

Summary

The central theme of my research focuses on **collaborative autonomy to enable team awareness for multi-robot and human-autonomy teaming**. To achieve this goal, I have been pursuing interdisciplinary research about robotics, machine learning, explainable AI, control theory, optimization, and computer vision. My broad research interests include connected automated vehicles, heterogeneous multi-robot cooperation and adaptation, human-centered robotics, and the Internet of Robotics things.

I got a postdoc fellowship (\$60,000) at Maryland Robotics Center, published 16 (13 first-author) papers in top conferences and journals (RSS, ICRA, IROS, ICML, AAAI, IJRR, AuRo) and 1 patent, co-chaired the multi-robot session at IROS 2023, served as an associate editor for IEEE RAL, and reviewed over 50 papers in premier journals/conferences. I also assisted with proposal writing, gave guest lectures, worked as a teaching assistant, mentored students, organized workshops, and participated in university outreach programs.

Education

Ph.D. Degree Computer Science Department GPA: 3.63/4 Thesis: Collaborative Perception for Multi-Robot Team Awareness Advisor: Dr. Hao Zhang	Colorado School of Mines 2017 – 2022
Master Degree Automation Department	Southeast University, China 2012 – 2015
Bachelor Degree Automation Department	Chongqing University, China 2008 – 2012

Professional Experience

University of Massachusetts, Amherst Postdoc Associate (Doing Research with Umass)	2023 – Present MA, USA
Colorado School of Mines Postdoc Associate (Funding from Mines)	2023 – Present CO, USA
University of Maryland, College Park Postdoc Associate	2022 – 2023 MD, USA
Toyota InfoTech Lab Research Intern, Advised by Dr. Rui Guo and Dr. Hongsheng Lu	2019 CA, USA
Colorado School of Mines Teaching Assistant	2017 – 2019 CO, USA
IBM Software Engineer	2015 – 2017 Beijing, China

Awards

- Best Paper Award for Agri-Robotics in IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2023.
- Outstanding Graduate Student Research Award, Colorado School of Mines (2021).
- Graduate Student Government Travel Grants, Colorado School of Mines (2020).
- AAAI Student Scholarship, Association for the Advancement of Artificial Intelligence (2020).

5. IBM Agile Innovator Award, IBM (2015)
6. Second Prize in National Graduate Contest of Mathematical Modeling, Southeast University (2013).
7. Outstanding Student Award (top 5%), Chongqing University (2012).
8. Outstanding Student Leadership in Chongqing Province, top 1 in Automation Department (2012).

Publications

Conference Papers

1. **Peng Gao**, Yu Shen and Ming C. Lin. “Collaborative Decision-Making Using Spatiotemporal Graphs in Connected Autonomy.” *IEEE International Conference on Robotics and Automation (ICRA)*, 2024.
2. Jing Liang, **Peng Gao**, Xuesu Xiao, Adarsh Jagan Sathyamoorthy, Mohamed Elnoor, Ming C. Lin and Dinesh Manocha. “MTG: Mapless Trajectory Generator with Traversability Coverage for Outdoor Navigation.” *IEEE International Conference on Robotics and Automation (ICRA)*, 2024.
3. **Peng Gao**, Jing Liang, Yu Shen, Sanghyun Son, and Ming C. Lin, Visual, Spatial, *Geometric-Preserved Place Recognition for Cross-View and Cross-Modal Collaborative Perception* in IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2023. **Best Paper Award for Agri-Robotics (<1%)**.
4. **Peng Gao**, Sriram Siva, Anthony Micciche, and Hao Zhang. “Collaborative Scheduling with Adaptation to Failure for Heterogeneous Robot Teams.” in *IEEE International Conference on Robotics and Automation (ICRA)*, 2023.
5. **Peng Gao**, Qingzhao Zhu, Hongsheng Lu, Chuang Gan, and Hao Zhang. “Deep Masked Graph Matching for Correspondence Identification in Collaborative Perception.” in *IEEE International Conference on Robotics and Automation (ICRA)*, 2023.
6. Yu Shen, Xijun Wang, **Peng Gao**, and Ming C. Lin, “Auxiliary Modality Learning with Generalized Curriculum Distillation”, in *International Conference on Machine Learning (ICML)*, 2023.
7. **Peng Gao**, Brian Reily, Rui Guo, Hongsheng Lu, Qingzhao Zhu and Hao Zhang. “Asynchronous Collaborative Localization by Integrating Spatiotemporal Graph Learning with Model-Based Estimation.” in *IEEE International Conference on Robotics and Automation (ICRA)*, 2022.
8. **Peng Gao** and Hao Zhang. “Bayesian Deep Graph Matching for Correspondence Identification in Collaborative Perception.” in *Robotics Science and System (RSS)*, 2021.
9. **Peng Gao**, Rui Guo, Hongsheng Lu, and Hao Zhang. “Multi-view Sensor Fusion by Integrating Model-based Estimation and Graph Learning for Collaborative Object Localization.” in *IEEE International Conference on Robotics and Automation (ICRA)*, 2021.
10. **Peng Gao**, Rui Guo, Hongsheng Lu, and Hao Zhang. “Regularized Graph Matching for Correspondence Identification under Uncertainty in Collaborative Perception.” in *Robotics Science and System (RSS)*, 2020.
11. **Peng Gao**, and Hao Zhang. “Long-Term Loop Closure Detection through Visual-Spatial Information Preserving Multi-Order Graph Matching.” in *AAAI Conference on Artificial Intelligence (AAAI)*, 2020.
12. **Peng Gao**, Ziling Zhang, Rui Guo, Hongsheng Lu, and Hao Zhang. “Correspondence identification in collaborative robot perception through maximin hypergraph matching.” in *IEEE International Conference on Robotics and Automation (ICRA)*, 2020.
13. **Peng Gao**, and Hao Zhang. “Long-term Place Recognition through Worst-case Graph Matching to Integrate Landmark Appearances and Spatial Relationships.” in *IEEE International Conference on Robotics and Automation (ICRA)*, 2020.
14. **Peng Gao**, Brian Reily, Savannah Paul, and Hao Zhang. “Visual reference of ambiguous objects for augmented reality-powered human-robot communication in a shared workspace.” in *International Conference on Virtual, Augmented and Mixed Reality (VAMR)*, 2020, invited paper.
15. Rui Guo, Hongsheng Lu, **Peng Gao**, Ziling Zhang, and Hao Zhang. “Collaborative localization for occluded objects in connected vehicular platform.” in *IEEE Vehicular Technology Conference (VTC)*, 2019.

