

ICRSA 2026

2026 **9th** International Conference on
ROBOTIC SYSTEMS AND APPLICATIONS

2026年第九届机器人系统与应用国际会议

Huizhou, China **惠州** Oct. 30-Nov. 1, 2026 10月30日-11月1日

Co-Sponsored by



惠州学院
HUIZHOU UNIVERSITY



IEEE

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Welcome Message | 欢迎辞

Dear Distinguished Delegates,

It is our great pleasure and privilege to welcome you all to the 2026 9th International Conference on Robotic Systems and Applications (ICRSA 2026), to be held from October 30 to November 1, 2026, in Huizhou, China. On behalf of the Organizing Committee, we extend our warmest greetings to scholars, researchers, industry experts, and students from around the world joining us at this important academic event.

The conference is co-sponsored by Huizhou University, China, and IEEE. It aims to provide an international platform for researchers and scholars in the field of robotic systems and applications to exchange knowledge, share innovative ideas, and discuss the latest technological advancements. The conference is dedicated to promoting academic communication and collaboration in areas including autonomous and intelligent robotics, robotic control and mechatronics, robot perception and sensing, and other emerging fields.

Over the course of the three days, we are excited to present a comprehensive program featuring keynote speeches by distinguished experts, invited talks, and parallel sessions covering cutting-edge research achievements. Whether you are presenting your latest findings, exploring new research directions, or seeking opportunities for collaboration, your active participation will bring great value to this conference.

We would like to express our sincere appreciation to all those who have contributed to the success of ICRSA 2026—keynote and invited speakers, paper authors, reviewers, technical program committee members, sponsors, and dedicated volunteers. Your efforts and support are the foundation of this conference's success.

We sincerely hope that ICRSA 2026 will provide you with valuable academic insights, inspire new collaborations, and create memorable experiences. May your time with us be both intellectually rewarding and personally meaningful.

Yours sincerely,
Conference Organizing Committee

Organization Committee | 委员会

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Zhongtao Fu, Wuhan Institute of Technology, China

Conference Venue | 会议地点

Crowne Plaza Huizhou by IHG | 惠州皇冠假日酒店

Address: No. 8 Huangguan Road, Shuikou Subdistrict, Huicheng District, Huizhou, Guangdong, 516002, China

地址: 广东省惠州市惠城区水口街道皇冠路 8 号



Note

Accommodation is not included in the registration fee.

注册费中不包含住宿,需自行安排住房

酒店协议价: RMB500 元/夜 (含 1-2 早)

预订电话: 18819668171 罗女士

Transportation 交通指南 (仅供参考)



From Huizhou Pingtan Airport | 从惠州平潭机场

By taxi: Around 27 minutes | 出租车: 大约 27 分钟



From Huizhou North Railway Station | 从惠州北站

By taxi: Around 24 minutes | 出租车: 大约 24 分钟



From Huizhou South Railway Station | 从惠州南站

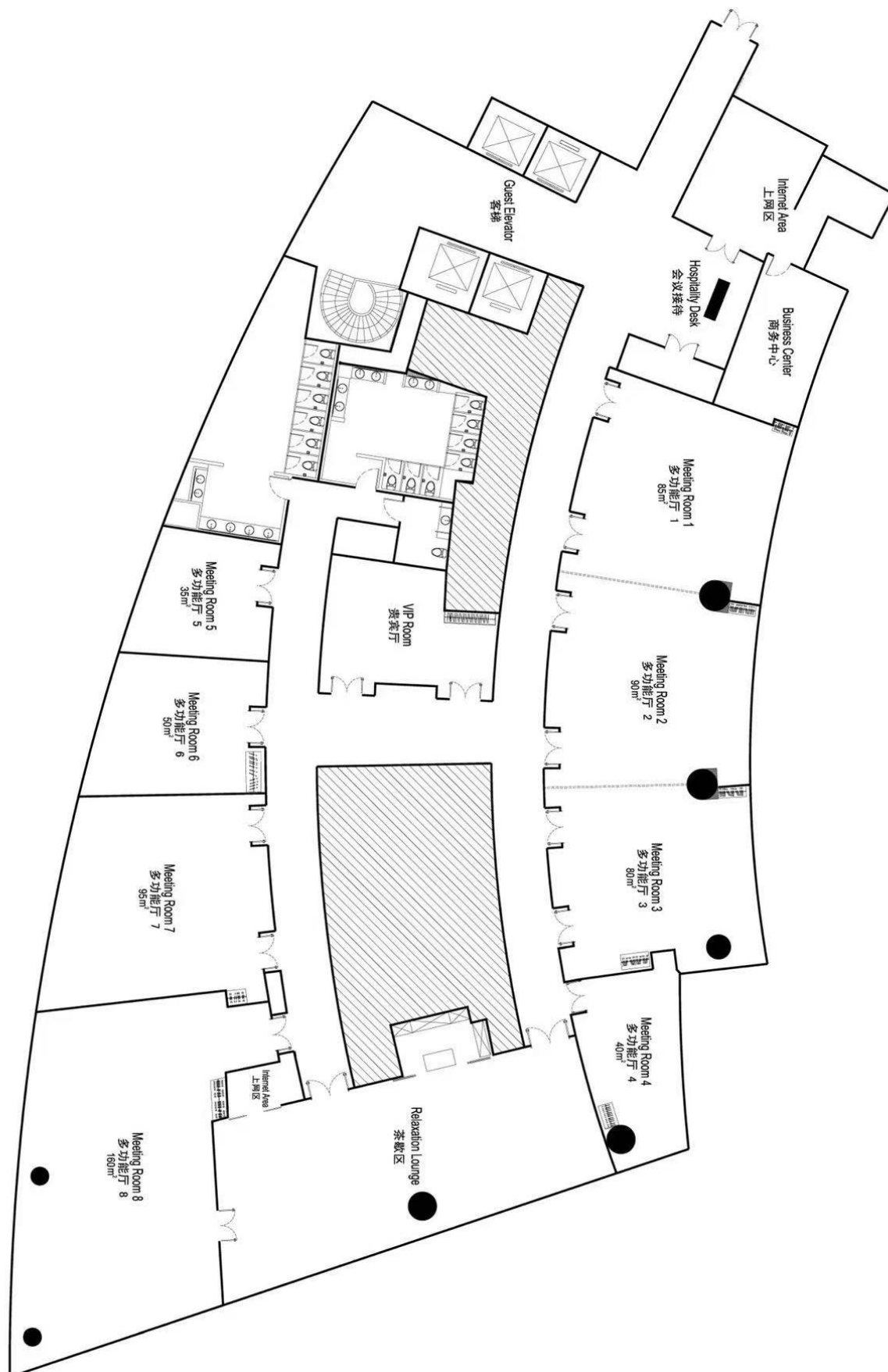
By taxi: Around 16 minutes | 出租车: 大约 16 分钟



From Huizhou Railway Station | 从惠州站

By taxi: Around 16 minutes | 出租车: 大约 16 分钟

Conference Rooms-3rd Floor Plan 会议室平面图 (3楼)



Guideline for Participation | 参会指南

Oral Presentation | 口头报告

- Oral presentation language: English
口头报告语言: 英语
- Regular oral presentation: 15 minutes (including Q&A)
口头报告时间: 15 分钟 (含问答)
- Get your presentation PPT or PDF files prepared. Presentations must be uploaded at the session room at least 15 minutes before the session starts.
请准备好您的演示 PPT 文件 (英语), 提前 15 分钟到达会议室拷贝您的 PPT 至会议电脑。

Poster Presentation | 海报报告

- Please print poster (A1 size, English), and ensure the content is limited to one page. During your poster session, you should stay by the poster to explain and discuss your poster.
请打印 A1 大小海报 (英语), 内容必须在 1 页。在海报展示期间, 请尽量在海报旁边, 以便向参观者解释和讨论您的海报。
- The content must include: paper title, author names and paper ID, the key framework knowledge of the article and other necessary basic information.
内容必须包括: 文章题目, 作者姓名和文章 ID, 文章的重点框架知识等必要基础信息。
- Please prepare a 3-5 minutes presentation of the framework for on-site communication.
请准备 3-5 分钟对海报的讲解以便现场交流。

Important Notes | 注意事项

- Please enter the meeting room at least 15 minutes before your session. Your punctual arrival and active involvement will be highly appreciated.
请至少在会议开始前 15 分钟进入会议室, 并积极参与会议各环节。
- Please wear your name tag for all the conference activities. Lending it to others is not allowed. If you have any accompanying person, please do inform our staff in advance.
会议期间请佩戴代表证进入会场。请勿将代表证转借给他人。如果您有陪同人员, 请提前告知工作人员。
- Please keep all your belongings (laptop and camera etc.) at any time. The conference organizer does not assume any responsibility for the loss of personal belongings.
请随身携带贵重物品 (笔记本电脑和相机等)。本会议不对个人物品的丢失承担任何责任。
- Please show name tag and meal coupons when dining.
就餐时请同时出示代表证与餐券。

Agenda | 会议日程

Day 1- Friday, October 30, 2026

Participants Registration & Conference Kits Collection 会议签到及资料领取 [Hotel Lobby 酒店大厅]	
10:00-17:00	• Tell the staff your Paper ID • Sign your name in the attendance list and confirm meal information. • Collect the conference kit.

Day 2- Saturday, October 31, 2026

Opening Ceremony & Keynote / Invited Speeches 开幕式 & 主旨/特邀报告 [Meeting Room 3-2F 多功能厅 3-2 楼]	
Chaired by Dafeng Long, Huizhou University, China	
09:00-09:10	Opening Remarks 开幕致辞 Xiaohui Wei, Huizhou University, China
09:10-09:20	Conference Group Photo 集体照
Chaired by Weiquan Ni, Huizhou University, China	
09:20-10:00	Keynote Speech I Yongsheng Ou, Dalian University of Technology, China <i>Speech Title: Research on the Complex Skill Learning Method of Embodied Intelligence Robots</i>
10:00-10:40	Keynote Speech II Ning Wang, Dalian Maritime University, China <i>Speech Title: TBA</i>
10:40-11:00	Coffee Break 茶歇
11:00-11:40	Keynote Speech III Hejun Wu, Sun Yat-sen University, China <i>Speech Title: Generative Policy Optimization for Embodied Intelligence</i>
11:40-12:00	Invited Speech I Zhifeng Huang, Guangdong University of Technology, China <i>Speech Title: Flying Humanoid Robots: Structural Innovation, Control, and Experimental Validation</i>
12:00-13:30	Lunch Time Venue: Western restaurant 1F (西餐厅 1 楼)

Invited Speeches | 特邀报告

Chaired by Hongxiang Lin, Huizhou University, China

13:30-13:50	Invited Speech II Mei Li, China University of Geosciences (Beijing) , China <i>Speech Title: Psychological and Emotional Companion Agent Based on MyAI</i>
13:50-14:10	Invited Speech III Heng Wang, South China University of Technology, China <i>Speech Title: Versatile Magnetic Navigation Systems for Precise Medical Robotics</i>
14:10-14:30	Invited Speech IV Cunman Liang, Tianjin University, China <i>Speech Title: Bioinspired Magnetically Actuated Miniature Soft Robots</i>
Chaired by Yunshou Mao, Huizhou University, China	
14:30-14:50	Invited Speech V Yunquan Li, South China University of Technology, China <i>Speech Title: Low-Cost and Highly Sensitive Optical Tactile Sensors for Robotic Force Perception</i>
14:50-15:10	Invited Speech VI Yang Li, Northwestern Polytechnical University, China <i>Speech Title: Adversarial Patch Attacks on Vision Recognition</i>
15:10-15:30	Invited Speech VII Peng Chen, Shantou University, China <i>Speech Title: Collaborative Representation and Decoupling for Fault Diagnosis of Robotic and Mechatronic Systems under Transient Interference and Multi-Source Coupling</i>
15:30-15:50	Invited Speech VIII Yukang Cui, Shenzhen University, China <i>Speech Title: Multi-Sensor Fusion for UAV-Based Perception and 3D Reconstruction in Dense Forest Environments</i>
15:50-16:10	Coffee Break 茶歇

