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
交通巡检自主机器人关键技术与应用

| 组织者 |
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| 1.秦勇，教授，北京交通大学 |
| 2.王志鹏，教授，北京交通大学 |
| 3.于重重，教授，北京工商大学 |
| 4.耿毅轩，讲师，北京交通大学 |

个人简介

秦勇，博士，教授，博士生导师，先进轨道交通自主运行全国重点实验室副主任，国家万人计划科技创新领军人才，全国优秀科技工作者，科技部中青年科技创新领军人才，教育部新世纪优秀人才，俄罗斯工程院外籍院士，国家十三五重点研发计划"综合交通运输与智能交通"重点专项总体专家组专家。主要研究领域为轨道交通运营安全保障与应急指挥、列车智能故障诊断、智能轨道交通系统等。

王志鹏，博士，交通运输学院/先进轨道交通自主运行全国重点实验室教授，博士生导师。长期从事复杂装备系统智能化感知和健康管理技术的研究与教学，近三年主持参与了国家重点研发计划任务、国家自然基金重大研究计划集成项目、国家自然基金重点项目、国家重点研发计划、北京市自然基金等国家级课题。发表 IEEE Transactions 等高水平 SCI 论文 50 余篇，获得国防科技进步奖二等奖，国际发明联合会（IFIA）发明金奖，IBIX 英国国际发明创新技术展金奖。
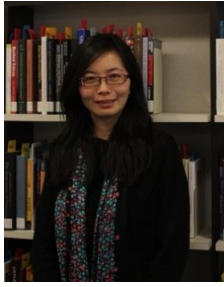
于重重，博士，教授，博士生导师，北京工商大学人工智能学院院长。现任北京工商大学数据科学与人工智能学部主任，系统科学一级学科带头人、中国仿真学会理事、北京人工智能学会常务理事、工业互联网战略咨询专家委员会委员、CAAI 智能产品与产业工作委员会常务委员、CAA 女科技者委员会委员、CAA 专家咨询委员会委员、中国轻工业工业互联网与大数据重点实验室主任。获建设部和科技部"国家九五科技攻关项目"科技成果奖 1 项、中国自动化学会教育教学成果二等奖 1 项，中国轻工业联合会科技进步奖三等奖 1 项，中国职业安全健康协会科学技术奖二等奖 1 项。主持国家重点研发计划课题、国家社会科学基金重大项目子课题等课题多项。

耿毅轩，博士，北京交通大学讲师。其研究领域聚焦于基于无人飞行机器人的高速铁路自主巡检、3D 点云处理和语义分析、同时定位与映射（SLAM）技术，以及利用增强学习开发群体智能（SI）系统以执行复杂任务。曾主持或参与国家重点研发计划、国家自然科学基金重大研究计划、中央高校基本科研业务费科研专项等多项科研课题，并在 IEEE TII，IEEE TITS 等顶级期刊上发表多篇高影响力的学术论文，获得日内瓦国际专利发明展览会金奖。

特邀专题简介

随着自动化和智能化技术的快速发展，自主机器人在交通巡检领域的应用越来越广泛，成为确保交通系统高效、安全运行的关键技术之一。自主机器人能够在各种环境条件下执行监测、检测和维护任务，特别是在对人员可能构成风险的环境中，如高速公路、桥梁、隧道及铁路系统等，展现出其独特的价值。它们能够搭载多种传感器，如视觉、热成像和声波传感器，进行实时数据采集和处理，从而实现对交通基础设施的持续监控和评估，有效提升了交通系统的安全性和可靠性。此外，结合人工智能和深度学习算法，自主机器人在数据分析、故障诊断和决策支持方面的能力得到了极大增强，为交通系统的预防性维护和优化管理提供了有力支持。

本特邀专题致力于探索交通巡检自主机器人的关键技术、创新发展及应用案例，重点关注自主机器人如何在交通系统的巡检、监控和维护中发挥作用，

以及如何通过技术进步提高交通系统的整体性能和安全水平。我们诚邀全球的研究者、工程师、学者和行业专家就以下主题提交原创论文：

- 自主机器人在交通基础设施巡检和维护中的技术和应用
- 交通安全评估和灾害响应中自主机器人的作用
- 高精度和实时数据采集技术在交通系统监测中的应用
- 人工智能和深度学习在自主机器人交通应用中的集成和创新
- 先进图像和信号处理技术在交通基础设施管理和损害评估中的应用
- 自主机器人在交通规划、建设和环境监测中的应用
- 自主机器人在交通系统应急管理中的应用，包括灾害风险评估、预警、事故响应和恢复计划
- 自主机器人系统的设计、测试和优化，以满足交通系统独特的需求和挑战

IEEE ICUS 2024
Invited Session Summary

Title of Session
Key Technologies and Applications of Autonomous Robots for Traffic Inspection

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| **Organizers** |
| **1. Prof. Yong Qin** |
| Beijing Jiaotong University, China |
| **2. Prof. Zhipeng Wang** |
| Beijing Jiaotong University, China |
| **3. Prof. Chongchong Yu** |
| Beijing Technology and Business University, China |
| **4. Dr. Yixuan Geng** |
| Beijing Jiaotong University, China |

Biosketches of Organizers

Yong Qin, Ph.D., Professor, Doctoral Supervisor, Deputy Director of the National Key Laboratory for Advanced Rail Transportation Autonomous Operation, National "Ten Thousand Talent Program" Leading Talent in Scientific and Technological Innovation, National Outstanding Scientific and Technical Worker, Ministry of Science and Technology's Mid-Young Age Science and Technology Innovation Leading Talent, Ministry of Education's New Century Excellent Talent, Foreign Member of the Russian Academy of Engineering, and an expert in the General Expert Group of the National "Thirteenth Five-Year Plan" Key R&D Program "Comprehensive Transportation and Intelligent Transportation" Key Project. His main research areas include operational safety assurance and emergency command for rail transportation, intelligent fault diagnosis for trains, and intelligent rail transportation systems.

