Rui Liu

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Director of Cognitive Robotics and AI Lab (CRAI)
Associate Editor of: *IEEE Robotics and Automation Letters (R-AL)*
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Research Interests

My work is broadly about **Autonomous Robots and AI Systems,** designing the "Mind" for safe and secured robotic and AI systems. Robot mind is cognitive models based on cutting-edge AI algorithms and theory in cognitive science, psychology, and neuroscience. I envision that with cognitive models, robots have self-awareness, trust, safety/risk awareness, attention and security, understanding human attention and environmental risk, and build a trustworthy relation with humans and other robotic systems. Research directions in my CRAI lab include i). Human-Robot/UAV Interaction, ii). Multi-Robot Teaming and Robot Swarm, and iii). Intelligent Additive Manufacturing (metal 3D printing).

Education & Employment

Assistant Professor		**Kent State University** (R1 research univ)	Kent, OH
Postdoc	06/18-06/19	**Carnegie Mellon University**	Pittsburgh, PA
Ph.D.	01/14~05/18	**Colorado School of Mines**	Golden, CO
		Robotics & AI	

Honor and Awards

1. Best Student Paper Award from IEEE RO-MAN 2024, August 2024 for the work "Physics Representation Learning for Robotic Manipulation".
2. Nomination for Three Awards in IEEE ICRA 2015 (1.7%, H-Index:119): Best Cognitive Robotics Paper, Best Student Paper, Best Conference Paper.
3. Nominations for Best Conference Paper Award in IEEE RO-MAN 2019 for the work "trustworthy swarm".
4. Teaching Fellowship, Colorado School of Mines, 2017 summer.

Teaching

ENGR-71095-002: ST: Autonomous Robots and Interactive Learning (2024 Fall).
ENGR 78200/58200 Autonomous Unmanned Aerial Systems (2023 Fall, 2022 Fall)
AERN-35830: UAS Sensing and Sensor Systems (2020 Spring, 2021 Spring, 2022 Spring, 2023 Spring, 2024 Spring, 2025 Spring)
AERN-35810: Unmanned Aircraft Systems (2019Fall, 2020 Fall, 2021 Fall, 2022 Fall, 2023 Fall, 2024 Fall)
MEGN315A Dynamics (2017 Fall, Colorado School of Mines)

Professional Service Activities

Associate Editors for IEEE Robotics and Automation Letter (R-AL), since 2021 to now.

Conference Program Committee/Review Committee:

-The Association for the Advancement of Artificial Intelligence (AAAI) 2023, 2024.https://aaai.org/aaai-conference/

-IEEE International Conference on Robotics and Automation (ICRA) 2022, 2023. https://2024.ieee-icra.org/

-IEEE International Conference on Robot and Human Interactive Communication (RO-MAN) 2021, 2022, 2023, 2024. https://ro-man2023.org/main

-IEEE International Conference on Automation Science and Engineering (CASE), 2021. https://case2023.org/

-International Conference on Autonomous Agents and Multiagent Systems (AAMAS) 2019, 2020. https://aamas2023.soton.ac.uk/

-International Symposium on Multi-Robot and Multi-Agent Systems (MRS), 2019 https://sites.bu.edu/mrs2023/

Conference Organizer:

-Organizer of Workshop in Conference of Robotics Science and Systems (RSS).

"Large Foundation Model for Interactive Robot Learning" 2025 June.

-Organizer of Workshop in Conferences of IEEE/RSJ IROS 2021

"Cognitive and Social Aspects of Human Multi-Robot Interaction", 2021 September.

Review Panel for: National Science Foundation (NSF), 2021, 2022, 2024, 2025.

Drafts Under Review

2025

[1]. T. Guo, T. Banerjee, R. Liu, L. Su, Building Real-time Awareness of Out-of-distribution in Trajectory Prediction for Autonomous Vehicles, IEEE IROS, submitted 2025 March.

[2]. Y. Liu, R. Liu, Reflective VLM Planning for Dual-Arm Desktop Cleaning: Bridging Open-Vocabulary Perception and Precise Manipulation, arXiv:submit/6553765 [cs.RO] 2025 June.

