

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

不确定环境下的自动驾驶鲁棒预测与规划

组织者

- 1.高洪波，研究员，中国科学技术大学
- 2.宋东鉴，副教授，吉林大学
- 3.王亚飞，教授，上海交通大学

个人简介



高洪波，中国科学技术大学研究员、博士生导师，国家网信创新人才支持计划入选者。2016年在李德毅院士的指导下获得北京航空航天大学计算机应用技术专业工学博士学位，后在清华大学跟随李克强院士从事博士后研究，并赴新加坡南洋理工大学任高级访问学者。长期致力于机器人、智能网联汽车、自动驾驶与协同智能等领域关键技术研发及产业化工作。主持国家自然科学基金重点项目、集成项目，以及科技创新重大项目课题和国家重点研发计划课题等多项国家/省部级科研课题 20 余项。作为第一作者或通讯作者，发表 JCR 1 区、2 区论文 100 余篇，7 篇入选 ESI 高被引论文，谷歌学术引用 4875 余次，H 因子 66，获最佳论文奖 15 次。作为第一发明人，获授权发明专利 30 余件，其中美国专利 2 件。现任智能汽车安全技术全国重点实验室学术委员会委员、中国指挥与控制学会理事、安徽省机器人学会监事长、安徽省机器人学会青年工作委员会主任。入选安徽省“特支计划”创新领军人才计划，获安徽省自然科学基金杰出青年项目资助，荣获安徽省科技进步一等奖等及省部级奖项 10 项以及多项个人学术奖励。他还担任 IEEE TNNLS 和 TASE 两大人工智能领域顶级 SCI 期刊的副主编，《国际先进机器人系统》知名 SCI 期刊的副主编，两次 EI 期刊编委，九次领域主席和客座主编。曾多次受邀参加国际和国内会议发表演讲，次数超过 5 次。



宋东鉴，吉林大学汽车工程学院副教授、博士生导师，吉林省高层次人才，吉林大学“唐敖庆青年学者”，现任吉林大学汽车工程学院汽车工程系副主任。本科毕业于吉林大学汽车工程学院车辆工程专业，博士毕业于吉林大学汽车工程学院车辆工程专业。2024年8月至今任吉林大学汽车工程学院副教授、博士生导师，2025年4月至今任汽车工程系副主任。主要从事汽车智能化技术研究，研究方向包括智能汽车环境感知、态势认知与决策控制、端到端自动驾驶、自动驾驶视觉语言模型与视觉语言动作模型、智能体与世界模型、基于第三代神经网络的类脑自动驾驶、专家在环与长尾场景驱动的模式可持续进化、非结构化道路自动驾驶、多车协同感知与决策控制，以及驾驶人生理—心理—行为分析与表征等。近5年主持和参加省部级以上科研项目10余项，包括国家自然科学基金项目、吉林省重大科技专项课题、吉林省自然科学基金项目、长春市国家重点实验室重大专项，以及国家重点研发计划课题等。作为第一责任作者，他在国内外高水平学术期刊发表论文20余篇，授权发明专利20余项。相关代表性成果发表于 *IEEE Transactions on Intelligent Transportation Systems*、*Expert Systems with Applications*、*Automotive Innovation* 等期刊。其科研与学术成果曾获吉林省科学技术进步奖一等奖、中国汽车工程学会科学技术进步一等奖、中国汽车工程学会优秀博士学位论文、《汽车工程》年度优秀论文、ESI全球高被引论文等科技奖励与学术荣誉；同时曾获教育部“全国高校百名研究生党员标兵”、共青团中央“全国向上向善好青年”、全国优秀共青团员、中国大学生自强之星等荣誉。



王亚飞，上海交通大学机械与动力工程学院教授、博士生导师，现任智能汽车研究所教师。本科毕业于吉林大学汽车工程学院，硕士毕业于上海交通大学机械与动力工程学院，博士毕业于日本东京大学。2008年至2009年曾任德尔福中国科技研发中心电子与安全部门工程师；2013年至2016年在日本东京大学新领域创成研究科从事博士后研究；主要从事智能网联汽车与自动驾驶方向研究，研究方向包括特种车辆无人驾驶、无人驾驶建图与规划、端到端自动驾驶、车路协同等。其承担的科研项目包括国家自然科学基金

