

2024 第七届 IEEE 国际无人系统大会 特邀专题简介表

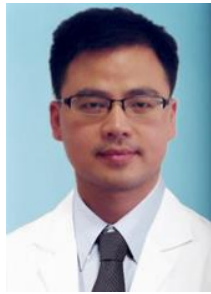
特邀专题名称

自主医疗机器人系统关键技术

组织者

1. 朱正志，副教授，中国科学技术大学
2. 鹿楠楠，副教授，中国科学技术大学
3. 周林，博士后研究员，中国科学技术大学

个人简介



朱正志，男，中国科学技术大学附属第一医院西区（安徽省肿瘤医院）头颈肿瘤外科、乳腺诊疗中心副主任医师，肿瘤学博士。主要从事肿瘤外科临床和基础研究工作，擅长于甲状腺肿瘤的外科治疗，乳腺良性肿瘤乳晕小切口切除及微创旋切，乳管镜检查，乳腺癌根治术、保乳、保腋（前哨淋巴结活检）、乳腺肿瘤整形及重建等乳腺外科手术及综合治疗。2018 年中国医师协会举办的“指尖上艺术”乳腺癌手术视频大赛北中国区冠军，全国总决赛第四名。近年来重点关注乳腺癌新辅助治疗系列研究，肿瘤整形技术在乳腺外科手术中应用，AI 技术在肿瘤影像诊断和病理图像识别中应用，机器人辅助技术在肿瘤外科手术和操作中应用。担任安徽省医学会肿瘤学分会内分泌外科学组委员、乳腺病分会青年委员，安徽省抗癌协会肿瘤内分泌治疗委员会常委兼秘书长、甲状腺癌专业委员会常委、乳腺癌专业委员会委员，安徽省医师协会微无创医学专业委员会委员，安徽省全科医学会甲状腺乳腺外科分会副主任委员兼秘书，安徽省预防医学会肿瘤预防与控制委员会委员，安徽省农村贫困人口大病专治乳腺癌专家组成员。主持课题 3 项，发表相关学术论文 10 余篇。安徽省科学技术进步奖一项、安徽省医学科学技术奖一项，安徽省蚌埠市科技进步一等奖一项。



鹿楠楠，女，中科大附一院肿瘤内科副主任医师，肿瘤学博士学位，中国科学技术大学博士后，美国 Mary Washington Hospital 访问学者。药物 1 期临床试验中心副主任医师（兼职）。中国科学技术大学和蚌埠医学院硕士研究生导师。中国科学技术大学附属第一医院博士后工作站导师。先后获安徽省第一届卫生健康“骨干人才”、中科大附一院“杰出中青年人才”、“优秀博士”、“最佳贡献-个人奖”、“单篇优秀论文奖”等省部级和院级人才项目和荣誉称号。“精准药物制剂与临床药学”安徽省重点实验室骨干成员。目前兼任安徽省医学会乳腺病学分会委员、安徽省老年医学学会乳腺专业委员会青年委员、安徽省药学会精准药物治疗专业委员会委员。作为项目负责人先后主持 7 项国家级和省部级课题，其中国家自然科学基金 1 项、中国博士后科学基金面上项目 1 项、安徽省自然科学基金 2 项，安徽省博士后基金 1 项。参与国家级和省部级课题共 5 项。作为 Key Sub-I 和 Sub-I 在研 30 项国际、国内多中心临床试验。共发表专业学术论文 20 余篇，包含 J. Control. Release、ACS Appl. Mater. Interfaces 等国际著名期刊，其中以第一作者或通讯作者发表 IF 5 分以上 SCI 文章 6 篇（其中 JCR 1 区 5 篇），最高 IF 11.5 分，累计影响因子愈 50 分。在 SCI 期刊担任 Guest Editors 等学术职务。参编 3 部肿瘤学学术专著。教育部学位论文评审专家。熟悉常见恶性肿瘤的个体化诊疗路径，特别是恶性肿瘤的个体化多途径化疗、精准靶向/免疫治疗，长期致力于乳腺癌的个体化靶向和免疫治疗。基础研究方向为肿瘤微环境响应性纳米载药体系的构建及抗肿瘤作用机制研究。



周林，男，中国科学技术大学信息科学技术学院博士后研究员，2023 年毕业于中国科学技术大学，获得控制科学与工程博士学位。主要从事生物信息学和深度学习在精准医疗中的应用研究，共发表专业学术论文 10 余篇。