Zhipeng Wang, Ph.D., Professor at the School of Transportation and the National Key Laboratory for Advanced Rail Transportation Autonomous Operation, Doctoral Supervisor. He has long been engaged in research and teaching related to intelligent perception and health management technologies for complex equipment systems. In the past three

years, he has led or participated in national key research and development plan tasks, major research program integration projects of the National Natural Science Foundation, key projects of the National Natural Science Foundation, national key research and development programs, Beijing Municipal Natural Science Foundation, and other national-level projects, directing over 20 million yuan in national research funds. He has published more than 50 SCI papers and received a gold medal at an international patent invention exhibition and the second prize of the National Defense Science and Technology Progress Award.
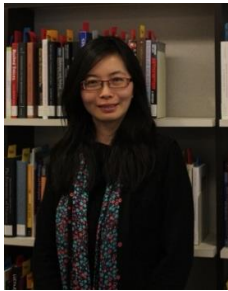
Chongchong Yu, Ph.D., Professor, Doctoral Supervisor, and Dean of the School of Artificial Intelligence at Beijing Technology and Business University. He currently holds the position of Director of the Data Science and Artificial Intelligence Division at Beijing Technology and Business University, leader of the first-level discipline of System Science, a director of the China Simulation Society, an executive director of the Beijing Artificial Intelligence Society, a member of the Industrial Internet Strategy Advisory Expert Committee, an executive member of the CAAI Intelligent Products and Industry Working Committee, a member of the CAA Women in Science and Technology Committee, a member of the CAA Expert Advisory Committee, and the Director of the Key Laboratory for Industrial Internet and Big Data of China Light Industry. He has received a Science and Technology Achievement Award for the "National Ninth Five-Year Plan Science and Technology Project" from the Ministry of Construction and the Ministry of Science and Technology, a Second Prize for Educational and Teaching Achievement from the Chinese Association of Automation, a Third Prize for Scientific and Technological Progress from the China Light Industry Federation, and a Second Prize for Science and Technology from the China Occupational Safety and Health Association. He has led several projects, including national key R&D program projects and sub-projects of major projects funded by the National Social Science Fund.

Yixuan Geng, Ph.D., Lecturer at Beijing Jiaotong University. His research focuses on autonomous inspection of high-speed railways using unmanned aerial robots, 3D point cloud processing and semantic analysis, Simultaneous Localization and Mapping (SLAM) technology, and the development of Swarm Intelligence (SI) systems for complex tasks using reinforcement learning. He has led or participated in several research projects, including national key research and development programs, major research programs of the National Natural Science Foundation, and special research funds for basic scientific research in central universities. He has published multiple high-impact academic papers in top journals such as IEEE TII and IEEE TITS and received a gold medal at the Geneva International Patent Invention Exhibition.

Details of Session

With the rapid development of automation and intelligent technologies, the application of autonomous robots in the field of traffic inspection is becoming increasingly widespread, emerging as one of the key technologies for ensuring the efficient and safe operation of transportation systems. Autonomous robots are capable of performing monitoring, detection, and maintenance tasks under various environmental conditions, especially in environments that may pose risks to human personnel, such as highways, bridges, tunnels, and railway systems, showcasing their unique value. They can carry a variety of sensors, such as visual, thermal imaging, and acoustic sensors, to collect and process real-time data, thereby achieving continuous monitoring and assessment of transportation infrastructure, effectively enhancing the safety and reliability of transportation systems. Moreover, combined with artificial intelligence and deep learning algorithms, the capabilities of autonomous robots in data analysis, fault diagnosis, and decision support have been greatly enhanced, providing strong support for the preventive maintenance and optimization management of transportation systems.

This special topic is dedicated to exploring the key technologies, innovative developments, and application cases of autonomous robots for traffic inspection, focusing on how autonomous robots play a role in the inspection, monitoring, and maintenance of transportation systems, and how technological advancements can improve the overall performance and safety level of transportation systems. We

cordially invite researchers, engineers, scholars, and industry experts from around the world to submit original papers on the following topics:

- Technologies and applications of autonomous robots in the inspection and maintenance of transportation infrastructure
- The role of autonomous robots in traffic safety assessment and disaster response
- The application of high-precision and real-time data collection technologies in traffic system monitoring
- Integration and innovation of artificial intelligence and deep learning in autonomous robot applications for traffic
- Advanced image and signal processing technologies in the management and damage assessment of transportation infrastructure
- Applications of autonomous robots in traffic planning, construction, and environmental monitoring
- Applications of autonomous robots in emergency management of transportation systems, including disaster risk assessment, early warning, accident response, and recovery planning
- The design, testing, and optimization of autonomous robot systems to meet the unique needs and challenges of transportation systems