranked 7th), among others.

Details of Session

With the rapid development of unmanned swarm systems in aerial, ground, and marine domains, these systems have demonstrated broad application prospects in environmental monitoring, intelligent transportation, cooperative inspection, emergency response, and defense security. Compared with single-agent unmanned systems, swarm systems are characterized by large-scale deployment, complex interactions, limited communication, and strong dynamics, which pose significant challenges to autonomous operation and long-term stability in complex and uncertain environments. To achieve highly reliable and autonomous swarm operation, it is necessary not only to develop advanced distributed cooperative control and autonomous decision-making methods, but also to integrate intelligent maintenance mechanisms incorporating perception, health management, and predictive maintenance, thereby ensuring system continuity and robustness during mission execution. However, traditional centralized control and human-dependent maintenance strategies are no longer sufficient for large-scale networked swarm systems, making the deep integration of autonomous control and intelligent maintenance a key frontier research direction. In recent years, significant progress has been made with the development of distributed control theory, data-driven methods, machine learning techniques, and event-triggered mechanisms, enabling advances in cooperative control, state estimation, fault diagnosis, and resource optimization for unmanned swarm systems. This special session aims to facilitate in-depth discussions on key theoretical and engineering issues in autonomous control and intelligent maintenance for unmanned swarm systems, promoting methodological innovation and application-oriented integration, and enhancing system autonomy, reliability, and long-term operational capability in complex dynamic environments.

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 “Autonomous Control and Intelligent Maintenance for Unmanned Swarm Systems: Methods and Applications”.

- Distributed autonomous control of unmanned swarm systems
- Learning-based decision-making and optimization methods for swarms
- Event-triggered and resource-aware control strategies
- State estimation and information fusion in swarm systems
- Fault diagnosis and fault-tolerant control methods

- Health management and prognostics and maintenance technologies
- Digital twin-driven intelligent maintenance methods
- Integrated perception-control-maintenance frameworks
- Cooperative task planning and scheduling for multi-unmanned systems
- Applications of UAV, UGV, and USV swarms