特邀专题简介

随着科技进步的步伐日益加快，尤其在信息技术、人工智能与精密制造等领域取得的重大突破，医疗领域正经历着一场前所未有的变革，朝着智能化、精准化和个性化的方向迈进。在此背景下，自主医疗机器人系统以其卓越的技

术优势和广阔的应用前景，成为推动医疗技术创新与发展的重要战略支点。它不仅能够解决传统医疗服务中面临的诸多难题，如人力资源短缺、操作误差风险、劳动强度大等问题，还极大地拓展了医疗服务的可能性边界，使得更为精细化、精准化的医疗服务得以实现。本特邀专题围绕自主医疗机器人系统这一核心议题，深度剖析其所涵盖的关键技术及其在近年来取得的显著研究成果。我们将重点研讨医疗机器人在诸如手术室内的精准操作、病房内的个性化护理、康复过程中的辅助治疗，乃至药房自动化服务等多元医疗场景下的应用实践和技术挑战。同时，也将详尽呈现自主医疗机器人系统在环境感知、智能决策、精确运动控制、多模态信息融合、以及人性化交互设计等方面的先进技术手段与解决方案。期待能够进一步激发自主医疗机器人系统技术研发的新思路，促进其在多个医疗细分领域的广泛应用与持续优化升级，从而引领医疗行业步入更高层次的智能化时代，切实提高医疗服务质量和效率，造福广大病患群体和社会公众。

专题涵盖但不限于以下几个核心研究方向：

- 医疗机器人人工智能技术
- 医疗机器人精准导航与操控技术
- 医疗机器人多模态信息融合技术
- 医疗机器人新型传感与驱动技术
- 医疗机器人人机交互与协作技术
- 医疗设备自主化设计和开发

IEEE ICUS 2024

Invited Session Summary

Title of Session

Key Technologies of Autonomous Medical Robot Systems

Organizers

1. Assoc. Prof. Zhengzhi Zhu

University of Science and Technology of China

2. Assoc. Prof. Nannan Lu

University of Science and Technology of China

3. Dr. Lin Zhou

University of Science and Technology of China

Biosketches of Organizers



Zhengzhi Zhu is an Associate Chief Physician in the Department of Head and Neck Tumor Surgery and the Breast Diagnosis and Treatment Center at the West Campus of the First Affiliated Hospital of the University of Science and Technology of China (Anhui Provincial Tumor Hospital). He holds a doctoral degree in oncology. His main focus is on clinical and basic research in tumor surgery, with expertise in surgical treatment of thyroid tumors, minimally invasive surgery for benign breast tumors through small areolar incision and nipple-sparing techniques, ductoscopy, radical mastectomy for breast cancer, breast-conserving surgery, axillary lymph node dissection (sentinel lymph node biopsy), breast tumor reconstruction, and comprehensive treatment of breast diseases. In 2018, he won the North China Regional Champion and ranked fourth in the national finals of the "Art on the Fingertips" Breast Cancer Surgery Video Competition organized by the Chinese Medical Doctor Association. In recent years, his research has focused on neoadjuvant therapy for breast cancer, the application of tumor reconstruction techniques in breast surgery, the application of AI technology in tumor imaging diagnosis and pathological image recognition, and the application of robot-assisted techniques in tumor surgery and operations. He serves as a committee member of the Endocrine Surgery Group of the Oncology Branch of the Anhui Medical Association, the youth committee member of the Breast Disease Branch, the standing member and secretary-

general of the Endocrine Treatment Committee of the Anhui Anti-Cancer Association, the standing member of the Thyroid Cancer Professional Committee, the member of the Breast Cancer Professional Committee, the member of the Microinvasive Medical Professional Committee of the Anhui Medical Doctor Association, the deputy director and secretary of the Thyroid and Breast Surgery Branch of the Anhui General Practitioners Association, the member of the Tumor Prevention and Control Committee of the Anhui Preventive Medicine Association, and a member of the Breast Cancer Expert Group for the treatment of major diseases in rural poor populations in Anhui Province. He has presided over three projects and published more than ten related academic papers. He has been awarded the Anhui Province Scientific and Technological Progress Award, the Anhui Medical Science and Technology Award, and the First Prize for Scientific and Technological Progress in Bengbu City, Anhui Province.