基金联合基金重点项目、国家自然科学基金面上项目、国家自然科学基金青年项目、国家重点研发计划课题、科技创新特区项目、上海市经信委软件与集成电路专项、上海市经信委工业强基项目，以及多项面向矿山、园区物流、自动驾驶测试、车路协同、路径规划、数字孪生和多传感器融合的企业合作项目。在自动驾驶领域发表中英文论文 100 余篇，其中包括 ESI 热点论文 1 篇、高被引论文 3 篇；授权中外发明专利 50 余件；主编或参编国家标准 7 项、行业标准 1 项、团体标准 12 项。其科研成果曾获 2025 年机械工业科学技术发明一等奖、2025 年中国智能交通协会科技进步一等奖、2024 年上海市技术发明一等奖、2024 年日内瓦国际发明金奖，以及 IEEE/ASME AIM 最佳会议论文提名奖、IEEE ICUS 最佳会议论文奖、SAE Intelligent and Connected Vehicles Symposium 最佳会议论文奖、日本自动车技术协会研究奖励等。其学术兼职包括《IEEE Vehicular Technology Magazine》副主编、《ASME Journal of Dynamic Systems, Measurement and Control》副主编、《汽车工程学报》编委、《中国公路学报》青年编委、《汽车工程》青年编委、中国人工智能学会智能驾驶专业委员会委员、中国自动化学会车辆控制与智能化专业委员会委员等。

特邀专题简介

自动驾驶系统在走向真实开放道路的过程中，面临着高度的复杂性与多维度的不确定性。实际交通环境中，不仅存在因传感器噪声、目标遮挡和高精地图缺失带来的感知信息不完整，还包含交通参与者行为的随机性、极端天气的影响以及罕见的长尾场景。这些不确定性因素对自动驾驶车辆的场景理解、交互博弈、未来轨迹预测以及安全运动规划提出了严峻挑战，传统算法在面临这些非理想条件时往往容易产生严重的性能衰减或失效。

在不确定环境中实现鲁棒的预测与规划，是保障自动驾驶系统安全可靠运行的核心。本专题旨在探讨如何有效处理和融合多源/不完整数据，构建高鲁棒性的时空特征表征与多智能体交互模型；同时，探索在复杂物理约束和动态博弈环境下，如何利用先进的机器学习、大模型技术或传统优化方法，生成安全、高效且符合交通规则的计划控制指令。本专题将致力于全面提升自动驾驶系统在未知、复杂和极端条件下的可靠性、适应性与安全底线。

本特邀专题邀请以下与“不确定环境下的自动驾驶鲁棒预测与规划”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。

- 复杂环境下的轨迹预测与意图推理
- 不完整观测下的无图自动驾驶
- 应对不确定性的多智能体交互建模
- 风险感知的安全运动规划与决策
- 数据与规则融合的鲁棒规划控制
- 基础大模型在预测与规划中的应用
- 真实交通场景的系统应用与验证

IEEE ICUS 2026
Invited Session Summary

Title of Session

Robust Prediction and Planning for Autonomous Driving in Uncertain
Environments

Organizers

1. Prof. Hongbo Gao

University of Science and Technology of China

2. Assoc. Prof. Dongjian Song

Jilin University, China

3. Prof. Yafei Wang

Shanghai Jiao Tong University, China

Biosketches of Organizers



Dr. Hongbo Gao, Researcher and Doctoral Supervisor, University of Science and Technology of China, is a recipient of the National Cyberspace Innovation Talent Support Program. He received the Ph.D. degree in Computer Application Technology from Beihang University in 2016 under the supervision of Academician Deyi Li. He subsequently worked at Tsinghua University as a postdoctoral researcher under the guidance of Academician Keqiang Li, and served as a Visiting Research Fellow at Nanyang Technological University, Singapore. He has long been dedicated to the research and industrialization of key technologies in fields such as robotics, intelligent connected vehicles, autonomous driving, and collaborative intelligence. He has presided over more than 20 national, provincial, and ministerial research projects, including Key Programs and Integrated Programs of the National Natural Science Foundation of China (NSFC), subjects of Major Science and Technology Innovation Projects, and subjects of the National Key Research and Development Program of China. As first author or corresponding author, he has published over 100 papers in JCR Q1 and Q2 journals, 7 of which are ESI Highly Cited Papers. He has received more than 4,875 citations on Google Scholar, with an h-index of 66, and has won 15 Best Paper Awards. As the first inventor, he holds over 30 granted invention patents, including 2 US patents. He currently serves as a member of the Academic Committee of the National Key Laboratory of Intelligent Vehicle Safety Technology, a council member of the Chinese Institute of Command and Control (CICC), the Supervisor-General of the Anhui Robotics Society, and the Director of the Youth Working Committee of the Anhui Robotics Society. He was selected as the Innovation Leading Talent of Anhui Province TeZhi Plan, supported