Journal Papers

1. **Peng Gao**, Qingzhao Zhu and Hao Zhang. “Uncertainty-aware correspondence identification for collaborative perception.” in *Autonomous Robots (AuRo)*, 1-14, 2023.
2. **Peng Gao**, Rui Guo, Hongsheng Lu, and Hao Zhang. “Correspondence identification for collaborative multi-robot perception under uncertainty.” in *Autonomous Robots (AuRo)*, 1-16, 2022.
3. Brian, Reily, **Peng Gao**, Fei Han, Hua Wang, and Hao Zhang. “Real-Time Recognition of Team Behaviors by Multisensory Graph Embedded Robot Learning.” in *International Journal of Robotics Research (IJRR)*, 2021.

Patent

1. Rui Guo, Hongsheng Lu and **Peng Gao**. “Asynchronous observation matching for object localization in connected vehicles“. U.S. Patent No. 11,564,116. 24 Jan. 2023.

Workshop

1. **Peng Gao**, Ahmed Jaafar, Brian Reily, Christopher Reardon, and Hao Zhang. “Compositional Zero-Shot Learning for Attribute-Based Object Reference in Human-Robot Interaction”, *Conference on Robot Learning*, workshop, 2024.
2. Sriram Siva, **Peng Gao**, Yiming Deng, Hao Zhang, “Multisensory Internal Pipe Threat Prediction Using Inline Inspection Robots”, in *IEEE International Conference on Robotics and Automation (ICRA)*, Abstract-Only Poster, 2018.

Under Review

1. **Peng Gao**, Williard Joshua Jose, Hongsheng Lu, Takayuki Shimizu, Qi Chen and Hao Zhang. “Bandwidth-Adaptive Spatiotemporal Correspondence Identification for Collaborative Perception.” submitted to *Robotics Science and System (RSS)*, 2024.

Invited Talks and Presentations

Collaborative Perception in Connected Autonomy

1. Shanghai Jiao Tong University and Shanghai AI Laboratory, 2022.
2. Colorado School of Mines, 2022.
3. Marquette University, 2021.

Interdisciplinary Study on Vision-based Long-Term Pipelines Inspection

1. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA) Forum, poster 2020.

Conference Presentation

1. Cross-View Cross-Modal Multi-Robot Collaborative Perception, IROS 2023
2. Heterogeneous Multi-Robot Task Allocation and Failure Adaptation, ICRA 2023
3. Correspondence Identification in Connected Autonomous Driving, ICRA 2023
4. Asynchronous Collaborative Localization, ICRA 2022
5. Human-Robot Collaborative Assembly, RSS 2021
6. Collaborative Object Localization, ICRA 2021
7. Uncertainty-Aware Correspondence Identification, RSS 2020
8. Long-Term Loop Closure Detection, ICRA 2020, AAAI 2020

Teaching

Guest Lecturer, University of Maryland, College Park, Spring 2023

1. ENAE4880/7880 Introduction to Autonomous Multi-Robot Swarms

Teaching Assistant, Colorado School of Mines, 2017-2018

1. CSCI-101: Introduction of Computer Science, Fall 2017.
2. CSCI-573: Human-Centered Robotics, Spring 2018.
3. CSCI-598: Robot Planning and Manipulation, Spring, 2018.