[3]. M. Gozde, E. Novak, S. Ahmadi, J. Li, Y. Guo, R. Liu, L. Borgerding, Pathways to Knowing: Exploring High School Students' Learning in AI-Powered Educational Robotics, Journal of Educational Technology Research and Development, submitted at June 2025. Under Review.

[4]. W. Zang, R. Liu, Vision-based Adaptive Formation Control for Quadcopter Teaming in Uncertain Obstacle Environments, to be submitted.

[5]. R. Jin and R. Liu, "Adaptive Formation Control for Decentralized Multi-Robot Navigation in Densely Obstructed Environments," IEEE Robotics and Automation Letters, to be submitted.

[6]. Y. Guo, R. Liu, E. Novak. "Modeling student learning progress in robotics education via structured mentor observations" to be submitted.

[7]. W. Zang, H. Shen, R. Liu, Predicting DNA Hairpin Extension-Force Relations Using Sequence-Aware Transformer Models for DNA Ensemble Behavior Understanding, to be submitted.

Peer-Reviewed Publications

2025

[8]. Y. Guo, B. Song, X. Chen, X. Zhang, R. Liu**,** Human-to-Robot Attention Transfer for Robot Execution Failure Avoidance Using Stacked Neural Networks**,** ASME Open Journal of Engineering, DOI: 10.1115/1.4066367, 2025.

[9]. W. Zang, R. Liu, Large Language Model Driven Situation Awareness Assessment in Human-Swarm Systems, Robotics Science and Systems (RSS) workshop "Large Foundation Model for Interactive Robot Learning", accepted at May 2025.

[10]. Y. Wu, R. Liu, ActionRAG: Generalizing Instruction-to-Code via Action Graph Retrieval for Robotic Manipulation, Robotics Science and Systems (RSS) workshop "Large Foundation Model for Interactive Robot Learning", accepted at May 2025.

2024

[11]. R. Liu, Y. Guo, R. Jin, X. Zhang, A Review of Natural Language Instructed Robot Execution Systems, Journal of Artificial Intelligence, https://doi.org/10.3390/ai5030048, 2024 June.

[12]. Y. Guo, Y. Pang, J. Lyons, M. Lewis. K. Sycara, R. Liu, Trust-Aware Reflective Control for Fault-Resilient Dynamic Task Response in Human-Swarm Cooperation, Journal of Artificial Intelligence, DOI: https://doi.org/10.3390/ai5010022, 2024.

[13]. Y. Guo, C. Huang, R. Liu, Develop an Attention Mechanism for Task-Adaptive Heterogeneous Robot Teaming, Journal of Artificial Intelligence, 5(2), 555-575, https://doi.org/10.3390/ai5020029, 2024.

[14]. J. Medhi, R. Liu, Q. Wang, X. Chen, Robust Multi-agent Reinforcement Learning for UAV Systems: Countering Byzantine Attacks, Journal of Information, 14(11), 623, https://doi.org/10.3390/info14110623, 2023 November.

[15]. X. Jiang, Y. Guo, M. Hu, R. Jin, H. Phan, J. Alberts, R. Liu. Privacy-Aware Federated Joint Learning for Robot Networks in Stroke Rehabilitation, IEEE International Conference on Robot and Human Interactive Communication (RO-MAN 2024, H-Index: 28), DOI: 10.1109/RO-MAN60168.2024.10731407, 2024.

[16]. C. Huang, Y. Guo, Z. Zhu, M. Si, D. Blankenberg, R. Liu. Quantum Exploration-based Reinforcement Learning for Efficient Robot Path Planning in Sparse-Reward Environment, IEEE RO-MAN 2024, DOI: 10.1109/RO-MAN60168.2024.10731199, 2024.

[17]. W. Zang, M. Hu, R. Liu. Large Language Model Driven Interactive Learning for Real-Time Cognitive Load Prediction in Human-Swarm-System, IEEE RO-MAN 2024, DOI: 10.1109/RO-

MAN60168.2024.10731286, 2024.

[18]. Yi Wu, R. Liu, Physics Representation Learning for Dexterous Robotic Manipulation, IEEE RO-MAN 2024, DOI: 10.1109/RO-MAN60168.2024.10731363,2024. Best Student Paper Award.