Parallel Sessions | 平行分会

16:10-18:10	Technical Session 1: Machine Vision & Intelligent Perception RS049, RS652, RS848, RS358, RS542, RS590, RS916, RS740	Meeting Room 3 多功能厅 3 (2F)
16:10-18:10	Technical Session 2: Robot Motion Planning, Control & Human-Robot Interaction RS997, RS937, RS369, RS760, RS224, RS741, RS420, RS545	Meeting Room 1 多功能厅 1 (3F)

16:10-18:10	Technical Session 3: Intelligent Optimization, Robotic Platforms and Mechatronic Systems RS263, RS694, RS332, RS418, RS773, RS075, RS988, RS696	Meeting Room 2 多功能厅 2 (3F)
16:10-17:10	Poster Session 1: Intelligent Perception, Fault Diagnosis and Sensing Systems RS002, RS004, RS810, RS593, RS966, RS003, RS910, RS954, RS476	Outside of Meeting Room 2 多功能厅 2 外 (3F)
17:10-18:10	Poster Session 2: Multi-Agent Robot Navigation, Visual Servoing and Generative Robot Control RS711, RS605, RS619, RS375, RS817, RS142, RS965, RS777	Outside of Meeting Room 2 多功能厅 2 外 (3F)
18:10-20:00	Dinner Time Venue: Meeting Room 7-3F (多功能厅 7-3 楼)	

Keynote Speech | 主旨报告



Yongsheng Ou

Dalian University of Technology, China

Speech Title: Research on the Complex Skill Learning Method of Embodied Intelligence Robots

Abstract: At present, there is still a big gap between robots and humans in terms of mechanism, perception and control, and it is difficult for robots to adapt to changing scenes or tasks. In contrast, humans are better at handling missing, contradictory, and vague information. Therefore, integrating with human beings and the environment is an important means to solve the problem of insufficient robot intelligence. For complex scenarios, in-depth exploration of robot theory and practical problems under the situation of "human-in-loop", and robot multi-mode perception, knowledge reasoning, accurate and compliant control and other methods are studied. The main research contents include: (1) human operation intention understanding and behavior prediction in dynamic unstructured environment; (2) efficient migration and generalization technology of robot collaboration skills driven by knowledge reasoning; and (3) Human-machine collaborative compliance force control based on multi-mode information fusion.

Biography: Ou Yongsheng, professor in Dalian University of Technology. In 2011, he received the support of the 100 Talents Program of the Chinese Academy of Sciences, and was selected into the National "Ten Thousand Talents Program" in 2020. Experts of the 13th Five-Year Key Intelligent Robot Group of the Ministry of Science and Technology, key project evaluation expert of Natural Science Fund Committee, and evaluation expert of national Science and Technology Award plan. He has undertaken many national projects, such as key projects of the National Natural Science Foundation of China, national major research plan projects, and the 863 project of the Ministry of Science and Technology. With the interdisciplinary background of robotics and intelligent control, in the past five years, he has published more than 180 EI / SCI papers in the field of artificial intelligence and robotics. He has cited 5047 times and published more than 30 articles in JCR 1, Google H-index 55. He led the team to develop a number of core key technologies and realize the transformation. The low-cost navigation technology developed by him is used for the new product Xinluo sweeping robot developed by Shenzhen Silver Star Intelligent Company, and the humanoid service robot of Shenzhen UBTECH Technology Co., Ltd. His research won the 2016 Wu Wenjun Artificial Intelligence Technology Progress Award (ranked first), the 2018 Shenzhen Municipal Science and Technology Progress Award (ranked first), and the 2020 Guangdong Provincial Technology Invention Award (ranked first).

Keynote Speech | 主旨报告



Ning Wang

Dalian Maritime University, China

Speech Title: TBA

Abstract: TBA

Biography: Ning Wang received his B. Eng. degree in Marine Engineering and the Ph.D. degree in control theory and engineering from the Dalian Maritime University, Dalian, China in 2004 and 2009, respectively. From September 2008 to September 2009, he was financially supported by China Scholarship Council to work as a joint-training PhD student at the Nanyang Technological University (NTU), Singapore. In view of his significant research at NTU, he received the Excellent Government-funded Scholars and Students Award in 2009. From August 2014 to August 2015, he worked as a Visiting Scholar at the University of Texas at San Antonio. His research interests include self-learning autonomy, unmanned (marine) vehicles, and autonomous systems.

Dr. Wang was honored with the National High-level Talents Program for Young Top-notch Talents. He has published more than 200 SCI-indexed journal papers. He is a Fellow of IET, IMarEST, IIAV, and ISCM. He currently serves as Associate Editors of IEEE Transactions on Intelligent Transportation Systems, IEEE Signal Processing Letters, IEEE Systems Journal, Journal of Field Robotics, Ocean Engineering, International Journal of Robust and Nonlinear Control, ISA Transactions, Transactions of the Institute of Measurement and Control, and IET Electronics Letters. He was recognized as the Highly Cited Researcher by Clarivate Analytics, and the Highly Cited Chinese Researcher in Naval Architecture and Ocean Engineering by Elsevier.

Keynote Speech | 主旨报告



Hejun Wu

Sun Yat-sen University, China

Speech Title: Generative Policy Optimization for Embodied Intelligence

Abstract: Generative policies enable robots to learn complex behaviors from demonstrations, but their effectiveness depends on representation quality, the ability to improve through interaction, and the computational cost of generating actions. This talk presents our recent findings on these challenges, focusing on diffusion policies and one-step generative policies for robot control.

We first investigate representation collapse in diffusion policies, where similar observations produce indistinguishable representations, obscuring subtle differences that are critical for precise manipulation. We show how dispersive regularization during pretraining improves representation learning and how subsequent online fine-tuning with proximal policy optimization improves task performance. We then examine the challenge of reducing action generation costs while maintaining policy quality. By combining native one-step generation, representation spreading, and online reinforcement learning, we develop policies that support fast inference and further improvement through environment feedback. Experiments on simulation benchmarks and a physical robot demonstrate progress in manipulation performance and control efficiency.

The talk connects these findings through a common perspective: pretraining should establish useful representations, policy optimization should improve behavior through interaction, and action generation should meet the demands of real-time execution. We conclude by discussing how these components work together to support the practical deployment of generative policies.

Biography: Hejun Wu, Professor, PhD Supervisor, School of Computer Science and Engineering, Sun Yat-sen University. Deputy Director, Guangdong Key Laboratory of Big Data Secretary-General, Working Committee, New Engineering Alliance of the Ministry of Education Senior Member, China Computer Federation (CCF) Chairman, Emergency Medicine Branch, Guangdong Medical Association. Professor Hejun Wu received his PhD degree from the Hong Kong University of Science and Technology in 2008. His current research interests include embodied AI, and cross-disciplinary applications of artificial intelligence in healthcare and transportation. He has undertaken four national-level projects and numerous provincial and municipal science and technology programs. He has published more than 60 academic papers in international journals and conferences, three of which have won Best Paper Awards. He also holds more than 20 authorized invention patents. In 2023, Professor Wu was honored as an "Outstanding Teacher in Computer Science among National Higher Education Institutions."

Invited Speech | 特邀报告



Zhifeng Huang

Guangdong University of Technology, China

Speech Title: Flying Humanoid Robots: Structural Innovation, Control, and Experimental Validation

Abstract: Aerial locomotion serves as an efficient means for humanoid robots to rapidly approach targets and execute missions, offering significant application value in disaster emergency response, high-altitude operations, and isolated-area rescue. This keynote reviews the state-of-the-art development of flying humanoid robots and multi-link deformable aerial vehicles, and highlights the speaker's latest research achievements and technical breakthroughs in this field. The presentation is organized as follows: (1) innovative structural designs of ducted-fan-propelled flying humanoid systems; (2) a model predictive control (MPC)-based full-body control framework for stable aerial maneuvering; and (3) systematic experimental validations on physical prototypes, including aerial trajectory tracking, autonomous take-off and landing, and in-flight deformation.

Biography: Dr. Zhifeng Huang is an Associate Professor, Doctoral Supervisor, and Deputy Director of the Department of Automatic Control at the School of Automation, Guangdong University of Technology, and also a Visiting Researcher at the The Research into Artifacts, Center for Engineering of the University of Tokyo; he received his B.Eng. from South China University of Technology (2007), M.Eng. from Harbin Institute of Technology (2010), and Ph.D. from the University of Tokyo (2014). His research focuses on mechanism design and control theory for humanoid robots and applications of mobile manipulators, and he has published over 20 SCI/EI-indexed papers in leading journals and conferences such as IEEE Transactions on Mechatronics, IEEE Transactions on Learning Technologies, IEEE Robotics and Automation Letters, IROS, and ICRA, along with 12 authorized invention patents. As principal investigator, he has secured one National Natural Science Foundation project, three Guangdong Provincial Natural Science Foundation projects, one key R&D project for central state-owned enterprises (¥1.55 million), and ten industry collaborative projects, with cumulative research funding exceeding ¥3 million RMB. In 2018, he was honored with the title of "Innovation Hero" by the Guangzhou Municipal Publicity Department. His notable achievements include developing in 2017 the world's first bipedal robot based on a ducted-fan propulsion system for large-scale obstacle crossing, which set a world record among humanoid robots with a stepping distance reaching 147% of its own leg length; and in 2021, he designed the world's first flying bipedal robot using vector-thrust control and successfully demonstrated controllable take-off. This series of research has been widely reported by both domestic and international media, including IEEE Spectrum, the Daily Mail (UK), Guangdong Television, China Daily, Southern Daily, and China News Service.

Invited Speech | 特邀报告



Mei Li

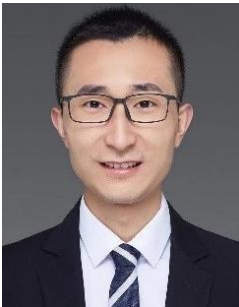
University of Geosciences (Beijing), China

Speech Title: Psychological and Emotional Companion Agent Based on MyAI

Abstract: This talk introduces a psychological and emotional companion agent developed based on MyAI. Rooted in person-centered therapy, positive psychology and emotional coaching, this AI agent provides lightweight daily emotional support. It practices non-judgmental listening, captures emotional cues and helps users reflect on inner feelings in easy-to-understand language. Please note that it is merely an auxiliary tool and cannot replace licensed counselors. Those with serious mental problems should seek offline professional help. This work explores how AI can deliver convenient emotional accompaniment for parents and the general public.

Biography: Mei Li, female, born in July 1969, Ph.D., Professor and Doctoral Supervisor. Research areas: Artificial Intelligence, Self-evolving Agents, Computer Vision, Knowledge Graphs, Internet of Things and Big Data Technologies. She has been working at China University of Geosciences (Beijing) since 2003, mainly engaged in teaching and research on signal and information processing.

Invited Speech | 特邀报告



Heng Wang

South China University of Technology, China

Speech Title: Versatile Magnetic Navigation Systems for Precise Medical Robotics

Abstract: Miniature medical robots, e.g., capsule robots and transluminal flexible robots, have been increasingly developed in recent years for minimally invasive medicine due to their small size and easy access to narrow lumens. However, there exists significant technical challenges in precise navigation and dexterous actuation of such miniature robots through tortuous and complicated intracorporeal lumens such as gastrointestinal tracts, bronchi, and blood vessels. Magnetic navigation systems are advantageous for intracorporeal medical robots because the magnetic field can permeate the human body safely and achieve remote sensing and actuation. In this talk, diverse magnetic sensing and actuation systems will be discussed for wireless, autonomous, and precise navigation of miniature medical robots in minimally invasive medicine. First, magnetic pose tracking systems with novel magnetic materials, configurations of magnetic sources, estimation algorithms, and field control strategies are discussed. These innovations give magnetic tracking systems more degrees of freedom, better accuracy, larger coverage, and more uniform sensitivity. A novel magnetic shape sensing method based on magnetic elastomers is also discussed for continuum medical robots. Second, magnetic actuation systems are developed for full 6-DoF dexterous manipulation of miniature capsule robots. The added DoF comes from either the use of anisotropic soft magnet as the magnetic actuation element or the skew configuration of the Helmholtz-Maxwell coils. Finally, an open-source simulator for magnetic robots is developed to facilitate research and development of such robots. In this seminar, the versatility of magnetic systems for medical robots is demonstrated by their diverse configurations, functions and applications.

