

Proposal for a Special Session at IEEE RO-MAN 2024

Title: Multimodal Sensing, Learning, and Control for Robots in Human-Robot Collaborative Contexts

Aim and Scope of the Special Session

Collaborative robots play a critical role in the Automation 5.0 revolution. They are increasingly employed in many societally impacted areas such as smart manufacturing, healthcare, aerospace, intelligent agriculture, and autonomous driving. The collaboration of humans and robots will take the strengths from both sides to boost the shared human-centered tasks with better quality, enabling improved well-being for humans. During human-robot interaction, it is significant for the robot to optimally and accurately sense, understand, learn, and accommodate its human partner through the multimodal information from the human (e.g., physiological biometrics and behavioral biometrics) and the working environment for a natural collaboration and control process like human-human interaction. This will highly enable collaboration safety and enhance task quality in human-robot partnerships. With the increasing requirements and complexity of collaborative tasks, new interdependent research issues arise and need to be addressed to make human-robot teams more productive. This special session aims to bring scientists and engineers engaged in frontier research and technologies of robotics, sensors, control, automation, and smart systems to explore and address different open questions in the fields of robot sensing, learning, and control for human-centered collaborative tasks in societally impacted applications. Prospective authors are invited to share their original research findings for the gaps in the topics of this special session. The objectives of this special session are well aligned with the theme of RO-MAN 2024 and will potentially contribute broader engagement of researchers and engineers to the RO-MAN community.

Sub-topics of the Special Session:

- Multimodal interaction and communication in human-robot partnerships
- Cooperation and collaboration in human-robot teams
- Multimodal situation awareness and spatial cognition in human-robot interaction
- Robot learning from human demonstrations for collaborative tasks
- Human intention understanding and prediction in human-robot interaction
- Innovative robot system development
- Human factors in human-robot interactive contexts
- Robotics-enabled sustainability
- Novel sensory system development for robot control
- Robot action planning and navigation in human-centered contexts

Organizers

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Short Bio: Dr. Weitian Wang (IEEE Senior Member, ACM Senior Member) is an associate professor in the School of Computing at Montclair State University. He has longstanding and extensive research experience

in robotics, autonomy, human-robot interaction (HRI), and smart cyber-physical systems. In the past recent years, his research has been supported by \$1,601,200.00 in funding from different federal agencies and organizations. The results of his research have generated over 65 publications in multiple top-tier journals and conferences in the fields of robotics, autonomous systems, sensor technology, and artificial intelligence. He has been invited to present his work at IEEE, ACM, and ASME conferences in the US and abroad. One of his publications is recognized as the ASME Most Accessed Paper in 2022. He has received five Best Paper/Presentation/Mentor Awards in his research activities. Dr. Wang is an associate editor for 4 journals including IEEE Transactions on Automation Science and Engineering and IEEE Systems, Man, And Cybernetics Letters. He has served as a conference program chair/associate editor/co-chair/publication chair/session chair/TPC member for over 30 academic conferences in the past years.

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Short Bio: Dr. Yu She is an assistant professor at Purdue University School of Industrial Engineering. Prior to that, he was a postdoctoral researcher in the Computer Science and Artificial Intelligence Laboratory (CSAIL) at MIT from 2018 to 2021. He earned his Ph.D. degree in the Department of Mechanical Engineering at Ohio State University in 2018. His research, at the intersection of mechanical design, sensory perception, and dynamic control, explores human-safe collaborative robots, soft robotics, and robotic manipulation. He is an associate editor of IEEE Robotics and Automation Letters. He is a recipient of the 2022 Google Research Scholar Award and multiple paper recognitions, including the Best Paper Award Finalist for the 2020 ASME Journal of Mechanisms and Robotics, the Best Paper Award Finalist at the 2020 Robotics: Science and Systems (RSS) Conference, the Best Paper Award at the 2018 ASME Dynamic Systems & Control Conference (DSCC), and the Best Paper Award Finalist at the 2013 IEEE International Conference on Robotics and Biomimetics (ROBIO).

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Short Bio: Dr. Lifeng Zhou is an Assistant Professor in the Department of Electrical and Computer Engineering at Drexel University. Previously, he was a Postdoctoral Researcher at the GRASP lab of the University of Pennsylvania. He obtained his Ph.D. in Electrical and Computer Engineering from Virginia Tech in 2020. Before that, he received his MS from Shanghai Jiao Tong University in 2016 and his BS from Huazhong University of Science and Technology in 2013. He serves as an Associate Editor for the ICRA Conference Editorial Board. Dr. Zhou's research focuses on designing algorithms to enable security, reliability, and long-term autonomy for multi-robot systems. His research draws from robotics, algorithms, game theory, and machine learning and is motivated by real-world applications to environmental monitoring, surveillance, reconnaissance, search and rescue, and urban mobility. His long-term goal is to investigate secure, reliable, and scalable autonomy when robots use machine learning techniques in the areas of cyber-physical systems, the Internet of things, precision agriculture, and smart cities.

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Short Bio: Dr. Wenhao Luo is an assistant professor in computer science at UNC Charlotte. His research interests lie at the intersection of robotics, control theory, artificial intelligence, and machine learning. Specifically, his research focuses on principled methods for robust and interactive autonomy that enable robots to safely and effectively collaborate with each other and with humans in the physical world. He received a B.E. degree with honors in Measurement & Control Technology and Instruments from Central South University (China) and his M.S. and Ph.D. in Robotics from Carnegie Mellon University. He was a research intern at Microsoft Research in the summer of 2019 and 2020.

Tentative Speakers

1. Cooperative Spatial Awareness-based Robot Action Planning in Dynamic Environments, Maxim Lyons, Weitian Wang, Montclair State University.
2. VisTac: Multi-Modal Sensing Finger for Robot Manipulation. Sheeraz Athar, Gaurav Patel, Zhengtong Xu, Qiang Qiu, and Yu She. Purdue University.
3. Multi-factory Robot-assisted Remanufacturing Process Optimization Problem and Value Distribution Categorical Algorithm based on Worker Disassembly Posture Layout. Xiwang Guo, Liaoning Petrochemical University.
4. A Systematic User Study for Human Teaching and Robot Learning in Human-Robot Collaborative Contexts. Omar Obidat, Garrett Modery, Montclair State University.
5. Dynamic Adversarial Attacks on Autonomous Driving Systems, Amirhosein Chahe, Chenan Wang, Abhishek Jeyapratap, Kaidi Xu, Lifeng Zhou, Drexel University.
6. Multimodal Human Emotion Recognition for Empathetic Collaborative Robots. Jianna Loor, Montclair State University.
7. Semantic Representation of Robot Manipulation with Knowledge Graph for Human-robot Collaboration. Leiyang Fu, Jiawen Fu, Shaowen Li, Anhui Agricultural University.
8. Multi-Product Human-Robot Collaborative Hybrid Disassembly Line Balancing Problem Considering Multi-Type Resource Scheduling Based on Deep Deterministic Policy Gradient Algorithm. Xiwang Guo, Liaoning Petrochemical University, Weitian Wang, Montclair State University.
9. Safety-assured Shared Control of Human Multi-Robot Interaction. Wenhao Luo, University of North Carolina at Charlotte.
10. Interactive Digital Human for Friendly Human-Robot Collaboration. Jordan Murphy, Rui Li, Montclair State University.