[19]. J. Zhu, R. Liu. Fairness-Sensitive Policy-Gradient Reinforcement Learning for Bias-Mitigated Robotic Assistance, IEEE RO-MAN 2024, DOI: 10.1109/RO-MAN60168.2024.10731257, 2024.

[20]. M. Hu, J. Li, R. Jin, C. Shi, L. Xu, R. Liu, HGIC: A Hand Gesture Based Interactive Control System for Efficient and Scalable Multi-UAV Operations, IEEE RO-MAN 2024, DOI: 10.1109/RO-MAN60168.2024.10731385.

[21]. M. Hu, Y. Wu, Y. Guo, Y. Wu, C. Shi, L. Xu, R. Liu, Accessibility-Aware Reinforcement Learning for Inclusive Robotic Navigation, IEEE RO-MAN 2024, DOI: 10.1109/RO-MAN60168.2024.10731219.

2023

[22]. J. Medhi, C. Huang, R. Liu, X. Chen, Byzantine Resilient Reinforcement Learning for Multi-Agent UAV Systems, AIAA SCITECH, pp. 2472, DOI: https://doi.org/10.2514/6.2023-2472, 2023.

[23]. R. Liu, V. Koliyaee, F. Lucak, Y. Guo, R. Liu, Changing Roles of Human in the Human-Robot Interactions in Design and Construction, Architectural Research Centers Consortium (ARCC), 2023.

[24]. S. Liu, B. Amin-Ahmadi, R. Liu, Q. Zheng, X. Zhang, Automated phase segmentation and quantification of high-resolution TEM image for alloy design, Materials Characterization, https://doi.org/10.1016/j.matchar.2023.112779, 2023. (IF=4.7)

2022

[25]. Z. Zhao, B. He, W. Luo, and R. Liu, Collective Conditioned Reflex: A Bio-Inspired Fast Emergency Reaction Mechanism for Designing Safe Multi-Robot Systems, IEEE Robotics and Automation Letters (RAL, IF:5.2), Vol 7(4), pp. 10985 – 10990, 2022.

[26]. C. Huang, R. Liu, Design Attention Awareness Among Robots for Uncertainty-Adaptive Heterogeneous Teaming, IEEE International Conference on Advanced Robotics and its Social Impacts (ARSO), DOI: 10.1109/ARSO54254.2022.9802958, 2022.

2021

[27]. C. Huang, W. Luo, R. Liu, Meta Preference Learning for Fast User Adaptation in Human-Supervisory Multi-Robot Deployments, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS, H-index: 78), pp. 5851-5856, 2021.

[28]. Y. Pang, C. Huang, R. Liu, Synthesized Trust Learning from Limited Human Feedback for Human-Load-Reduced Multi-Robot Deployments, IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN), DOI: 10.1109/RO-MAN50785.2021.9515509, 2021.

[29]. Y. Pang, R. Liu, Trust-Aware Emergency Response for A Resilient Human-Swarm Cooperative System, IEEE International Symposium on Safety, Security, and Rescue Robotics (SSRR), pp. 15-20, DOI: 10.1109/SSRR53300.2021.9597682, 2021.

[30]. B. Song, Y. Peng, Ruijiao Luo, Rui Liu, An Attention Transfer Model for Human-Assisted Failure

Avoidance in Robot Manipulations, IEEE International Conference on Automation Science and Engineering (CASE), pp. 2293-2298, 2021.

[31]. R. Luo, C. Huang, Y. Peng, B. Song, Rui Liu, Repairing Human Trust by Promptly Correcting Robot Mistakes with An Attention Transfer Model, IEEE International Conference on Automation Science and Engineering (CASE), pp. 1928-1933, 2021.

[32]. Q. Yu, S. Zhexin, Y. Pang, R. Liu, Proficiency Constrained Multi-Agent Reinforcement Learning for Environment-Adaptive Multi UAV-UGV Teaming, IEEE International Conference on Automation Science and Engineering (CASE), DOI: 10.1109/CASE49439.2021.9551457, 2021.