Biography: Dr. Heng Wang is an Associate Professor with the Shien-Ming Wu School of Intelligent Engineering, South China University of Technology, Guangzhou, China, and the director of SCUT-Shanghai Huayi Tech joint Medical Virtual Reality Lab. He received the bachelor's degree from Xi'an Jiaotong University, China, in 2016 and received the Ph.D. degree in Mechanical Engineering from University of Minnesota, Twin Cities, USA, in 2021. His research interests include magnetic motion tracking for surgical robot navigation and embodied intelligence training, magnetically actuated capsule robots and continuum robots, medical robotics, and medical VR/AR and human-machine interaction. Dr. Wang is a principal investigator of multiple research projects including NSFC project, Guangdong and Guangzhou science and technology projects, and numerous industry-funded projects. Dr. Wang was granted a US patent and three China patents, and published more than 20 research papers in renowned journals and conferences such as Nature Communications / TRO / TMECH / TIM / MSSP / RAL / ACC, etc.

He received the Doctoral Dissertation Fellowship from University of Minnesota in 2020, the honor of Editor's Highlight paper (Best 50 papers) in "Applied Physics and Mathematics" in Nature Communications, ASME Best Mechatronics Paper Award in 2020, Best Application Paper Award in the 2022 IEEE International Conference on Digital Twins and Parallel Intelligence.

Invited Speech | 特邀报告



Cunman Liang

Tianjin University, China

Speech Title: Bioinspired Magnetically Actuated Miniature Soft Robots

Abstract: Miniature soft robots are robotic systems with characteristic dimensions at the millimeter or micrometer scale. Among them, magnetically actuated miniature soft robots have attracted considerable research interest because of their untethered actuation, flexible control, and strong environmental adaptability. However, achieving versatile and robust locomotion in confined, unstructured, and complex environments remains a major challenge. This talk presents two complementary studies that address this challenge through bioinspired structural design and tailored magnetic actuation strategies. The first study introduces a miniature amphibious soft robot capable of crawling, rolling, jumping, and swimming. A polyhedral deployable structure with flexible joints concentrates deformation and elastic energy storage at designated compliant regions, thereby improving the efficiency of magnetic actuation. Multi-objective optimization of the robot's structural dimensions balances the competing performance requirements of its four locomotion modes. In addition, vision-based closed-loop control enables precise planar trajectory tracking. Experiments in complex obstacle environments and an ex vivo porcine stomach demonstrate the robot's ability to navigate confined and unstructured environments by transitioning between different locomotion modes. The second study focuses on robust swimming under fluid disturbances. Inspired by the autorotation of *Dipterocarpus alatus* seeds and the pulsatile propulsion of jellyfish, the robot combines inclined magnetized legs with a flexible polyhedral deployable body to generate pulsatile thrust and stabilizing self-rotation. A resonance-based actuation strategy increases the maximum swimming speed to 43.7 mm/s, while the self-rotational angular velocity reaches 4.7 rad/s. Analysis of the coupling between propulsion and self-rotation provides guidance for selecting suitable actuation conditions that balance swimming speed and stability. When subjected to a lateral water flow of 150 mm/s, the robot recovers its stability within 1.3 s. It also demonstrates directional navigation and targeted pH sensing in a confined underwater space. Together, these studies show how the coordinated design of bioinspired structures and magnetic actuation strategies can enable both versatile locomotion across different environments and robust movement under external disturbances, offering new possibilities for miniature soft robots in complex terrestrial and aquatic environments.

Biography: Dr. Cunman Liang is an Associate professor at the School of Mechanical Engineering, Tianjin University, Deputy Director of the International Joint Research Center for Micro/Nano Manufacturing Technology and Equipment, and a recipient of the Young Talent Recruitment Program launched by the Ministry of Education of China. He earned his Bachelor's, Master's and Doctoral degrees in Mechanical Engineering from Tianjin University in 2012, 2015 and 2020 respectively.

From 2017 to 2018, he completed joint doctoral training at Northwestern University in the United States under the guidance of Professor John A. Rogers. From 2020 to 2023, he carried out postdoctoral research at The Chinese University of Hong Kong and the Hong Kong Centre for Cardio-Cerebrovascular Health Engineering (COCHE). Dr. Liang has presided over a number of research projects, including programs funded by the National Natural Science Foundation of China, the Overseas Talent Recruitment Special Project of the Ministry of Education and open projects of State Key Laboratories. He has published over 50 academic papers in journals such as *Science Robotics* and *Nature Communications*, alongside 2 book chapters. His work has accumulated more than 3,000 citations on Google Scholar with an H-index of 25. He also owns over 10 authorized national patents and has filed 2 U.S. patents. He has received numerous academic accolades, including the 2016 IEEE 3M-NANO Best Student Paper Award, the 2024 IEEE 3M-NANO Best Conference Paper Nomination, the Excellent Youth Editorial Board Member Award of SmartBot and the 2024 Pioneer Award from the School of Mechanical Engineering, Tianjin University. Currently serving as a Youth Editorial Board Member of four journals, including *Soft Science* and *SmartBot*, he was invited to deliver a keynote speech at the 2023 Annual Conference of the Chinese Society of Micro-Nano Technology. His research mainly concentrates on micro/nano robotics and micro/nano sensing technologies, and his outstanding research outcomes have been featured by more than ten mainstream media platforms including Sina, Sohu, China Science and Technology Network.

Invited Speech | 特邀报告



Yunquan Li

South China University of Technology, China

Speech Title: Low-Cost and Highly Sensitive Optical Tactile Sensors for Robotic Force Perception

Abstract: This report presents a comprehensive overview of our recent research on low-cost, highly sensitive flexible optical tactile sensors for intelligent robots. The presentation will first introduce the background and significance of tactile perception in human-robot interaction and complex operations. It will then cover two primary technical approaches developed in our lab: 1) A particle-jamming gripper integrated with a stretchable optical waveguide skin for large-area shape-adaptive grasping and slip detection; 2) A compact optical blocking structure-based tactile sensor for high-sensitivity 1D/3D force detection. The report will also discuss how machine learning algorithms (such as GRU and SVM) are utilized to achieve accurate 3D force decoupling, contact position recognition, and grasping posture classification. Finally, practical applications in robotic arms, including adaptive grasping, hardness/texture detection, and multi-axis teleoperation, will be demonstrated.

Biography: Yunquan Li, Associate Professor and Doctoral Supervisor at the Shien-Ming Wu School of Intelligent Engineering, South China University of Technology. He received his Ph.D. in Mechanical Engineering from the University of Hong Kong and completed postdoctoral research at the HKU Faculty of Medicine. His research interests include embodied intelligent robots, dexterous end-effectors, high-sensitivity tactile sensors, bio-inspired robotics, and mobile robotics. He has published 59 papers with over 1,300 Google Scholar citations and an h-index of 19. His work has appeared in IEEE TIE, T-MECH, Soft Robotics, and other leading journals. He holds 4 invention patents. He has led the NSFC project, several provincial and municipal projects, and industry-university collaborations with Midea Group and SIAT. He was selected for the Guangzhou Young Top-Talent Program and is a core member of the Guangzhou Embodied Intelligent Robot Innovation and Entrepreneurship Team. He received the Excellence Award in the Intelligent Robot Championship at the National Disruptive Technology Innovation Competition and the Wiley China Top-Cited Author Award.

Invited Speech | 特邀报告



Yang Li

Northwestern Polytechnical University, China

Speech Title: Adversarial Patch Attacks on Vision Recognition

Abstract: Physical adversarial patches pose a credible threat to vision-based detection in autonomous driving and surveillance, yet must survive printing, viewpoint, illumination, and distance changes. This report traces the progressive evolution of physical attack design, revealing a clear arc from 2D image-space perturbations toward full 3D object camouflage. The field has advanced by successively addressing deeper questions of physical deployment — generalization across unknown models, robustness across viewing distances, and fidelity to real three-dimensional geometry — but these dimensions remain partially ununified. A framework that jointly optimizes transferability, scale invariance, and physical realism is identified as the key open direction.

Biography: Dr. Yang Li is an Associate Professor at the School of Automation, Northwestern Polytechnical University, whose research has long centered on artificial intelligence and intelligent security; he is affiliated with the Key Laboratory of Information Fusion Technology of the Ministry of Education, Xi'an Key Laboratory of UAV Information Security, and Shaanxi Engineering Research Center for Intelligent Equipment System Safety Control. He previously worked as a Postdoctoral Research Fellow at Nanyang Technological University (NTU), a Joint Research Fellow at the Agency for Science, Technology and Research (A*STAR) High Performance Computing Research Centre in Singapore, and a joint-training doctoral candidate at NTU. He serves as an Executive Member of the Technical Committee on Network and System Security of the China Computer Federation, has published more than 60 high-level papers in top journals including IEEE Transactions on Information Forensics and Security (TIFS) and IEEE Transactions on Dependable and Secure Computing (TDSC), and holds multiple editorial appointments: Associate Editor of IEEE Transactions on Affective Computing, IEEE Sensors Journal and Progress of Artificial Intelligence, Youth Editorial Board Member of Intelligent Security, and Guest Editor for Future Generation Computer Systems and IEEE Intelligent Systems.

Invited Speech | 特邀报告



Peng Chen

Shantou University, China

Speech Title: Collaborative Representation and Decoupling for Fault Diagnosis of Robotic and Mechatronic Systems under Transient Interference and Multi-Source Coupling

Abstract: Transient interference and multi-source coupling obscure weak fault signatures and complicate fault diagnosis in robotic and mechatronic systems. Superposed responses from motors, bearings, and transmission components can mask fault-induced impulses and hinder source separation. This talk presents collaborative representation and decoupling methods for extracting interpretable diagnostic information from coupled responses. Adaptive transient detection and signal reconstruction suppress interference while preserving fault-related periodicity. Walsh–Fourier representations and cross-correlation heat maps support joint feature characterization, while target-guided multiband demodulation and confidence-weighted fusion integrate diagnostic evidence across frequency bands. Particular attention is given to distinguishing fault-induced impacts from external disturbances and separating overlapping source contributions. Applications to robotic manipulators and mechanical transmission systems illustrate the relevance of these approaches to fault discrimination and condition assessment. Future directions include learning with limited labeled data, multimodal sensing, and efficient online implementation. The discussion connects these methods with condition monitoring and predictive maintenance requirements in industrial robotics, automated production lines, and precision manufacturing equipment.

Biography: Dr. Peng Chen is an Associate Professor and Master’s Supervisor at Shantou University, recognized as a Shantou High-Level Talent and selected for the university’s “Outstanding Talents Program.” He received his Ph.D. in Engineering from the University of Electronic Science and Technology of China (UESTC) in 2020, under the supervision of Prof. Ming J. Zuo - IEEE Fellow and Fellow of the Canadian Academy of Engineering - with joint doctoral training at KU Leuven (Belgium) and a visiting research appointment at the University of Pretoria (South Africa). He is an IEEE member, an external peer reviewer for the National Natural Science Foundation of China (NSFC) and serves on multiple technical committees of the Chinese Society for Vibration Engineering, including the Signal Processing Branch, Dynamic Testing Professional Committee, and Rotor Dynamics Branch. As a principal investigator, he has led over 10 research projects - including an NSFC Young Scientists Fund project rated “Excellent” upon completion and an AVIC Key R&D sub-project - while also contributing to six major national-level initiatives. He has published over 50 SCI-indexed journal articles as first or corresponding author in premier venues such as MECH SYST SIGNAL PR, EXPERT SYST APPL, KNOWL BASED SYST, ENG APPL ARTIF, IEEE INTERNET THINGS J, IEEE T INSTRUM MEAS, IEEE T RELIAB, among others (featuring two

Highly Cited / Hot Papers), and holds six granted invention patents. He has served as session chair and delivered invited talks at international conferences including UNified-2026-SMMI, IMCC 2025, and TEPEN2024-IWFDP, and actively contributes to the academic community as a reviewer and guest editor for multiple prestigious international journals.

