

# 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

开放动态环境下的智能无人集群系统的自适应分布式决策理论与方法

## 组织者

1. 衣鹏，教授，同济大学
2. 袁德明，教授，南京理工大学
3. 曾宪琳，教授，北京理工大学

## 个人简介



**衣鹏**，2011 年从中国科学技术大学获得自动化本科学位，2016 年从中国科学院数学与系统科学研究院获得运筹学与控制论博士学位。2016 年-2019 年分别于加拿大多伦多大学和美国圣路易斯华盛顿大学从事博士后研究。2019 年加入同济大学，现任“青年百人”教授。主要研究方向为多智能系统的分布式优化与博弈。入选国家海外青年人才计划，获得中国科协“青年人才托举工程”与上海市科技英才“扬帆计划”支持，主持国家自然科学基金委青年和面上项目，科技部国家重点研发计划课题，参与上海市重大专项、先导专项等项目。



**袁德明**，毕业于南京理工大学，分别获工学学士和工学博士学位；现为南京理工大学自动化学院教授，博士生导师，澳大利亚“奋进”研究学者。主要从事分布式优化、学习与控制相关研究。近年来，在 IEEE Transactions on Information Theory、IEEE Transactions on Automatic Control、Automatica、SIAM Journal on Control and Optimization 等学术刊物发表论文数篇。2020 年获国家自然科学基金优秀青年基金资助，2017 年获江苏省自然科学基金优秀青年基金资助，同时主持并参与多项国家和江苏省自然科学基金。目前担任国际刊物 Journal of the Franklin Institute、Transactions of the Institute of Measurement and Control、Franklin Open 编委。



**曾宪琳**，北京理工大学教授，博士生导师。2015 年获得美国德克萨斯理工大学机械工程系博士学位；2015-2017 年在中国科学院数学与系统科学研究院从事博士后研究；2017-2019 年在北京理工大学从事博士后研究，后留校任教。主要研究方向包括多智能体系统分布式非光滑控制与优化、无人系统的规划和博弈决策等。主持国家自然科学基金优青项目、面上项目等多项。获中国自动化学会自然科学一等奖 1 项；现任《控制理论与技术》和《自主智能系统》青年编委。近 5 年，发表 IEEE TAC、Automatica、IEEE NNLS 等 SCI 论文 30 余篇，出版专著 1 部，授权发明专利 18 项。

### 特邀专题简介

智能无人集群系统是由大规模具备感知、存储、信息处理、计算和决策以及执行能力的简单智能体(软/硬件)，借助通信/物理耦合和交互而组成的复杂系统，具有结构复杂、动态复杂和功能复杂的特点。随着智能无人集群系统的发展与进步，其工作环境逐渐从封闭空间进入开放动态环境。另外，在对抗性任务中，智能体可能会损毁或者离开集群，也可能有新智能体加入集群任务中。这带来了变化的任务、时变的目标函数、变化的智能体数量下自适应快速决策的研究挑战，并涌现了新的理论和技术瓶颈。因此，开放动态环境下的智能无人集群系统的决策方法成为愈发重要的研究问题。首先在动态和对抗环境下，目标分布范围广、非合作智能体的意图和认知水平无法预知，需要解决认知层级辨析、态势推断、在线意图识别的难题。其次，为了协同应对复杂任务需要对异构智能体进行动态的分组和任务规划，需要解决动态集群自主划分，任务实时重构的难题。最后，开放动态环境带来了集群数量变化、不完全信息以及不确定等约束，需要解决具有鲁棒性和适应性的分布式在线决策方法的难题。

本特邀专题邀请以下与“开放动态环境下的智能无人集群系统的自适应分布式决策理论与方法”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。

- 在线分布式优化
- 鲁棒博弈
- 多阶段博弈

- 意图理解与对手建模
- 开放多智能体系统
- 集群协同广域探测
- 自适应决策方法

# IEEE ICUS 2024

## Invited Session Summary

### Title of Session

Distributed Adaptive Decision Theory and Method for Intelligent Unmanned Cluster System under Dynamic and Open Environment