by the Anhui Province Natural Science Funds for Distinguished Young Scholar, and awarded the First Prize of Anhui Provincial Science and Technology Progress Award, together with 10 provincial and ministerial-level awards and several individual academic honors. He also serves as an Associate Editor for two top-tier SCI journals in artificial intelligence: *IEEE Transactions on Neural Networks and Learning Systems* (TNNLS) and *IEEE Transactions on Automation Science and Engineering* (TASE), as well as for the well-known SCI journal *International Journal of Advanced Robotic Systems*. He has twice served as an editorial board member for EI-indexed journals, and nine times as an Area Chair and Guest Editor. He has been invited to deliver more than 5 talks at international and domestic conferences.



Dr. Dongjian Song, Associate Professor and Doctoral Supervisor, Jilin University, is a Jilin Provincial High-Level Talent and a Tang Aoqing Young Scholar of Jilin University. He currently serves as Deputy Head of the Department of Automotive Engineering at the College of Automotive Engineering, Jilin University. He received his B.E. degree from the College of Automotive Engineering, Jilin University, and his Ph.D. degree in Vehicle Engineering from the College of Automotive Engineering, Jilin University. Since August 2024, he has served as Associate Professor and Doctoral Supervisor at the College of Automotive Engineering, Jilin University. Dr. Song is mainly engaged in research on intelligent vehicle technologies. His research interests include intelligent vehicle environmental perception, situational awareness and decision control, end-to-end autonomous driving, vision-language models and vision-language-action models for autonomous driving, agents and world models, brain-inspired autonomous driving based on third-generation neural networks, expert-in-the-loop and long-tail-scenario-driven sustainable model evolution, autonomous driving on unstructured roads, multi-vehicle cooperative perception and decision control, and the analysis and representation of drivers' physiological, psychological, and behavioral characteristics. He has led and participated in more than ten provincial-, ministerial-, and national-level research projects, including projects funded by the National Natural Science Foundation of China, Major Science and Technology Projects of Jilin Province, the Natural Science Foundation of Jilin Province, major special projects of national key laboratories in Changchun, and tasks under the National Key R&D Program of China. As the lead author, he has published more than 20 papers in high-level domestic and international academic journals and has been granted more than 20 invention patents. His representative works have appeared in journals such as *IEEE Transactions on Intelligent Transportation Systems*, *Expert Systems with Applications*, and *Automotive Innovation*. His scientific research and academic

achievements have received awards and honors including the First Prize of the Jilin Province Science and Technology Progress Award, the First Prize of the Science and Technology Progress Award of the China Society of Automotive Engineers, the Excellent Doctoral Dissertation Award of the China Society of Automotive Engineers, the Annual Excellent Paper Award of Automotive Engineering, and an ESI Highly Cited Paper. He has also been honored as one of the National Top 100 Model Graduate Student Party Members in Higher Education Institutions by the Ministry of Education, a National Upward and Good Youth by the Central Committee of the Communist Youth League, a National Excellent Communist Youth League Member, and a China College Students' Self-Reliance Star.