Dr. Nannan Lu is a female associate chief physician in the Department of Oncology at the First Affiliated Hospital of the University of Science and Technology of China (USTC). She holds a doctoral degree in oncology and is a postdoctoral researcher at USTC, with a visiting scholar experience at Mary Washington Hospital in the United States. She is also the deputy director physician (part-time) of the Phase I Clinical Trial Center for Drugs. She serves as a master's supervisor at USTC and Bengbu Medical College. Dr. Lu has been awarded various provincial and ministerial talent projects and honors, such as the "Backbone Talent" in the first Anhui Provincial Health and Health Talent Project, "Outstanding Young Middle-aged Talent" and "Outstanding Doctor" at USTC First Affiliated Hospital, "Best Contribution - Individual Award," and "Best Single Paper Award." She is a core member of the Anhui Provincial Key Laboratory of "Precision Drug Formulation and Clinical Pharmacy." Currently, she is a member of the Breast Disease Branch of the Anhui Provincial Medical Association, a young member of the Breast Professional Committee of the Anhui Provincial Geriatrics Medical Association, and a member of the Precision Drug Treatment Professional Committee of the Anhui Provincial Pharmaceutical Association. Dr. Lu has led seven national and provincial-level projects, including one National Natural Science Foundation project, one China Postdoctoral Science Foundation project, and two Anhui Provincial Natural Science

Foundation projects. She has participated in five national and provincial-level projects. As the project leader, she has been responsible for 30 international and domestic multi-center clinical trials as a Key Sub-Investigator and Sub-Investigator. Dr. Lu has published over 20 professional academic papers in journals such as J. Control. Release and ACS Appl. Mater. Interfaces, including six SCI articles with an Impact Factor (IF) of over 5 as the first author or corresponding author (including five in JCR Q1), with the highest IF being 11.5, and a cumulative IF of over 50. She serves as a Guest Editor for SCI journals and has contributed to three academic monographs in oncology. Dr. Lu is an expert in the evaluation of doctoral dissertations appointed by the Ministry of Education. She is familiar with personalized diagnosis and treatment pathways for common malignant tumors, especially individualized multi-pathway chemotherapy, precise targeted/immunotherapy for malignant tumors, and has long been committed to personalized targeted and immunotherapy for breast cancer. Her basic research direction is the construction of tumor microenvironment-responsive nanodrug delivery systems and the study of the mechanism of anti-tumor effects.



academic papers.

Lin Zhou is a male postdoctoral researcher at the School of Information Science and Technology, University of Science and Technology of China (USTC). He graduated from USTC in 2023 with a Ph.D. degree in Control Science and Engineering. His research focuses on the application of bioinformatics and deep learning in precision medicine. He has published over 10 professional academic papers.

Details of Session

With the rapid advancement of technology, especially in information technology, artificial intelligence, and precision manufacturing, the medical field is undergoing an unprecedented transformation towards intelligence, precision, and personalization. In this context, autonomous medical robot systems have become an important strategic pivot driving innovation and development in medical technology. They not only solve many challenges faced by traditional medical services, such as shortages of human resources, risks of operational errors, and high labor intensity but also greatly expand the boundaries of medical services, enabling more refined and precise medical services. This special topic focuses on autonomous medical robot systems, deeply analyzing the key technologies they encompass and the significant research achievements made in recent years. We will discuss in depth the application practices

and technical challenges of medical robots in various medical scenarios, including precise operations in the operating room, personalized care in the ward, auxiliary treatment in the rehabilitation process, and even automated services in the pharmacy. At the same time, we will present in detail the advanced technical means and solutions of autonomous medical robot systems in environmental perception, intelligent decision-making, precise motion control, multimodal information fusion, and personalized interaction design. We hope to further inspire new ideas for the technological development of autonomous medical robot systems, promote their wide application and continuous optimization in various medical subfields, and lead the medical industry into a higher level of intelligence, effectively improving the quality and efficiency of medical services for the benefit of the general public and society.

The special topic covers but is not limited to the following core research directions:

- Artificial intelligence technology for medical robots
- Precision navigation and manipulation technology for medical robots
- Multimodal information fusion technology for medical robots
- New sensing and driving technology for medical robots
- Human-machine interaction and collaboration technology for medical robots
- Autonomous design and development of medical devices