Invited Speech | 特邀报告



Yukang Cui

Shenzhen University, China

Speech Title: Multi-Sensor Fusion for UAV-Based Perception and 3D Reconstruction in Dense Forest Environments

Abstract: Reliable perception in dense forest environments remains challenging for unmanned aerial vehicles (UAVs) due to canopy occlusion, limited visibility, and fragmented sensor observations. This talk presents a multi-sensor fusion framework that integrates LiDAR, RGB cameras, thermal cameras, inertial measurements, and GNSS to enhance aerial perception and three-dimensional reconstruction in complex environments. The proposed framework combines tightly coupled multi-modal state estimation, online spatiotemporal alignment, and adaptive sensor fusion to improve localization accuracy, mapping consistency, and robustness under challenging sensing conditions. By exploiting complementary geometric, visual, and thermal information, the system enables more reliable environmental reconstruction and target perception under partial canopy occlusion. Experimental results obtained using multirotor and vertical-takeoff fixed-wing UAV platforms demonstrate the effectiveness of the proposed approach in real-world forest environments. Finally, practical challenges and future research directions for robust multi-modal UAV perception will be discussed.

Biography: Yukang Cui is an Associate Professor at the College of Mechatronics and Control Engineering, Shenzhen University. His research interests include multi-sensor fusion perception and 3D Gaussian Splatting, multi-UAV cooperation and Vision-Language-Action (VLA)-based navigation, embodied intelligence and aerial manipulators, and planning and control of highly dynamic unmanned systems. He has published more than 40 papers in IEEE Transactions journals as a first or corresponding author. He serves as an Associate Editor of IEEE Transactions on Industrial Cyber-Physical Systems.

Technical Session 1: Machine Vision & Intelligent Perception

Date: October 31st, 2026 / Duration: 16:10-18:10

Venue: Meeting Room 3-2 F (多功能厅 3-2 楼)

Session Chair: Wei Liang, Huizhou University, China

RS049 16:10-16:25	Title: Grasp Anything: Zero-Shot Soft Robotic Grasping with a Single Depth Camera Author(s): Rene M. Suarez Flores, Natee Chirachongcharoen, Farhad Shabani, Sajid Nisar Presenter: Rene Manuel Suarez Flores, Kyoto University of Advanced Science, Japan Abstract: This research presents a versatile AI-powered soft robotic grasping system capable of performing grasping, sorting, and pick-and-place tasks for objects of diverse sizes, shapes, and stiffnesses. Unlike most existing systems that rely on multiple sensors or extensive training datasets, the proposed approach achieves zero-shot object recognition using only a single depth camera, significantly reducing sensing and computational requirements. The system integrates a previously developed soft gripper with the Grounded Segment Anything Model (Grounded-SAM), an open-source AI pipeline combining Grounding-DINO and SAM for zero-shot object detection and segmentation. Using prompt-based input from the user, the system identifies, localizes, and manipulates both familiar and unseen everyday objects without prior training. Experimental validation in real-world single- and multi-object scenarios demonstrates the system's high reliability and adaptability. The proposed method achieved a nearly 100 % task success rate, with an average response time below 4 s, and completed object transport over 35 cm in under 20 s. These results highlight the system's potential for human-centered robotic applications, such as in homes, supermarkets, and service environments, where simplicity, versatility, and gentle interaction are essential.
RS652 16:25-16:40	Title: From Image Coordinates to Electrical-Structure Coordinates: Shed-Level Perception of Iced Insulators Author(s): Wei Liang, Ziyang Zhuang, Lin Liu, Juncheng Zou, Yunshou Mao, Dafeng Long, Hongxiang Lin, Jinqiang He Presenter: Wei Liang, Huizhou University, China Abstract: Robotic inspection and maintenance of power transmission lines require visual targets to be associated with specific positions on electrical equipment. However, conventional image coordinates vary with camera viewpoints and cannot directly provide such equipment-level position information. This paper presents a shed-level perception method that transforms image observations into equipment-attached electrical-structure coordinates for iced insulators. Starting from a single field image, the method establishes an equipment-referenced representation and associates visual regions with ordered shed positions. Experiments on 120 field images covering glaze, rime, mixed rime, and wet snow show that the proposed method achieves a shed-level F1 score of 78.0%. The normalized center and boundary errors are 13.4% and 14.3%, respectively. The results demonstrate the feasibility of converting image-space observations into equipment-level structural positions for subsequent monitoring, inspection, and robotic operation.
RS848 16:40-16:55	Title: A Lightweight Visual Perception Model for Litchi Fruit Detection in Robotic Orchard Harvesting Author(s): Yiyin Chen, Wenxue Chen, Hongxiang Lin, Yunshou Mao, Dafeng Long, Guangyu Yang, Juncheng Zou

	Presenter: Yiyin Chen, Huizhou University, China Abstract: Accurate and real-time visual perception in natural orchards is crucial for autonomous harvesting robots, yet remains challenging due to severe foliage occlusion and edge-device computational constraints. This paper proposes a lightweight visual perception model, \textbf{YOLOv8n-Litchi}, tailored for robotic harvesting. The architecture integrates an Efficient Multi-Scale Attention (EMA) mechanism at the backbone tail to enhance occluded fruit features, constructs a GSConv-based Slim-Neck structure to compress model parameters and computational load, and adopts a dynamic Wise-IoU (WIoU v3) loss function to optimize bounding box regression for overlapping targets. Evaluated on a natural orchard benchmark, YOLOv8n-Litchi achieves 93.20\% Precision, 93.80\% Recall, and 96.90\% mAP@0.5 (63.80\% mAP@0.5:0.95) with only 2.92\,M parameters and 8.00\,G FLOPs, achieving improved detection accuracy over the baseline while maintaining comparable computational efficiency. Physical deployment on an NVIDIA Jetson Nano edge processor confirms its real-time viability under a strict 10W power budget, achieving 15.58\,FPS (64.18\,ms latency, 95.70\% mAP@0.5) via an asynchronous double-buffering TensorRT FP16 pipeline and 30.87\,FPS with interleaved keyframe tracking, providing an efficient perception solution for autonomous harvesting robots.
RS358 16:55-17:10	Title: ADC-Net: Adaptive Directional Causal Network for Acupoint Localization via Artificial Visual Markers in Bionic Robot Author(s): Xu Wang, Deyi Wang, Zhijie Lin, Hao Liang Presenter: Xu Wang, Guangdong Mechanical and Electrical Polytechnic, China Abstract: Human acupoint localization is essential for traditional Chinese medicine therapies in bionic robots. However, it is challenging to detect acupoints from skin surfaces due to these issues: 1) The arbitrary and random poses of the human body; 2) The complex spatial distribution and intrinsic topological dependencies among acupoints. To overcome the limitations of visual perception, we propose an Adaptive Deformable Causal Network (ADC-Net) for robust acupoint localization via artificial markers, where the Adaptive Deformable Alignment (ADA) module is designed to align feature sampling with local gradient directions for arbitrary body rotations, while the Causal Relational Reasoning (CRR) module is devised to model the inherent spatial dependencies among acupoints via a causal self-attention mechanism. Extensive experiments on a benchmark dataset demonstrate that the proposed ADC-Net outperforms other state-of-the-art methods, providing support for bionic robot.
RS542 17:10-17:25	Title: Research on SSD Small Target Detection Algorithm Based on Multi-scale Feature Enhancement Author(s): Kejia Zhu, Rui Yang Presenter: Kejia Zhu, Guangzhou University of Software, China Abstract: To solve the problems of insufficient feature extraction and low detection accuracy of the traditional SSD (Single Shot MultiBox Detector) algorithm in small target detection tasks, this article proposes an improved SSD detection algorithm. First, the training network is designed to enhance small target features, and the feature extraction capability is enhanced by improving the VGG-16 backbone network and adding convolutional layers; secondly, a multi-layer large feature and small feature fusion mechanism is constructed; and finally, a high-frequency signal weighting mechanism is introduced. Experiments show that the algorithm in this paper has improved its small target detection capabilities on the test set data

	set.
RS590 17:25-17:40	Title: Markerless Real-Time AI Tracking of Robotic Surgical Tool Pose from RGB Intraoperative Video Author(s): AbdelRahman H. Ibrahim, Rene M. Suarez Flores, Sajid Nisar Presenter: AbdelRahman H. Ibrahim, Kyoto University of Advanced Science, Japan Abstract: Accurate localization and tracking of robotic surgical instruments are essential for robotic skill assessment, context-aware assistance, and surgical automation. However, many state-of-the-art vision-based 3D pose estimation methods depend on RGB-D sensors or other sources of depth information, limiting their applicability in real-world operating rooms where only monocular endoscopic video is typically available. This paper proposes a modular perception pipeline that estimates and tracks the pose of robotic surgical instruments using RGB images alone, without requiring explicit depth sensing or depth reconstruction. The pipeline first segments surgical instruments from monocular video to generate binary masks, after which geometric features are extracted and analyzed to infer instrument pose. Temporal tracking is then applied to preserve instrument identity and maintain pose consistency across successive video frames, even in the presence of occlusions and visual clutter. The architecture also allows individual pipeline components, such as the segmentation or pose estimation module, to be replaced independently without affecting the overall framework. The proposed method is evaluated using a large-scale, publicly available dataset collected during real robot-assisted surgical procedures. Quantitative and qualitative results demonstrate consistent instrument tracking and temporally stable pose estimation across multiple instruments using RGB data alone. These findings highlight the potential of RGB-based perception pipelines as scalable and hardware-agnostic alternatives to depth-dependent approaches for robotic surgical perception.
RS916 17:40-17:55	Title: EgoCap-Edge: Resource-Performance Tradeoffs of Quantized VLMs in Egocentric Robotic Video Understanding Author(s): Wenfeng Xu, Siming Wang, Caixia Bai, Yijie Zhou, Junbin Qin Presenter: Wenfeng Xu, Guangdong University of Technology, China Abstract: We study resource--performance tradeoffs of quantized vision-language models (VLMs) in egocentric robotic video understanding through structured action descriptions from first-person video. EgoCap-Edge combines a documented data-production workflow with a reproducible model-evaluation protocol. The inspected delivery contains 1,757 task videos and 17,616 action annotations spanning 30.09 hours of annotated intervals. We evaluate five public Qwen2.5-VL configurations on 311 actions from 21 recording-disjoint groups, preserving the frame indices, prompt, output schema, and frozen scoring functions. At batch one on RTX A6000, 7B AWQ reduces serialized weight size by 58.3% and peak allocated memory by 55.5% relative to 7B FP16. Rule accuracy changes from 20.26% to 19.61%, while end-to-end latency increases from 4.57 to 5.97 seconds. LLM.int8 also saves memory but takes 12.97 seconds per action. Six prespecified frame-sampling ablations quantify the accuracy--latency tradeoff, and separate 50-action profiles distinguish visual encoding from other model computation. These results support measured memory savings under the tested backend, while exposing accuracy and runtime costs that must be resolved before real-time deployment.