Mentorship

1. Jasmine Taank, Ama Sefah, Jorge Murillo Bajana, Neena Thota, Sahana Satish, Omar Osman (undergraduate team): University of Massachusetts, Amherst, 2023
2. Li Chen (graduate): University of Massachusetts, Amherst, 2023
3. Zihao Deng (graduate): University of Massachusetts, Amherst, 2023
4. Ahmed Jaafar (undergraduate): University of Massachusetts, Amherst, 2023
5. Chris Jose (Undergraduate): University of Maryland, College Park, 2023
6. Williard Joshua Jose (Ph.D.): University of Massachusetts, Amherst, 2022
7. Qingzhao Zhu (Ph.D.): Colorado School of Mines, 2022.
8. Pheobe Wu (high school): PROGRESS, Colorado School of Mines, 2021.
9. Mehmet Yilmaz (undergraduate): Colorado School of Mines, 2020-2021.
10. Savannah Paul (graduate): Colorado School of Mines, 2020
11. Luc Lafave (undergraduate): Colorado School of Mines, 2021.
12. Carl Schader (undergraduate): Colorado School of Mines, 2018-2019.
13. Evan Lim (graduate): Colorado School of Mines, 2021.
14. Shutong Qi (graduate): Colorado School of Mines, now at University of Toronto, 2019
15. Ziling Zhang (graduate): Colorado School of Mines, 2018-2019.

Academia Service

Co-Chair

1. “Multi-Robot and Distributed Robot Systems II” session at IROS 2023.

Organizing Workshop

1. Co-Organizer: “Bridging the Gap between Cognitive Science and Robot Learning in the Real World: Progresses and New Directions” in Conference on Robot Learning (CoRL) Workshop, 2023 (accepted).

Associate Editor

1. IEEE Robotics and Automation Letters (**RAL**), 2022-present
2. IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**), 2024-present.

Program Committee Member

1. IEEE Vehicular Technology Conference (**VTC**), 2023

Reviewer

1. Robotics Science and Systems (**RSS**), 2024.
2. IEEE Transactions on Robotics (**T-RO**), 2024

3. IEEE International Conference on Robotics and Automation (**ICRA**), 2020-present.
4. IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**), 2019-present.
5. IEEE Robotics and Automation Letters (**RAL**), 2019-present.
6. AAAI International Conference on Automated Planning and Scheduling (**ICAPS**), 2021
7. IEEE Vehicular Technology Conference (**VTC**), 2021.
8. IEEE International Conference on Humanoid Robots (**Humanoids**), 2019.
9. The ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (**IMWUT**), 2022.
10. Elsevier Robotics and Autonomous Systems (**RAS**), 2021.
11. Elsevier Intelligent Service Robotics, 2021
12. Elsevier Journal of Visual Communication and Image Representation, 2021
13. ASME Journal of Dynamic Systems Measurement and Control, 2021

Grants and Fellowships

Principle Investigator

1. Maryland Robotics Center Postdoc Associate Fellowship on “Collaborative Perception for Multi-Robot/Human-Robot Team Awareness”, University of Maryland, College Park, \$60,000 awarded, PI: Peng Gao, 2022.

Leading Proposal Writing

1. NSF’s Mind, Motor, and Machine Nexus (M3X) “Neuro-symbolic Co-adaptation for Tightly Coupled Human-robot Collaboration”, PIs: Hao Zhang and Donghyun Kim in UMass Amherst, \$300,000, under preparation.
2. Toyota Program on “Learnable Communications among Connected Vehicles for Collaborative Localization of Dynamic Street Objects”, \$300,000 awarded, PI: Prof. Hao Zhang.

Assisting Proposal Writing

1. DARPA Project on “Autonomous Group Introspective Learning and coopEtition (AGILE) for Cross-Capability Multi-Robot Adaptation”, \$500,000 awarded, PI: Prof. Hao Zhang.
2. NSF CPS project on “xVision: Edge-Assisted Cooperative Perception for Connected Vehicle Systems”, PIs: Ruozhou Yu at NCSU, Hao Zhang at UMass, and Dejun Yang at Mines, \$420,000, under review.

DEI and Outreach

1. Undergraduate mentor for independent study at the University of Massachusetts, Amherst, including 1 Latin, 1 Africa American, and 3 female students.
2. Graduate mentor for PROGRESS (Program for Robotics Outreach on Gender and Racial Equity in School and Society), providing mentorship to K-12 students and teachers, at Colorado School of Mines.
3. Student representative for the suggestion and evaluation of the computer science department at Colorado School of Mines.

References

Prof. Hao Zhang, Associate Professor

University of Massachusetts Amherst.

Prof. Ming C. Lin, Former Chair of Computer Science and Distinguished University Professor

University of Maryland, College Park.

Prof. Tracy Camp, Founding Department Head and Emeritus Professor

Colorado School of Mines

Prof. Thomas Williams, Associate Professor

Colorado School of Mines

Dr. Hongsheng Lu, Principal Researcher

Toyota InfoTech Lab