

# 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

无人集群系统自主协同关键技术

## 组织者

1. 董希旺，教授，北京航空航天大学
2. 丁文锐，研究员，北京航空航天大学
3. 索津莉，副教授，清华大学
4. 李杰，副教授，国防科技大学
5. 宋勋，高工，中国航天科工二院

## 个人简介



**董希旺**，北京航空航天大学教授、博士生导师。2017 年入选中国科协青年人才托举工程，2019 年获批国家自然科学基金优秀青年基金，2021 年荣获中国指挥与控制学会青年科学家，入选 2021 年爱思唯尔高被引中国学者。担任中国指挥与控制学会青年工作委员会主任、集群智能与协同控制专业委员会总干事，中国自动化学会青年工作委员会副秘书长。主要研究方向为集群智能、协同制导控制、协同决策规划及飞行器集群。坚持理论与实践并重，研发了基于无人机和无人车的集群智能协同验证平台并开展系列试验验证。参与 2018 年和 2021 年空军无人争锋比赛无人机密集编队穿越竞速飞行，在 50 余支参赛队伍中分别获得优胜奖和冠军。以第一作者和通讯作者在 *IEEE TAC* 和 *TCST* 等会刊以及 *Automatica* 等国际知名期刊发表 SCI 论文 80 余篇，发表在 *IEEE TAC* 上的论文被评为 2020 年北京地区广受关注的学术论文，发表在 *Control Engineering Practice* 的论文被评为该期刊 2019 年引用最多的论文，发表在 *Chinese Journal of Aeronautics* 的论文被评为 2020 年度中国精品科技顶尖学术论文 (F5000)，在 Springer 和 Taylor Francis 出版英文专著 2 部，授权、受理国家发明专利 30 余项。先后获得中国指挥与控制学会科技进步一等奖、创新奖一等奖，中国发明协会技术发明一等奖，中国产学研合作创新与促进成果奖二等奖，吴文俊人工智能优秀青年奖，IEEE CSS Beijing Chapter 青

年作者奖及 Springer 优秀博士论文等荣誉。



**丁文锐**，博士，研究员，北航无人系统研究院智能信息技术首席。主要研究方向为无人系统中的电磁感知、视觉感知、决策控制等。



**索津莉**，清华大学自动化系长聘副教授、博士生导师，教育部青年长江学者。主要从事计算摄像学理论与关键技术研究，包括高通量计算摄像、海量生物医学数据传输与共享等，发表学术论文 80 余篇，包括领域顶级期刊 Nature Photonics、IEEE TPAMI 等。先后承担国家自然科学基金面上、重点、优青等项目，以及北京市自然科学基金重点项目、科技部重点研发计划子课题等。获授权国家发明专利 30 余项。曾获国家科技进步二等奖（序 3）、电子学会科学技术奖一等奖（序 2）。



**李杰**，男，工学博士，国防科技大学智能科学学院副教授。长期从事无人机决策与规划技术研究工作，承研装备发展部预先研究共用技术项目、国家安全重大基础研究（国防 973）项目专题、科技部 2030“新一代人工智能”重大项目课题等 10 余项，获省部级科技进步一等奖 1 项。担任科技委某领域专家、中国指挥与控制学会集群智能与协同控制专委会委员、中国自动化学会无人飞行器自主控制专委会委员。



**宋勋**，男，北京电子工程总体研究所导航制导与控制研究室副主任，高级工程师，北航导航制导与控制博士，XX 智能专家组办公室副主任，某重点领域常务副总师。长期从事无人飞行器导航制导与控制系统、无人自主控制系统和多机编队协同控制系统研究，撰写航天报告、科技论文和专利商密二十余篇，翻译出版《集群智能》一书（第二作者）。在无人飞行器协同控制领域，牵头论证并承担科技部、军科委和各军兵种多个重大项目研

究；2018年以来，三年内五次带队获得空军“无人争锋”等全国无人集群挑战赛冠军，成为全国唯一一支完成多旋翼和全国无人集群挑战赛冠军固定翼编队协同识别精准穿越的队伍。

### 特邀专题简介

无人集群系统在军事和民用领域均有广阔的应用前景，例如微纳卫星集群协同探测、无人机集群协同干扰、无人车集群协同搬运等，分布式协同技术是集群智能领域的研究热点和难点，在无人集群系统协同执行任务中有重要应用价值。如何设计分布式协同方法实现通信组网、感知认知、决策规划、制导控制、评估验证等层面的有机协作是当前学术界和产业界共同关注的焦点。