RS740 17:55-18:10	Title: Simulation Study of the Electrohydraulic–Solid Coupled Driving Characteristics of a HASEL Flexible Haptic Actuator Author(s): Yue Chen Presenter: Yue Chen, Kyoto University of Advanced Science, Japan Abstract: To investigate the coupling among the electric field, dielectric liquid migration, and flexible structural deformation of HASEL flexible haptic actuators, a coupled electrohydraulic–solid finite element model was established using COMSOL Multiphysics. The effects of driving voltage, dielectric liquid content, and PDMS film thickness on the output force were analyzed. The results show that these parameters have significant effects on the output force, and reveal the coupled driving process involving electric-field action, liquid migration, and structural deformation. This study provides a theoretical basis for the structural design and output force regulation of HASEL flexible haptic actuators.
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Technical Session 2: Robot Motion Planning, Control & Human-Robot Interaction

Date: October 31st, 2026 / Duration: 16:10-18:10

Venue: Meeting Room 1-3 F (多功能厅 1-3 楼)

Session Chair: Han Han, Huizhou University, China

RS997 16:10-16:25	Title: Comparative Analysis of UAV Flight Attitude Control Performance Based on Cascade and Parallel PID Author(s): Xuqi Li, Hualin Chen, Juncheng Zou, Hongxiang Lin, Zidong Xiao, Yunshou Mao, Dafeng Long Presenter: Xuqi Li, Huizhou University, China Abstract: UAV attitude control accuracy is critical for flight stability and operational safety. PID control is the mainstream method for small multi-rotor UAVs, but the performance differences between cascade and parallel structures in engineering practice remain unclear. This paper uses a self-built quadrotor platform to collect IMU attitude data (roll, pitch, yaw) under hovering, and compares the two PID structures across four indicators: fluctuation range, response speed, anti-interference, and overshoot. Results show that parallel PID achieves only 37%–43% of the attitude variance of cascade PID under indoor windless conditions, with better steady-state accuracy and lower overshoot. Cascade PID responds faster and recovers more quickly, but exhibits noise amplification, larger overshoot, and greater fluctuations under current parameters. Measured-data validation highlights the critical impact of parameter matching and operating conditions on control performance, offering engineering references for flight controller selection and tuning.
RS937 16:25-16:40	Title: Preference-Based Learning of Semantics-Preserving Objective Functions for Urban Autonomous Vehicle Planning Author(s): Junaid Farooq Qureshi, Raoul Zöllner Presenter: Junaid Farooq Qureshi, Hochschule Heilbronn, Germany Abstract: Urban autonomous vehicle planning requires candidate trajectories to be evaluated with respect to multiple heterogeneous objectives, including safety, traffic-rule compliance, travel efficiency, and comfort. These objectives are commonly represented by manually specified reward functions and may ultimately be combined into a single scalar value for trajectory selection, which can obscure the contribution of the individual objectives. This paper therefore investigates preference-based learning of individual objective functions, each producing a scalar score that remains available for subsequent multi-objective planning. For each objective, trajectory-level metrics are extracted over 5-s windows and pairwise preference relations are used to learn the corresponding objective function. Scenario context is represented by the traffic state at the beginning of each window. The learned objectives are evaluated across ten objectives and five urban scenario classes using scenario-grouped cross-validation and are compared with fixed reward formulations from prior work and the literature. Metric-based models achieve 95.7%–100% preference accuracy, while adding explicit scenario context provides no further improvement for the evaluated objectives and scenario distributions, suggesting that the selected metrics already capture the information required by the specified preference relations. Compared with fixed rewards, the largest gains in agreement with the specified preference relations occur for objectives with sparse or weakly graded conventional formulations.

RS369 16:40-16:55	Title: Terrain-Aware Layered A* Path Planning for UAVs in Rugged Mountainous Terrain Author(s): Ziyang Zhuang, Wei Liang, Yiting Lai, Jun Hu, Manshuo Chen Presenter: Ziyang Zhuang, Huizhou University, China Abstract: Distance-only planning can select short routes through locally rough terrain in mountainous UAV missions. This paper presents a terrain-aware edge-cost formulation embedded in a layered A* search. Candidate transitions combine three-dimensional distance, ascent cost, a digital-elevation-model-derived terrain-ruggedness index (TRI), and a terrain-derived risk proxy, while all compared methods use the same clearance and climb constraints. On three scenarios extracted from a Nankunshan DEM in Huizhou, with five repeated deterministic executions per method, TAA* reduces mean TRI by 13.5--34.9% and the risk proxy by 17.0--36.0% relative to Standard A*, with a 6.2--7.5% path-length increase. A three-scenario component diagnostic shows that TRI-only and Risk-only variants reduce their corresponding terms, while the joint objective gives the lowest observed values for both metrics in S3 under the tested configuration. The evidence supports TAA* as an auditable offline or pre-flight planning method for the tested local DEM and protocol, not as a demonstrated onboard real-time or accident-probability model.
RS760 16:55-17:10	Title: Coordinated Motion Planning of Underwater Vehicle–Manipulator Systems via Non-Diagonal Motion Allocation and Nonlinear Self-Motion Exploitation Author(s): Han Han Presenter: Han Han, Huizhou University, China Abstract: This paper addresses the inverse kinematics of underwater vehicle–manipulator systems (UVMSs) in the presence of kinematic coupling and multiple state and actuator constraints. A coordinated motion planning method based on non-diagonal motion allocation and nonlinear self-motion exploitation is proposed. First, within the task-priority redundancy resolution framework, a motion distribution matrix with non-diagonal elements is developed to coordinate motion allocation between the autonomous underwater vehicle (AUV) and the manipulator according to their dynamic coupling characteristics. Specifically, the non-diagonal weighted pseudoinverse is employed to realize the proposed motion allocation. Furthermore, a nonlinear secondary task is designed to exploit the self-motion of the UVMS, thereby further coordinating AUV and manipulator motions and reducing the integrated actuation effort while satisfying manipulator joint limits and AUV roll/pitch constraints. Simulation results show that the proposed method satisfies all state constraints and reduces the integrated actuation effort by 72.8%, 53.8%, 52.9%, and 41.4% compared with the weighted pseudoinverse, full kinematic control (FKC), joint-limit FKC, and non-diagonal pseudoinverse methods, respectively.
RS224 17:10-17:25	Title: ROS 2 and EGM-driven sketching pipeline for ABB collaborative robots Author(s): Bartek Piotr Łukawski, Daniel G. Cubillo, Edwin Daniel Oña, Juan G. Victores, Carlos Balaguer, Alberto Jardón Presenter: Bartosz Piotr Łukawski, Universidad Carlos III de Madrid, Spain Abstract: A Python application is presented in this work to sketch user-supplied images with an ABB CRB 15000-5 “GoFa” robot (or compatible) and a custom drawing tool, optionally equipped with a force sensing unit for path correction via pressure control. A graphical interface is supplied to assist the user throughout the end-to-end pipeline, from image acquisition to motion execution, including a preview of the resulting trajectory. Motion

	commands are issued through the ABB's Externally Guided Motion (EGM) interface, backed by a ROS 2 node developed by the authors and available for wider use. The tool explores a range of available image generation solutions, including classic Canny edge detection via OpenCV, local AI models, and web services accessible through their public API and a user token. The selected methods are discussed and compared against reinforcement learning techniques (DQN, PPO, SAC) which did not perform adequately. An extensible ROS-compatible architecture is presented for broader use across other robot manufacturers. Targeted audiences and applications include academic contexts and technical demonstrations.
RS741 17:25-17:40	Title: Skill Acquisition in Robotic Teleoperation: Effects of Mixed Reality and Vibrotactile Feedback Author(s): Muhammad Abdullah Zahid, Rene M. Suarez Flores, Sajid Nisar Presenter: Muhammad Abdullah Zahid, Kyoto University of Advanced Science, Japan Abstract: This paper investigates whether spatially registered mixed reality (MR) supports faster acquisition of fine robotic teleoperation skills than a 2D multi-view representation, while also examining whether event-based vibrotactile feedback provides an additional training benefit. A 6-DoF virtual manipulator is controlled through a headset-tracked hand pose and rendered either as spatially registered content within the physical workspace or through three fixed camera views on a virtual monitor. The hand-to-end-effector control mapping and task remain unchanged across the two visual representations. To assess whether MR provides a training advantage over the 2D representation, the study quantifies performance change across repeated trials instead of relying on conventional single-point evaluations of teleoperation performance. Twelve participants completed a 2×2 within-subject precision pick-and-place study with five 2-min trials in each of four conditions. MR yielded higher overall performance (5.19 versus 1.19 successful placements per trial) and significantly greater training-related improvement than 2D. The MR-2D slope difference was +0.479 placements/trial for successful placements and -0.0528/trial for missed-grasp rate. Vibrotactile feedback reduced mean self-collisions by 0.71 per trial but did not accelerate improvement in either primary outcome. These results indicate that spatially registered MR provides not only a substantial task-execution advantage but also evidence of faster early acquisition of fine teleoperation skills, whereas vibrotactile feedback did not produce a measurable acquisition benefit over the five-trial practice period.
RS420 17:40-17:55	Title: Cross-Modal Attention Fusion for Lower Limb Motion Recognition Using sEMG and IMU Author(s): Wenxue Chen, Yiyin Chen, Hongxiang Lin, Yunshou Mao, Xiaohui Wei, Dafeng Long, Juncheng Zhou, Guangyu Yang Presenter: Wenxue Chen, Huizhou University, China Abstract: Decoupling and interpreting user movement intent from heterogeneous biosignals remains a fundamental challenge for robotic lower-limb assistance. Traditional multi-sensor approaches struggle to bridge the representational gap between neuromuscular activation and mechanical kinematics. To address this limitation, we develop a hybrid deep neural architecture tailored for sEMG-IMU fusion, driven by a Bidirectional Cross-Attention (BiCA) mechanism. The framework employs decoupled 1D convolutional branches to distill neuromuscular activation patterns and inertial kinematics, feeding them into recurrent layers to track temporal gait dynamics. Concurrently, the BiCA module orchestrates mutual

	contextual exchanges across modalities, recalibrating feature salience and suppressing cross-source discrepancies prior to decision-making. Comprehensive evaluations on both the public ENABL3S dataset and our self-collected wearable sensor dataset demonstrate exceptional intent recognition, achieving overall accuracies of 98.4\% and 96.6\%, respectively, while exhibiting heightened robustness during complex locomotion transitions (e.g., stair ascent and ramp negotiation). The findings highlight the potential of attention-guided multi-source integration in elevating the intuitive control of powered orthoses.
RS545 17:55-18:10	Title: Escapement-Like Kinesthetic Rendering with a Passive Wearable Device for a Virtual Piano Author(s): Muhammad Abdullah Zahid, Shubh Shukla, Rene M. Suarez Flores, Sajid Nisar Presenter: Muhammad Abdullah Zahid, Kyoto University of Advanced Science, Japan Abstract: Extended-reality (XR) systems can reproduce the appearance and sound of a piano, but without a physical keyboard, the mechanical response normally felt through the keys is lost. This paper presents a passive kinesthetic rendering method that provides an escapement-inspired sequence of resistance buildup, brief localized release, and recovery during key presses in a surfaceless virtual piano. A previously developed wearable electromagnetic tendon-resistance mechanism resists finger motion through two high-resistance stages separated by a short low-resistance interval. The controller uses normalized key depression to switch between resistance states and adapts the release duration to press speed within fixed time limits. The method is evaluated using virtual keys with approximately 20 mm of front-edge travel. Fingertip response measurements across five independent device fittings, with five presses per fitting, showed a consistent drop in the force proxy after release, followed by recovery during the remaining key travel and a further increase after full depression. In a study with ten participants, median accuracy was 95% for distinguishing the release from sustained resistance and 80% for identifying its relative location within the downstroke. Both exceeded their respective chance levels of 50% and 33.3%. A passive wearable device can therefore give a virtual key a non-monotonic response—resistance buildup, a brief release, then recovery—with no physical key surface beneath the finger. Participants detected that release and identified its relative position within the downstroke. The results indicate that passive wearable haptics can bring mechanically structured interaction to XR applications in which a grounded force display is impractical.