### Organizers

#### 1. Prof. Peng Yi

Tongji University, China

#### 2. Prof. Deming Yuan

Nanjing University of Science and Technology, China

#### 3. Prof. Xianlin Zeng

Beijing Institute of Technology, China

### Biosketches of Organizers



**Peng Yi** completed his bachelor's degree in automation from University of Science and Technology of China in 2011 and his PhD in operational research and cybernetics from the Institute of Mathematics and Systems Science, Chinese Academy of Sciences in 2016. He held postdoctoral positions at the University of Toronto in Canada and Washington University in St. Louis, USA from 2016 to 2019. He then joined Tongji University in 2019 and currently serves as a "Hundred Youth Talents" professor. Yi's research mainly focuses on distributed optimization and game theory for multi-agent systems. He is selected for the National Overseas Youth Talent Program, and is supported by the "Youth Talent Support Project" of China Association for Science and Technology, and the "Sailing Plan" for Science and Technology Talents of Shanghai. He leads the Youth and General Program of National Natural Science Foundation of China and the Special Program for National Science and Technology Key Research of China. Moreover, he participates in the Key and Development Program of Shanghai, etc.



**Deming Yuan** graduated from Nanjing University of Science and Technology with a Bachelor of Engineering degree and a PhD in Engineering, respectively. He is currently a professor and doctoral supervisor in the Department of Automation at Nanjing Institute of Technology, and an Australian "Striving for Progress" research scholar. Yuan mainly engaged in research related to distributed optimization, learning, and control. In recent years, he has published several papers in academic journals such as IEEE Transactions on Information Theory, IEEE Transactions on Automatic Control, Automatica, SIAM Journal on Control and Optimization. In 2020, he was supported by the Outstanding Youth Fund of National Natural Science Foundation of China. And in 2017, he was supported by the Outstanding Youth Fund of Jiangsu Provincial Natural Science Foundation of China. He also leads and participates in multiple national and Jiangsu Provincial Natural Science Funds. He currently serves as an editorial board member for many international journals, such as Journal of the Franklin Institute, Transactions of the Institute of Measurement and Control, and Franklin Open.



**Xianlin Zeng** is a professor and doctoral supervisor at Beijing Institute of Technology. He completed his PhD in Mechanical Engineering at Texas Institute of Technology in 2015. He held a postdoctoral position in the Institute of Mathematics and Systems Science, Chinese Academy of Sciences from 2015 to 2017. He also worked as a postdoctoral researcher at Beijing Institute of Technology from 2017 to 2019, and later stayed on as a teacher. Zeng's main research directions include distributed non-smooth control and optimization of multi-agent systems, planning and game decision-making of unmanned systems, etc. He has hosted multiple projects such as the Outstanding Youth Program and General Program of National Natural Science Foundation of China. He received the first prize in natural science from the Chinese Society of Automation. He is a young editorial board member for the journals Control Theory and Technology and Autonomous Intelligent Systems. In the past 5 years, he has published more than 30 SCI, including IEEE TAC, Automatica, IEEE TNNLS, etc, and a monograph. He also has authorized 18 invention patents.

## **Details of Session**

The intelligent unmanned cluster system is a complex system composed of large-scale simple agents (software/hardware) with the ability of perception, information processing, computing, decision-making, and execution capacity, coupling and interacting by communication/physical structure. It is complex in the aspects of structure, dynamic, and function. With the development and progress of intelligent unmanned cluster systems, their working environment is gradually transitioning from enclosed spaces to dynamic and open environment. In addition, when executing adversarial tasks, agents may be damaged or leave the cluster, and new agents may join the task. This has brought about research challenges in efficient adaptive decision-making due to the change of tasks, time-varying objective functions, and variable size of agents, and has given rise to many new theoretical challenges and technical bottlenecks. Therefore, the decision-making methods for intelligent unmanned cluster systems under dynamic and open environment have become increasingly important. Firstly, the intentions and cognitive levels of agents is unpredictable in dynamic and adversarial scenarios. It is necessary to address the problem of cognitive level identification, situation inference, and online intention recognition. Secondly, in order to deal with complex tasks collaboratively, it is essential to dynamically divide the agents into groups and give them the plan. Solving the problem of autonomous clustering and real-time task reconstruction is vital important. Finally, the dynamic and open environment leads to variable size of clusters, incomplete information, and uncertain constraints, requiring robust and adaptive distributed online decision-making methods.

The invited session invites original papers related to the theme of "Distributed Adaptive Decision Theory and Methods for Intelligent Unmanned Cluster Systems under Dynamic and Open Environment", which include innovative ideas, concepts, new discoveries, improvements, and new applications.

- Online distributed optimization
- Robust game theory
- Multi-stage game theory
- Intention recognition and opponent modelling
- Open multi-agent system
- Cooperative wide area detection
- Adaptive decision method