Dr. Yafei Wang, Professor and Doctoral Supervisor, Shanghai Jiao Tong University, is currently a faculty member of the Institute of Intelligent Vehicles. He received his B.E. degree from the College of Automotive Engineering, Jilin University, his M.E. degree from the School of Mechanical Engineering, Shanghai Jiao Tong University, and his Ph.D. degree from The University of Tokyo, Japan. From 2008 to 2009, he worked as an engineer in the Electronics and Safety Division of Delphi China Technical Center. From 2013 to 2016, he conducted postdoctoral research at the Graduate School of Frontier Sciences, The University of Tokyo. Dr. Wang is mainly engaged in research on intelligent connected vehicles and autonomous driving. His research interests include unmanned driving for special-purpose vehicles, autonomous driving mapping and planning, end-to-end autonomous driving, and vehicle-infrastructure cooperation. His research projects include an NSFC Joint Fund Key Project, NSFC General Program projects, an NSFC Young Scientists Fund project, tasks under the National Key R&D Program of China, projects under the Science and Technology Innovation Special Zone Program, the Software and Integrated Circuit Special Project of the Shanghai Municipal Commission of Economy and Informatization, the Industrial Foundation Strengthening Project of the Shanghai Municipal Commission of Economy and Informatization, as well as multiple industry-sponsored projects on mining autonomous driving, logistics-park autonomous driving, autonomous driving testing, vehicle-infrastructure cooperation, path planning, digital twins, and multi-sensor fusion. He has published more than 100 Chinese and English papers in the field of autonomous driving, including one ESI Hot Paper and three Highly Cited Papers. He has been granted more than 50 Chinese and international invention patents, and has led or participated in the preparation of seven national standards, one industry standard, and twelve group standards. His research achievements have received honors including the First Prize of the Machinery Industry Science and

Technology Invention Award in 2025, the First Prize of the Science and Technology Progress Award of the China Intelligent Transportation Systems Association in 2025, the First Prize of the Shanghai Technological Invention Award in 2024, the Gold Medal at the Geneva International Exhibition of Inventions in 2024, the Best Conference Paper Finalist Award at IEEE/ASME AIM, the Best Conference Paper Award at IEEE ICUS, the Best Paper Award at the SAE Intelligent and Connected Vehicles Symposium, and the Research Encouragement Award of the Society of Automotive Engineers of Japan. His academic services include serving as an Associate Editor of *IEEE Vehicular Technology Magazine*, an Associate Editor of *ASME Journal of Dynamic Systems, Measurement, and Control*, an editorial board member of *Chinese Journal of Automotive Engineering*, a Promotion Editor of *China Journal of Highway and Transport* and *Automotive Engineering*, a member of the Intelligent Driving Professional Committee of the Chinese Association for Artificial Intelligence, and a member of the Technical Committee on Vehicle Control and Intelligence of the Chinese Association of Automation.

Details of Session

As autonomous driving systems advance toward real-world open roads, they encounter high complexity and multi-dimensional uncertainties. Practical traffic scenarios involve not only incomplete perception information—such as sensor noise, target occlusions, and the absence of high-definition maps—but also the behavioral randomness of traffic participants, the impact of adverse weather conditions, and rare edge cases. These uncertainty factors pose severe challenges to scene understanding, interactive game-theoretic modeling, future trajectory prediction, and safe motion planning. Traditional algorithms often suffer from severe performance degradation or failure when faced with these non-ideal conditions.

Achieving robust prediction and planning in uncertain environments is core to ensuring the safe and reliable operation of autonomous driving systems. This session aims to explore how to effectively process and fuse multi-source or incomplete data to construct highly robust spatiotemporal representations and multi-agent interaction models. Furthermore, it seeks to investigate how advanced machine learning, foundation models, or traditional optimization methods can be utilized under complex physical constraints and dynamic interactive environments to generate safe, efficient, and rule-compliant planning and control commands. This session is dedicated to comprehensively enhancing the reliability, adaptability, and safety baseline of autonomous systems in unknown, complex, and extreme conditions.

This invited session invites original papers presenting innovative ideas and concepts, new discoveries and improvements, and novel applications related to the topic of

“Robust Prediction and Planning for Autonomous Driving in Uncertain Environments.”

- Trajectory prediction and intent reasoning in complex environments
- Map-free autonomous driving under incomplete observations
- Multi-agent interaction modeling under uncertainty
- Risk-aware safe motion planning and decision-making
- Robust planning integrating data-driven and rule-based methods
- Applications of foundation models in prediction and planning
- System application and validation in real-world scenarios