Technical Session 3: Intelligent Optimization, Robotic Platforms and Mechatronic Systems

Date: October 31st, 2026 / Duration: 16:10-18:10

Venue: Meeting Room 2-3 F (多功能厅 2-3 楼)

**Session Chair: Bo Jiang, Huizhou University, China
&Peng Chen, Shantou University, China**

RS263 16:10-16:25	Title: Reinforcement Learning-Based Scheduling for a Data Center With Batch Workloads and Shared Energy Storage Author(s): Linping Kuang, Mao Yunshou, Dafeng Long, Li Junhui, Wei Liang, Hongxiang Lin, Jiaqi Liang, Xiaochen Duan Presenter: Linping Kuang, Huizhou University, China Abstract: The coordinated scheduling of deferrable batch workloads and shared energy storage in data centers offers the potential to reduce operating costs and improve photovoltaic (PV) accommodation, but it must simultaneously satisfy job deadline constraints, energy storage state-of-charge (SOC) limits, and the time-varying power availability constraints arising from other tenants' occupancy. To address the inability of conventional deep reinforcement learning to guarantee these hard constraints, this paper proposes a deadline-aware safe Soft Actor-Critic (DA-Safe-SAC) method. The method employs deadline buckets to represent dynamically arriving batch tasks, and through a task-storage dual safety projection, it corrects policy actions onto the feasible set satisfying the job deadline, server computing-capacity, energy storage SOC, and shared power-quota constraints. Under the condition that jobs are continuously preemptible and the set of arrived jobs is initially schedulable, the task projection recursively preserves deadline feasibility. An operating cost model accounting for electricity purchase, demand charge, and shared-storage service costs is formulated, and simulation experiments are conducted to compare the proposed method with rule-based scheduling.
RS694 16:25-16:40	Title: Safe Optimal Scheduling of Data Center Integrated Energy System Using QP-Projection-Augmented TD3 Deep Reinforcement Learning Author(s): Junhui Li, Mao Yunshou, Dafeng Long, Jiaqi Liang, Wei Liang, Hongxiang Lin, Linping Kuang, Xiaochen Duan Presenter: Junhui Li, Huizhou University, China Abstract: This paper proposes a safe deep-reinforcement-learning scheduling method that combines twin delayed deep deterministic policy gradient (TD3) with quadratic-programming safety projection (QPS) for a data-center integrated energy system. A Markov decision model is formulated considering electricity-heat-cooling coupling, gas-turbine ramping, and the operating limits of electrical, thermal, and cooling storage. TD3 obtains continuous scheduling actions through twin critics and delayed policy updates, while the QP layer projects raw policy outputs onto a feasible action set. Four paired random scenarios are used to compare the proposed method with a heat-following rule and a fixed time-of-use storage heuristic. QPS-TD3 reduces the mean daily cost by 7.22%, 7.00%, 8.18%, and 6.49% relative to heat following, and by 5.38%, 4.84%, 6.68%, and 4.77% relative to the time-of-use heuristic. The QP layer eliminates the observed raw-action violation, and all storage states satisfy their bounds and terminal-state requirements. The results demonstrate the economic benefit and execution feasibility of the proposed method under the investigated conditions.

RS332 16:40-16:55	Title: A Dual-Agent HAPPO-Based Scheduling Method for Computing-Energy Coordination in Data Center Microgrids Author(s): Jiaqi Liang, Mao Yunshou, Dafeng Long, Minhao Li, Linping Kuang, Hongxiang Lin, Junhui Li, Xiaochen Duan Presenter: Jiaqi Liang, Huizhou University, China Abstract: This paper proposes a dual-agent heterogeneous-agent proximal policy optimization (HAPPO) method for the economic scheduling of data center microgrids. A coupled computing–electricity–cooling model is established to represent computing workloads, cooling demand, photovoltaic generation, gas-turbine waste-heat recovery, battery storage, and utility-grid interaction. The task scheduling agent adjusts flexible workload execution subject to deadline and server-capacity constraints, while the battery agent determines charging and discharging actions according to the post-scheduling load, electricity price, photovoltaic output, and state of charge. The scheduling problem is formulated as a cooperative Markov game under a centralized-training-and-decentralized-execution framework. HAPPO sequential policy updates and importance-ratio corrections are employed to improve the coordination of heterogeneous agents, while task-scheduling safeguards and battery-action projections ensure operational feasibility. Comparisons with PPO and MAPPO show that the proposed method effectively coordinates workload shifting and battery operation while satisfying task, storage, and energy-balance constraints. Simulation results show that HAPPO achieves cost savings above 2.2% across four seasonal test months without task dropping. In the summer test case, it achieves a saving rate of 2.333% and outperforms PPO and MAPPO in operating cost and flexible workload utilization.
RS418 16:55-17:10	Title: EdgeDiff: Social-Aware Incentive Mechanisms for Vehicular Crowd Sensing via Diffusion-Based Edge Reinforcement Learning Author(s): Dongdong Ye, Zhenlei Zhu, Yunshi Guo Presenter: Zhenlei Zhu, Huizhou University, China Abstract: Vehicular crowd sensing (VCS) relies on vehicles with mobility and heterogeneous sensing capabilities to contribute environmental data continuously. However, participants' self-interest, data-acquisition costs, and intervehicle social relationships jointly affect their contribution decisions. This paper studies a social-aware incentive problem involving one leader vehicle (LV) and multiple follower vehicles (FVs). The LV announces a total procurement price, while each FV receives a proportional payment according to its share of the aggregate data and chooses its data contribution under social benefits and quadratic collection costs. The interaction is formulated as a two-level Stackelberg game: the FVs form a noncooperative game at the lower level, and the LV optimizes the total price against the lower-level equilibrium response. To address the limited exploration and policy oscillations of deterministic actors in continuous coupled strategy spaces, we propose EdgeDiff. At the edge, EdgeDiff represents the continuous FV policy with a conditional diffusion model and combines double critics, value-guided denoising, multi-candidate action screening, and utility-based safety constraints; the LV performs outer-loop price search using the cross-entropy method. A 600-episode cloud experiment with one LV, eight FVs, $k=10$, $\zeta=0.5$, and $c=4$ stabilizes the total price at 3.3625 and aggregate data at 4.0840. The maximum unilateral FV regret, action residual, and LV regret are 1.35×10^{-4}, 0.00730, and 7.55×10^{-8}, respectively,

	all below the prescribed thresholds, indicating convergence to an approximate Stackelberg equilibrium. Relative to the historical DRL (DNC-PPO-CEM) baseline, the mean FV utility and LV utility enter their stable regions 71 and 123 episodes earlier, respectively, demonstrating faster empirical convergence under the evaluated configuration. Index Terms—vehicular crowd sensing, social effects, diffusion policy, edge reinforcement learning, Stackelbe
RS773 17:10-17:25	Title: Industry-Aware Educational Robots through Competency-Grounded Instructional Planning Author(s): Mengqiu Cheng, Yi Jia, Zongfang Ma Presenter: Mengqiu Cheng, Xi'an University of Architecture and Technology, China Abstract: Educational robots are increasingly capable of supporting knowledge explanation, interaction, demonstration, and practical guidance. However, existing systems primarily focus on executing predefined instructional content, while providing limited support for determining what competencies should be taught and how they should be translated into executable teaching tasks. This limitation is particularly important in vocational education, where instructional activities need to remain aligned with continuously evolving industrial competency requirements. To address this problem, we propose an Industry-Oriented Educational Knowledge Graph (IOEKG) as a competency-grounded instructional planning framework for educational robots. IOEKG integrates multi-source industrial materials and organizes occupational requirements into a three-level hierarchy of core job competencies, competency modules, and knowledge-skill units. A quality-controlled graph refinement mechanism is introduced to improve hierarchical consistency, semantic relevance, and evidence traceability. The resulting competency graph is further aligned with curriculum content, knowledge points, practical tasks, and assessment requirements to establish explicit mappings from occupational competencies to teachable content. Based on these mappings, fine-grained knowledge-skill units are transformed into robot-executable instructional tasks involving explanation, demonstration, practical guidance, and assessment. Experiments on robotics-related occupations and curriculum systems demonstrate that IOEKG improves competency coverage, competency-curriculum alignment, practical teaching support, and traceability compared with direct generation baselines. These results demonstrate the potential of IOEKG to provide educational robots with industry-driven instructional content determination and task planning capabilities, establishing a structured and traceable pathway from evolving occupational requirements to robot-executable
RS075 17:25-17:40	Title: A Low-Cost Replicable Quadruped Robot Platform for Undergraduate Robotics Education Author(s): Tonghui Lu, Renan Huang, Guangyu Yang, Dafeng Long, Yunshou Mao and Yuning Xu Presenter: Yuning Xu, Huizhou University, China Abstract: Quadruped robots serve as excellent interdisciplinary teaching platforms covering mechanism design, embedded systems and motion control. Nevertheless, existing educational quadruped platforms face practical obstacles: commercial prototypes are too costly for laboratory scale batch deployment; most platforms adopt closed architectures that prevent students from debugging low level hardware and validating algorithms; furthermore, standardized performance calibration procedures are rarely available to quantitatively

	evaluate teaching experiments. This paper develops and experimentally validates a low cost, replicable quadruped robot teaching platform. Built with off the shelf electronic components combined with in house Fused Deposition Modeling (FDM) 3D printing, the total bill of materials cost reaches approximately 200 CNY for easy laboratory scale multi unit construction. Static mechanical calculations and finite element simulation are carried out to verify the load safety margin of PLA printed structures. A dual mode (automatic/manual) servo calibration scheme based on mechanical dead stop reference is proposed, which suppresses joint zero offset dispersion from $\pm 5^\circ$ down to $\pm 2^\circ$. A series of repeatability experiments characterize the locomotion performance under quasi static conditions and clarify applicable constraints of the prototype
RS988 17:40-17:55	Title: Design of a Mechatronic System for Controlled Conveyor Belt Removal and Winding in Underground Mining Author(s): Edson Erik Campos Veliz, Enzo Leao Rau Utia, Ever Luis Poma Tintaya, Rubisnol Felix Julian Daga Presenter: Edson Erik Campos Veliz, School of Mechanical Engineering, Universidad Continental, Peru Abstract: The removal of conveyor belts in underground mining is usually carried out by manual winches and direct handling of personnel, despite the fact that the maintenance phase concentrates about 90% of the fatal incidents associated with this type of equipment. This work presents the design of a mechatronic system for the removal and controlled winding of conveyor belts for underground operations located at 4 200 m a.s.l. The VDI 2221 methodology was applied with technical-economic evaluation according to VDI 2225, decomposing the system into four subfunctions: motive power supply, belt guidance, voltage regulation and safe remote control. The hydraulic circuit was modeled in FluidSIM 5.1 according to ISO 1219-1, the structural analysis was solved by finite elements in SolidWorks Simulation on ASTM A36 steel under von Mises' criteria, and the control logic was implemented in a Siemens LOGO! by means of a functional block diagram. The hydraulic simulation yielded an operating pressure of 131 bar in the core radius against a relief setting of 180 bar, with a regulated flow rate of 0.96 L/min that produces the nominal winding speed of 5 m/min; it was determined that the regulation must operate in a meter-out configuration due to the dragging nature of the tensioned belt. The pressure roller and the winding reel satisfy the acceptance criteria with a wide margin, while the chassis does not comply with them and activates the redesign iteration loop provided for by the methodology.
RS696 17:55-18:10	Title: A Four-Direction Stretching Platform for PDMS-Assisted Microsphere Array Fabrication Author(s): Xinyi Chen, Bin Ai Presenter: Xinyi Chen, Huizhou University, China Abstract: Non-close-packed microsphere arrays require both particle spacing and preservation of the expanded pattern during release from a deformable support. This paper presents a four-direction stretching platform for a polydimethylsiloxane (PDMS)-assisted fabrication workflow. Four motorized linear stages pull a clamped film along two orthogonal axes, while a central working region remains accessible for particle loading and contact transfer. The architecture replaces a sequential orthogonal stretching route with one simultaneous stretching operation followed by one final transfer to a receiver film. Optical

images from experiments with nominal 5 μm polystyrene microspheres show locally ordered regions with separated particles after stretching and transfer, together with defects and variations in ordering. An ideal hexagonal-array calculation relates the desired particle gap to the required array area, but does not substitute stage motion for measured local film strain. The demonstrated contribution is the integration of coordinated film actuation and an accessible transfer workflow. Motion accuracy, field-wide strain uniformity, transfer yield, and biological functionality have not been quantitatively validated. The platform provides a practical starting point for studying automated handling of deformable particle-bearing films.