本专题围绕无人集群系统自主协同关键技术，聚焦最新研究成果，欢迎与以下主题相关的论文：

- 集群通信组网
- 感知认知
- 决策规划
- 制导控制
- 评估验证

# IEEE ICUS 2024

## Invited Session Summary

### Title of Session

Key Technologies on Autonomous Cooperation of Swarm Systems

### Organizers

**1. Prof. Xiwang Dong**

Beihang University, China

**2. Prof. Wenrui Ding**

Beihang University, China

**3. Assoc. Prof. Jinli Suo**

Tsinghua University, China

**4. Assoc. Prof. Jie Li**

National University of Defense Technology, China

**5. Prof. Xun Song**

Beijing Institute of Electronic System Engineering, China

### Biosketches of Organizers



**Xiwang Dong** received the Ph.D. degree in Control Science and Engineering from Tsinghua University, Beijing, China, in 2014. He has been a Research Fellow with the School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore, from 2014 to 2015, a Lecturer and an Associate Professor with the School of Automation Science and Electrical Engineering, Beihang University, Beijing, China from 2014 to 2018. Currently, he is a Full Professor and an Associate Dean at Institute of Artificial Intelligence, Beihang University, Beijing, China, and IEEE Senior Member. His research focuses on cooperative control of multi-agent systems, intelligent control of swarm systems, and distributed control UAV swarm systems. He is the first author or corresponding author of more than 70 referred international journal papers (6 ESI Highly Cited Papers), receiving more than 3000 non-self SCI citations with H-index 31 according to Web of Science. He serves as the Associate Editor and an Editorial Board Member of several journals, including the Drones, and National Science Open. Dr. Dong was the recipient of the Best Paper Award of IEEE International Conference on Control and Automation (IEEE ICCA) in 2018, Best Paper Award of IEEE Guidance,

Navigation and Control Conference (IEEE GNCC) in 2018, the Young Author Prize of IEEE CSS Beijing Chapter (CCC) in 2019, and the Springer Outstanding Thesis Award in 2015. He was the recipient of the First Prize of Innovation Award of Chinese Institute of Command and Control in 2019. He was the Top Reviewer of Asian Journal of Control (2016) and the Outstanding Reviewer of Journal of the Franklin Institute (2017). He was selected in the “Young Elite Scientists Sponsorship Program” by China Association for Science and Technology (CAST) in 2017 and was awarded a National Natural Science Fund for Excellent Young Scholars in 2019.



**Wenrui Ding** received the Ph.D. degree in electrical and information engineering from Beihang University, China. She is currently in charge of the Intelligent Information Research Center with the Institute of Unmanned System, Beihang University. Her current research interests include the electromagnetic perception, visual perception, and command and control of the UAV system.



**Jinli Suo** received the BS degree in computer science from Shandong University, Shandong, China, in 2004 and the PhD degree from the Graduate University of Chinese Academy of Sciences, Beijing, China, in 2010. She is currently an associate professor with the Department of Automation, Tsinghua University, Beijing, China. Her research interests include computer vision, computational photography, and statistical learning.



**Jie Li**, Male, Doctor of Engineering, Associate Professor, College of Intelligence Science and Technology, National University of Defense Technology. He has been engaged in the research of UAV decision-making and planning technology for a long time. He has undertaken more than 10 projects, such as the advanced research and sharing technology project of the Ministry of Equipment Development, the major Basic Research project of National Security (National Defense 973), and the 2030 "New Generation of Artificial Intelligence" major project of the Ministry of Science and Technology. He has won a first prize of provincial and ministerial Science and Technology Progress. He is an expert in some field of Science and Technology Commission, a member of the

Special Committee of Swarm Intelligence and Collaborative Control of Chinese Command and Control Society, and a member of the Special Committee of Autonomous Control of Unmanned Aerial Vehicles of Chinese Association of Automation.



**Xun Song** (male) is the Deputy Director of Navigation Guidance and Control Research Office from Beijing Institute of Electronic System Engineering, where he is a Senior Engineer and also the Deputy Director of XX Intelligence Expert Group Office as well as the Executive Deputy Chief Engineer of XX key fields. He received his Ph.D. degree in Navigation Guidance and Control from Beihang University, Chian. His research interests include UAV navigation guidance and control system, unmanned autonomous control system, and formation control of multi-UAV systems. He has written more than twenty Aerospace reports, technical papers, and patent commercial secrets. He has also translated and published the book "Cluster Intelligence" (second author). In the field of cooperative control of multi-UAV systems, he has taken the lead in demonstrating and undertaking several major research projects from the Ministry of Science and Technology, the Commission of Science and Technology, and other various military branches. Since 2018, he has led his team to win the championship of the Air Force "Unmanned Battle" and other national unmanned swarming challenges for five times in three years, which has become the only team in China that is capable of accomplishing the cooperative identification and obstacle crossing for multi-rotors or fixed-wings formation during the national unmanned swarming challenges.

#### **Details of Session**

Swarm systems can also be named as multi-agent systems consisting of multiple agents with neighboring interactions. Cooperative control of swarm systems has been a hot research topic in many scientific communities, especially the control and robotics communities. In the cooperative control of swarm systems, how to design the controller or protocol using only local relative information is the main challenge. Cooperative control of swarm systems is promising due to that the emerging behavior has the features of low cost, high scalability and flexibility, great robustness, and easy maintenance. It has been demonstrated that cooperative control has broad potential applications in various areas, such as cooperative control of intelligent transportation systems, distributed control of power systems, cooperation of multiple robots,

distributed optimization of networked systems, formation flying of multiple satellites and unmanned aerial vehicles. Motivated by the facts stated above, more and more researchers are devoting themselves to obtain sound results on this topic.

The objective of this invited session is to present the recent advanced techniques on cooperative control for swarm systems. In particular, relevant papers are included but not limited to below topics:

- consensus control
- consensus tracking control
- containment control
- formation control
- formation and containment control
- distributed optimization of swarm systems