[33]. R. Liu, S. Liu, and X. Zhang, A Physics Informed Machine Learning Model for In-Depth Porosity Analysis in Metal Additive Manufacturing, International Journal of Advanced Manufacturing Technology, DOI:10.1007/s00170-021-06640-3, 2021. (IF:3.226)

2020

[34]. C. Huang, R Liu, Flexible Teaming of Heterogeneous Multi Robots, Robotics Science and Systems (RSS, H-index:61) workshop poster, 2020.

[35]. Y. Pang, R Liu, Trust-Understanding for Swarm Emergency Response, Robotics Science and Systems (RSS, H-index:61) workshop poster, 2020.

2019

[36]. R. Liu and X. Zhang, Methodologies for Realizing Natural-Language-Based Human-Robot Cooperation, International Journal of Advanced Robotic Systems, https://doi.org/10.1177/1729881419851402, 2019.

[37]. R. Liu, Z. Cai, M. Lewis, K. Sycara, Trust-Repair in Human-Swarm Teams, IEEE International Conference on Robot and Human Interactive Communication (Ro-Man), DOI: 10.1109/RO-MAN46459.2019.8956420, 2019. Nominated as best conference paper award. (H5-index: 29)

[38]. R. Liu, M. Lewis, K. Sycara, Trust-Aware Behavior Reflection for Swarm Self-Healing, International Conference on Autonomous agents and multi-agent systems (AAMAS), pp. 122-130, 2019. (H-index: 51, acceptance rate: **22.4%**)

2018 and Before

[39]. R. Liu and X. Zhang, Generating Machine-Executable Plan from Human's Natural Instructions, Knowledge-based Systems, vol 140, pp. 15-26, 2017. (IF: 5.921)

[40]. R. Liu and X. Zhang, Context-Specific Grounding of Web Natural Descriptions to Human-Centered Situations, Knowledge-based Systems, 111, pp. 1-16, 2016. (IF: 5.921)

[41]. R. Liu and X. Zhang, Web-Video-Mining-Supported Workflow Modeling for Robotic Surgeries, Artificial Intelligence in Medicine, 74(C), pp. 9-20, 2016. (IF: 4.383)

[42]. R. Liu and X. Zhang, Understanding Human Behaviors with an Object Functional Role Perspective for Robotics, IEEE Transactions on Cognitive and Developmental Systems, vol. 8, no. 2, pp. 115-127, 2015. (IF: 2.667)

[43]. R, Liu and X. Zhang, Fuzzy-Context-Specific Intention Inference for Robotic Caregiving, International Journal of Advanced Robotic Systems, DOI: 10.1177/1729881416662780, 2016.

[44]. R. Liu, Z. Zhang, and X. Hua, An Active Control Method of Suppressing the Actuator Mutual Interference, Noise and Vibration Control, 33(5), pp. 158-160, 2012.

[45]. R. Liu and X. Zhang, Context-Specific Intention Awareness Through Web Query in Robotic

Caregiving, IEEE ICRA, pp. 1692-1697, 2015. (H-index: 105) Nominated as best conference paper, best student paper, best cognitive robotics paper. Nomination Rate: 1.7%.

[46]. R. Liu and X. Zhang, Use Context to Understand User's Implicit Intentions in Activities of Daily Living, IEEE ICMA, pp. 1214-1219, 2014.

[47]. R. Liu, J. Webb, and X. Zhang, Natural-Language-Assisted Industrial Task Execution, ASME IDETC, 2016.

[48]. X. Zhou, R. Liu, J. Zhang, and X. Zhang, Stabilization of a Quadrotor with Uncertain Suspended Load Using Sliding Mode Control, ASME IDETC, 2016.

[49]. R. Liu, X. Zhang, and A. Stebner, Intelligent Knowledge-Sharing Networks of 3D Metals Printers, Recent advances in integrated computational and experimental methods for additive manufacturing, 2017.

Degree Dissertations

[50]. R. Liu. A Cognitive Comprehension Model for Human-Centered Situation Learning and Adaptation in Robotics. Ph.D. Dissertation. Colorado School of Mines, 2018 May.

[51]. R. Liu, Multi-Channel Adaptive Control of Vibration. Master Thesis. SJTU, 2013 March