Poster Session 1: Intelligent Perception, Fault Diagnosis and Sensing Systems

Date: October 31st, 2026 / Duration: 16:10- 17:10

Venue: Outside of Meeting Room 2 - 3 F (多功能厅 2 外-3 楼)

Session Chair: Xinyi Chen, Huizhou University, China

RS002 16:10-16:40	Title: A Cross-Machine Fault Diagnosis Method Based on Cluster Discrimination and Domain Alignment Author(s): Youlin Zheng, Jianfeng Huang, Weichao Peng, Maiduo Huang, Ruiwei Huang, Gengyu Chen Presenter: Youlin Zheng, Huizhou University, China Abstract: In cross-machine fault diagnosis tasks, a significant distribution shift exists between the source and target domains, and the labeled samples in the target domain are scarce, which significantly increases the difficulty of cross-machine fault diagnosis. To address this, this paper, within a framework for adversarial transfer, first constructs few-shot pairs for adversarial learning to reduce the distribution difference within the same class while increasing it across different classes between the source and target domain data. Second, the Regional-Global Channel Attention (RGCA) attention module is employed to fuse regional and global channels for feature enhancement. Finally, Asymmetric Domain Alignment (ADA) is used to align source and target domain data, as well as sparse samples in the target domain, thereby reducing the distribution disparity between the source and target domains and improving the reliability of pseudo-labels. This paper validates the superiority of the proposed method through cross-machine transfer experiments on the CWRU and PT400pro datasets.
RS004 16:10-16:40	Title: Multi-Domain Feature Decoupling Network Based on Public Center Alignment and Domain Adversarial Training for Cross-Device Bearing Fault Diagnosis Author(s): Gengyu Chen, Jianfeng Huang, Weichao Peng, Youlin Zheng, Suhan Lin, Jingyi Lin, Huan Yan, Chenze Zou Presenter: Gengyu Chen, Huizhou University, China Abstract: Rolling bearing fault diagnosis across different devices faces domain shift, asymmetric fault categories and insufficient labeled samples, which limit the performance of traditional deep learning and domain adaptation methods. To address these issues, this paper proposes a Multi-Domain Feature Decoupling Network (MFDNN) combining public center alignment and domain adversarial training for semi-supervised cross-device bearing fault diagnosis. The network adopts a shared feature encoder to suppress device noise, and three parallel modules decouple temporal, frequency and time-frequency features. The public center alignment mechanism adapts to asymmetric fault categories, while domain adversarial training fully exploits unlabeled data to reduce domain discrepancy. We conduct experiments on CWRU and MFPT datasets under multiple noise levels. Results show that the proposed MFDNN outperforms Transformer-based models and classic domain adaptation methods in diagnosis accuracy and noise robustness. Ablation experiments and feature visualization verify the effectiveness of all core modules.

RS810 16:10-16:40	Title: Adaptive Signal Fusion Classification Model Based on Multi-Scale Features and Attention Mechanism for Machine Tool Fault Diagnosis Author(s): Suhan Lin, Jianfeng Huang, Weichao Peng, Youlin Zheng, Gengyu Chen, Jingyi Lin, Huan Yan, Chenze Zou Presenter: Suhan Lin, Huizhou University, China Abstract: Aiming at the problems of weak fault characteristics caused by single-axis accuracy degradation of machine tools and the susceptibility of traditional diagnosis methods to noise interference, an adaptive signal fusion classification model based on multi-scale features and attention mechanism is proposed. Firstly, the vibration signal is preprocessed by two-point average downscaling, wavelet denoising and Z-score normalization. Secondly, a three-channel structure is constructed using bidirectional LSTM (Bi-LSTM), WDCNN and lightweight TransDynCS attention module. TransDynCS adopts lightweight Transformer and channel-spatial interaction mechanism, and uses 3×3, 5×5 and 7×7 multi-scale convolutions to extract multi-scale features. Finally, a dynamic weight network is used to realize adaptive weighted fusion of three-channel features to complete the classification of machine tool health status. Experimental results show that the proposed model can effectively identify weak faults with high diagnosis accuracy and strong noise robustness. With lightweight structure and high computational efficiency, it is suitable for intelligent early fault diagnosis of machine tools in industrial scenarios.
RS593 16:10-16:40	Title: A Lightweight Relative-SMV Gate and Random Forest Cascade for Wearable Fall Detection Author(s): Siquan Xu, Haolong Chen, Xinyi Gong, Xiaoping Xiao, Hua-zhen Chen Presenter: Siquan Xu, Guangzhou University of Software, China Abstract: Wearable fall detection must distinguish falls from high-intensity activities of daily living (ADLs) with limited computation. We propose a two-stage detector in which a dimensionless relative-SMV gate, $R = \text{SMVmax}/\text{SMVmean}$, rejects low-risk events and an 11-feature random forest classifies the remaining candidates. The threshold is selected only from training subjects while retaining at least 99% of training falls. On 4,505 SisFall records under subject-independent five-fold validation, the cascade achieved 96.20% accuracy, 95.83% sensitivity, 96.45% specificity, and a 95.27% F1-score. It reduced random-forest invocation by 40.20% and median classification time by 17.74%, while sensitivity changed by -0.06 percentage points relative to the full classifier. With a WEDA-trained random forest, the frozen SisFall gate retained 83.71% sensitivity and reduced invocation by 23.94%. Strict SisFall-to-WEDA transfer remained unsuitable for deployment, but relative SMV improved specificity from 21.65% to 46.85% and F1-score from 55.41% to 63.93%.
RS966 16:40-17:10	Title: Compact Dual-Hollow-Core Anti-Resonant Fiber 3-dB Coupler for Coherent LiDAR Author(s): Wen Li, Kai Lu, YaNan Liu, DaCheng Hu, Daiyan Wu Presenter: Wen Li, Guangzhou University of Software, China Abstract: In a frequency-modulated continuous-wave (FMCW) coherent LiDAR system, the 3-dB coupler that splits the local-oscillator light and recombines it with the returning echo largely determines the receiving sensitivity and must be compact, low-loss, and polarization-insensitive. This paper proposes a dual-hollow-core anti-resonant fiber (DHC-ARF) 3-dB coupler based on a rectangular dielectric layer. Its thickness is set by the tenth-order resonant condition ($m = 10$), making the layer nearly half-transmissive at the operating wavelength so

	that it simultaneously separates and couples the two hollow cores. With the finite-element method, we analyze how the outer-jacket inner radius, the dielectric-layer thickness, the cladding-tube thickness, and the cladding-tube radii affect the coupling length, the coupling-length ratio (CLR), the mode loss, and the higher-order-mode extinction ratio (HOMER). At 1550 nm the optimized structure gives an identical coupling length of 9.9 mm for both polarizations (CLR = 1), polarization-insensitive coupling; over 1548.1-1551.2 nm more than 90% of the power transfers between the cores, a 3.1 nm effective bandwidth. The HOMER reaches 562 while the fundamental-mode loss stays below 0.061 dB/m, indicating excellent single-mode, low-noise operation. The tenth-order design also thickens the dielectric layer by nearly an order of magnitude over the first-order ($m = 1$) design, markedly improving fabricability, and a simplified two-half-structure stacking scheme is proposed.
RS003 16:40-17:10	Title: Two-Stage Transformer-based Appearance-Motion Association for Identity-Preserving Multi-Object Tracking Author(s): Lu Dai, Tao Lu Presenter: Lu Dai, Wuhan Institute of Technology, China Abstract: Online multi-object pedestrian tracking continues to face challenges in scenarios involving fast motion, severe occlusion and changes in lighting, while traditional single-stage association strategies often suffer from the problem of identity switching (ID switch). To address this issue, this paper proposes a two-stage Transformer-based association framework for real-time multi-object pedestrian tracking. Specifically, public detection boxes are directly utilized; subsequently, a global coarse-matching module performs computationally efficient initial matching via Transformer-based relationship modelling. For difficult targets identified by the hardness-aware routing mechanism, a local feature enhancement module further refines ambiguous matches through local contextual inference. Experiments on the MOT17 dataset demonstrate that the proposed method achieves improved ID consistency and competitive tracking accuracy while maintaining real-time inference speeds.
RS910 16:40-17:10	Title: Design and Training Convergence Analysis of Fault-Tolerant Control Strategy for Distributed Electric Drive Unmanned Platforms Based on Reinforcement Learning Author(s): Xu Xia, Guoquan Ren, Dinghai Wu Presenter: Xu Xia, Army Engineering University, China Abstract: To enhance the motion stability of distributed electric-drive unmanned platforms under extreme operating conditions, including low road adhesion, control delays, and drive faults, this paper proposes a reinforcement-learning-based fault-tolerant motion control strategy. First, the speed tracking, yaw-rate tracking, driving-force coordination, and fault compensation tasks of the unmanned platform are formulated within a unified partially observable Markov decision process. A proximal policy optimization algorithm is then employed to train an Actor-Critic policy incorporating an auxiliary velocity-estimation branch. The policy takes wheel speeds, steering angles, inertial measurement unit information, control commands, a wheel-fault mask, and historical actions as observations, and outputs front- and rear-axle steering actions together with four-wheel speed correction actions. In addition, command curriculum learning, physical-parameter randomization, control-delay randomization, and single-wheel fault randomization are introduced during training to improve the robustness and generalization capability of the policy. Simulation training results demonstrate that the system can maintain stable platform operation after a

	fault occurs. As the curriculum difficulty increases, the speed-tracking success rate remains above 98.9%, while the noise in the wheel actions gradually converges. These results provide preliminary validation of the feasibility of the proposed reinforcement learning system for fault-tolerant motion control of distributed electric-drive unmanned platforms.
RS954 16:40-17:10	Title: Urban-Rural Context Modeling for Service-Robot Deployment Planning: A Leakage-Controlled Chronological Evaluation Using National Indicators Author(s): Yanran Wang, Shilang Chen, Xuru Zheng, Shengan Zhou, Weinan Chen Presenter: Yanran Wang, Guangdong Vocational Institute of Public Administration, China Abstract: Regional differences in demand, digital connectivity, service capacity, and accessibility shape the siting and operation of service-robot pilots, including fleet sizing, station layout, remote oversight, and maintenance planning. This paper develops a leakage-controlled regional context modeling protocol for service-robot deployment planning. A 14-series World Development Indicators snapshot for China is assembled, with urban population share used as a transparent pipeline target. Four context anchors, total population, constant-price GDP per capita, Internet use, and modeled unemployment, are fixed by indicator code and deployment role before evaluation. Missing-value processing, scaling, and ridge regularization are fitted exclusively within chronological training windows. With 1993--2015 for training and 2016--2025 for testing, the four-anchor ridge model achieves an RMSE of 1.45 and an MAE of 1.19 percentage points, compared with 1.94 and 1.39 for a linear-trend baseline. The random forest remains near the training response range and yields an RMSE of 9.09. A trend-plus-indicator diagnostic yields an RMSE of 2.24, showing that shared temporal structure remains important. The experiment is formulated as contemporaneous chronological out-of-period prediction and establishes an auditable basis for subsequent province-level accessibility modeling and validation with robot deployment records.
RS476 16:40-17:10	Title: Lightweight Identity Recognition Using Mobile PIR Array and 1D-CNN-BiLSTM Algorithm Author(s): Tong Liu, Hongxiang Lin, Jianchu Liang, Jun Liu Presenter: Tong Liu, Huizhou University, China Abstract: This article presents a method integrating mobile infrared sensing with one-dimensional convolutional neural network-bidirectional long short-term memory~(1D-CNN-BiLSTM) algorithm for recognizing human targets during task execution by autonomous service robots (ASRs). A bar-shaped multi-unit pyroelectric infrared (PIR) sensors array is mounted on the robot, acquiring short-term thermal distribution changes of relatively stationary human targets in different body parts through self-rotation. The raw multidimensional outputs of the PIR array exhibit distinct inter-individual differences across various body postures, allowing them to serve directly as inputs to the classifier. A hybrid 1D-CNN-BiLSTM neural network with capability in modeling spatiotemporal patterns of thermal change signals is utilized for individual recognition. In validation experiments with a small-scale dataset collected from ten subjects under three postural conditions, the proposed method achieves an average recognition accuracy of 94.56%.

Poster Session 2: Multi-Agent Robot Navigation, Visual Servoing and Generative Robot Control

Date: October 31st, 2026 / Duration: 17:10- 18:10

Venue: Outside of Meeting Room 2 - 3 F (多功能厅 2 外-3 楼)

Session Chair: Heng Wang, South China University of Technology, China

RS711 17:10-17:40	Title: TAG-MAPPO: Dual-System Attention for Scalable Multi-AGV Navigation Author(s): Yufan Luo, Shenghuang He, Lecong Liu, Xudong Li Presenter: Yufan Luo, Dongguan University of Technology School of Computer Science and Technology, China Abstract: Coordinating automated guided vehicles (AGVs) in dense warehouses requires rapid collision avoidance and longer-horizon path planning under partial observability. A single interaction mechanism may suppress urgent proximity cues or bias planning toward nearby agents. We propose Topology-Aware Graph Multi-Agent Proximal Policy Optimization (TAG-MAPPO), which separates these roles in a dual-system encoder. System 1 combines max-pooling with distance-weighted pooling to retain local collision cues, whereas System 2 uses query– key–value attention to learn planning-relevant interactions. A fixed Top-K neighborhood limits the attention aggregation cost to $O(NK)$ for N agents. In a simulated warehouse with 3, 5, and 10 AGVs, TAG-MAPPO achieved the best overall safety–efficiency trade-off among the evaluated methods. With 10 AGVs, it reached 96.2% mean AGV completion, reduced collisions per AGV by 18.6% relative to MAPPO, and shortened episodes from 151.9 to 126.4 steps. Ablations link collision robustness to System 1 and trajectory efficiency to System 2. These results support dual-system interaction modeling for dense simulated multi-AGV coordination.
RS605 17:10-17:40	Title: Adaptive Split-Point Optimization for UAV-Edge Collaborative Inference in Marine Debris Detection Author(s): Chenye Hu, Suping Liu, Xinyi Wen, Junjie Yang Presenter: Chenye Hu, Guangdong University of Science and Technology, China Abstract: Unmanned aerial vehicles (UAVs) equipped with deep learning-based visual detection models provide a flexible and efficient solution for Marine debris detection. However, deploying the full detection model onboard UAVs is impractical due to limited onboard computing power and battery energy, while offloading all raw high-resolution images to an edge server is also undesirable because of the unreliable and dynamic over-sea communication links. In this paper, we propose a UAV-edge collaborative inference paradigm for marine debris detection, in which multiple UAVs execute a shallow submodel and transmit only intermediate features to a single edge server that completes the remaining computation and final detection. We formulate a split-point selection problem that jointly determines the model partition point for each UAV, with the objective of minimizing the total collaborative inference latency of all UAVs under per-UAV energy constraints. The problem is a discrete combinatorial optimization problem with a joint action space that grows exponentially with the number of UAVs. To solve it efficiently, we develop a deep Q-network (DQN)-based algorithm that learns an adaptive split-point selection policy from the system state, including channel conditions, UAV computing capability, and energy status. Simulation results on a water pollution dataset with YOLOv8s show that the proposed scheme consistently

	outperforms pure UAV inference, pure server inference, fixed split points, and random split points in terms of total inference latency, while maintaining zero energy violations under the guarded execution mode. These results demonstrate the effectiveness of the proposed paradigm and algorithm for real-time marine debris detection in resource-constrained robotic edge computing scenarios.
RS619 17:10-17:40	Title: A Multi-Rate Position-Based Visual Servoing Method for Moving-Target Following Author(s): Maoyong Cao, Yanqing Cui, Peng Ji Presenter: Yanqing Cui, Qilu University of Technology, China Abstract: Rate mismatch between camera sampling and robot servoing can lead to stationary tool center point (TCP) micro-motion, response lag, and abrupt command variations in eye-in-hand target following. We present a multi-rate position-based visual servoing (PBVS) method that combines YOLOv8n detection and particle tracking, acquisition-time base-frame reconstruction, One-Euro filtering, axis-wise stationary gating, coherence-screened velocity feedforward, and jerk-constrained command shaping. In 60 real-robot trials with a RealSense L515 and a JAKA manipulator, stationary gating reduced mean TCP peak-to-peak motion along X, Y, and Z from 11.31, 16.52, and 2.69 mm to 0.52, 0.51, and 0.63 mm, respectively. Feedforward showed a downward trend in mean internal-reference lag, from 487.2 to 449.4 ms (7.8%), although root-mean-square error (RMSE) did not improve. Jerk-constrained shaping reduced periodic-motion command jerk RMS by 90.3% with no material change in internal-reference RMSE. The method improves static stability and command smoothness under the tested conditions.
RS375 17:10-17:40	Title: Equivalent-Magnetic-Force Microrobot Simulation in a PIV-Validated Glioma Microvascular Model Author(s): Zhaolong Liu, Jianping Xiang, Wenjie Huang, Ziman Li, Bing Zhang Presenter: Zhaolong Liu, Shanghai University, China Abstract: Malignant glioma possesses disordered neovasculature and a complex hemodynamic microenvironment that hinders conventional targeted drug delivery. This work fabricated a biomimetic, bifurcated, tortuous microfluidic chip to replicate flow conditions within brain tumor microvessels. Particle image velocimetry (PIV) tests validated the steady, incompressible, laminar numerical model under low-Reynolds-number Newtonian water flow. Simulations reproduced the spatially heterogeneous disturbed velocity field inside the chip, providing an in vitro hemodynamic surrogate for tumor microvasculature. To reduce the computational cost of multi-physics simulations, a transient two-dimensional fluid-structure interaction (FSI) model was established for the bifurcation region near the chip inlet. Equivalent magnetic-force loading replaced iterative magnetic-field calculation to simulate the directional navigation of magnetic microspheres inside bifurcated microchannels. This efficient, simplified framework characterized magnetic microcarrier motion under tumor-mimicking flow and provided guidance for vascular navigation and motion control of magnetically driven microrobots.
RS817 17:40-18:10	Title: RECENT: A Region-Consistent Geometry-Preserving Network for Text-Driven 3D Face Editing Author(s): Kairui Wang, Xiaoyu Chai, Xingyu Guo, Zijun Luo Presenter: Kairui Wang, Wuhan Institute of Technology, China Abstract: Text-driven 3D face editing aims to manipulate 3D-aware faces using natural-

	language instructions,with applications in digital humans and avatar creation.However, existing methods often treat text guidance as a global semantic signal, leading to inaccurate local control,semantic leakage, identity drift, and inconsistent geometry across views. To address these issues, we propose RECENT,a Region-Consistent Geometry-Preserving Network, for controllable text-driven local 3D face editing. RECENT formulates local editing as a region-grounded and geometry-aware latent modulation problem. Specifically, we introduce a token-region alignment mechanism to associate instruction tokens with semantic facial regions, enabling region-focused editing. We further design a geometry-aware latent modulation strategy to inject explicit facial geometry priors into the editing direction, improving identity and structural stability. In addition, a region-consistent geometry-preserving objective is developed to suppress non-target perturbations and enhance multi-view consistency.Extensive experiments demonstrate that RECENT improves regional controllability and semantic alignment while effectively reducing identity drift, non-target perturbations, and multi-view geometric inconsistency.
RS142 17:40-18:10	Title: Streaming Text-Driven Humanoid Control via Motion-to-Tracker Compatibility Learning Author(s): Haiwei Zhang, Wencong Gan, Qingdu Li Presenter: Haiwei Zhang, University of Shanghai for Science and Technology, China Abstract: We study text-driven humanoid control as a two-level system comprising a streaming text-to-motion generator and a whole-body tracking policy. Starting from FloodDiffusion, we adapt its streaming VAE-Diffusion-Forcing architecture to a robot-authoritative motion representation that directly generates Unitree G1 references from changing text commands. We separately train a whole-body tracker, then freeze both the modified generator and the tracker. This separation exposes a policy-compatibility gap: a generated motion can be text-aligned yet fall outside the executable distribution of the downstream policy. We address the gap with tracker-aware candidate selection. For each command, the frozen generator samples K candidates; a compatibility proxy trained offline from frozen-tracker rollouts predicts execution cost and selects one candidate without simulation at deployment. In simulation, across 300 unseen text commands, proxy reranking reduces fall rate from 10.7% to 4.7% (McNemar $p = 3 \times 10^{-4}$) and tracking mean absolute error (MAE) from 0.158 to 0.129; an oracle reaches 2.3% and 0.112. A K-ablation shows that $K = 2$ captures a majority of the available candidate-space gain, while the proxy saturates below the oracle. On the primary generator, text-quality guardrails detect no significant alignment cost, and robot-centric proxy inputs improve execution-cost ranking over generator features. A continuous G1 rollout demonstrates real-time streaming command changes across walking, jogging, waving, kicking, and arm stretching.
RS965 17:40-18:10	Title: An Improved Intelligent Robotic System Security Structure Based on Internet of Things Author(s): Shiliang Luo, Zexiao Liang Presenter: Shiliang Luo, Huizhou University, China Abstract: The object is to research an AI-Driven intelligent robotic system security structure. So it is designed to match the AI-Driven intelligent robotic system. Firstly an intelligent robotic system architecture scheme is proposed. Then an AI-Driven intelligent robotic system security layer architecture is designed in order to monitor the intelligent robotic system

	reliably. And the intelligent robotic system nodes with security structure are deployed. Finally a lot of simulation experiment is done to evaluate the intelligent robotic system performances. It is showed that the improved intelligent robotic system structure is safe and effective. And it meets the performance requirements.
RS777 17:40-18:10	Title: Re-examining Social Robot Navigation Complexity under Anticipatory Pedestrian Models Author(s): Zafar Ali, Sajid Nisar Presenter: Zafar Ali, Kyoto University of Advanced Science, Japan Abstract: Social robot navigation benchmarks typically model pedestrians using the reactive ORCA or the Social Force Model (SFM), both of which lack the anticipatory collision-avoidance behavior in real human crowds. It remains unclear whether benchmark difficulty factors and algorithm rankings remain consistent under more human-like pedestrians. We implement two anticipatory models, PowerLaw and PLEdestrian, and re-run a four-factor complexity benchmark (Density, Environment Width, Directionality, Policy Mixture) across eight navigation algorithms, changing only the pedestrian policy for direct comparison with the ORCA/SFM baseline. Density remains the dominant difficulty driver, while the effects of Width and Directionality become stronger under anticipatory pedestrians. Algorithm-level effects do not follow a simple classical-versus-learned split: the force-based SFM planner collapses sharply, whereas the geometry-based ORCA and RP planners improve substantially, and among the learned methods only MPC-SGAN declines significantly. The resulting algorithm ranking is statistically unrelated to the baseline ranking (rank correlation of -0.10, $p = 0.82$). These findings show that pedestrian models are a critical experimental variable rather than a neutral benchmark detail.

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