Zhe Huang

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Research Overview

My research is focused on building **Human-Centered Embodied AI** to enable robots to safely and efficiently interact with humans and the physical world. A major challenge to achieve this goal is that existing fully autonomous robots do not have sufficient understanding of human behavior, and act conservatively with humans around to guarantee safety of humans and themselves, which is at the cost of efficiency. I develop human-centered autonomy frameworks including human prediction and robot planning with human intent and human trajectory as interface for robots to achieve challenging human-involved open-world tasks. My works integrate well-established algorithmic primitives and novel machine learning techniques to offer efficiency improvement under safety guarantees. My works illustrate generality of Human-Centered Embodied AI across various applications including autonomous driving, crowd navigation, collaborative manufacturing, and collaborative cooking.

Research Areas: Robotics, Artificial Intelligence, Human-Robot Interaction.

Education

2019 – 2024 University of Illinois Urbana-Champaign
Ph.D. in Electrical and Computer Engineering
Advisor: Katherine Driggs-Campbell
Thesis: *Bridging Prediction and Planning for Human-Centered Autonomy*

2017 – 2019 Stanford University
M.S. in Mechanical Engineering

2013 – 2017 Xi'an Jiaotong University
B.Eng. in Energy and Power Engineering, Honors Engineering Program

Employment

2024 - Present	Meta
	Research Scientist
2019 - 2024	University of Illinois Urbana-Champaign
	Human-Centered Autonomy Lab (PI: Katherine Driggs-Campbell)
	Graduate Research Assistant
Fall 2022	Amazon Robotics
	Advanced Robotics Research Co-op
Summer 2022	Nuro
	Ph.D. Intern
Spring 2019	Schlumberger Software Technology and Innovation Center
	Digital Technology Intern
2018	Stanford University
	Stanford Robotics Lab (PI: Oussama Khatib)
	Graduate Research Assistant
Fall 2017	Stanford University
	Collaborative Haptics and Robotics in Medicine Lab (PI: Allison Okamura)
	Graduate Research Assistant

Peer-Reviewed Publications

The (*) indicates equal contribution.

1. **Z. Huang**, T. Ji, H. Zhang, F. Cheraghi Pouria, K. Driggs-Campbell, and R. Dong. Interaction-aware Conformal Prediction for Crowd Navigation. International Workshop on the Algorithmic Foundations of Robotics (WAFR), 2024.

2. **Z. Huang**, H. Chen, J. Pohovey, and K. Driggs-Campbell. Neural Informed RRT*: Learning-based Path Planning with Point Cloud State Representations under Admissible Ellipsoidal Constraints. IEEE International Conference on Robotics and Automation (ICRA), 2024.

3. **Z. Huang**, J. Pohovey, A. Yammanuru, and K. Driggs-Campbell. LIT: Large Language Model Driven Intention Tracking for Proactive Human-Robot Collaboration – A Robot Sous-Chef Application. IEEE/CVF Computer Vision and Pattern Recognition Conference (CVPR) 3rd Workshop on Computer Vision in the Wild Workshop and 5th Annual Embodied AI Workshop, 2024.

4. F. Cheraghi Pouria*, **Z. Huang***, A. Yammanuru*, S. Liu, and K. Driggs-Campbell. Topology-Guided ORCA: Smooth Multi-Agent Motion Planning in Constrained Environments. Robotics: Science and Systems (RSS) Workshop on Unsolved Problems in Social Robot Navigation, 2024.

5. **Z. Huang***, Y. J. Mun*, X. Li, Y. Xie, N. Zhong, W. Liang, J. Geng, T. Chen, and K. Driggs-Campbell. Hierarchical Intention Tracking for Robust Human-Robot Collaboration in Industrial Assembly Tasks. IEEE International Conference on Robotics and Automation (ICRA), 2023.

6. S. Liu, P. Chang, **Z. Huang**, N. Chakraborty, K. Hong, W. Liang, D. McPherson, J. Geng, and K. Driggs-Campbell. Intention Aware Robot Crowd Navigation with Attention-Based Interaction Graph. IEEE International Conference on Robotics and Automation (ICRA), 2023.

7. **Z. Huang**, Y. J. Mun, H. Chen, Y. Xie, Y. Niu, X. Li, N. Zhong, H. You, D. L. McPherson, and K. Driggs-Campbell. Towards Safe Multi-Level Human-Robot Interaction in Industrial Tasks. IEEE

International Conference on Automation Science and Engineering (CASE) Special Session: The Next-Generation Resilient Cyber-Physical Manufacturing Networks, 2023.

8. H. Chen, Y. J. Mun, **Z. Huang**, Y. Niu, Y. Xie, D. L. McPherson, and K. Driggs-Campbell. Learning Task Skills and Goals Simultaneously from Physical Interaction. IEEE International Conference on Automation Science and Engineering (CASE) Special Session: The Next-Generation Resilient Cyber-Physical Manufacturing Networks, 2023.

9. **Z. Huang**, R. Li, K. Shin, and K. Driggs-Campbell. Learning Sparse Interaction Graphs of Partially Detected Pedestrians for Trajectory Prediction. IEEE Robotics and Automation Letters (RA-L), 2022.

10. **Z. Huang***, Y. J. Mun*, X. Li, Y. Xie, N. Zhong, W. Liang, J. Geng, T. Chen, and K. Driggs-Campbell. Seamless Interaction Design with Coexistence and Cooperation Modes for Robust Human-Robot Collaboration. IEEE International Conference on Automation Science and Engineering (CASE) Special Session: Adaptive and Resilient Cyber-Physical Manufacturing Networks, 2022.

11. T. Chen, **Z. Huang**, J. Motes, J. Geng, Q. M. Ta, H. Dinkel, H. Abdul-Rashid, J. Myers, Y. J. Mun, W. C. Lin, Y. Y. Huang, S. Liu, M. Morales, N. M. Amato, K. Driggs-Campbell, T. Bretl. Insights from an Industrial Collaborative Assembly Project: Lessons in Research and Collaboration. IEEE International Conference on Robotics and Automation (ICRA) Workshop: Collaborative Robots and the Work of the Future, 2022.

12. J. Xu, **Z. Huang**, Y. Wang, Z. Xiang, and B. Xiong. Identification of Novel Tumor Microenvironment Regulating Factor that Facilitates Tumor Immune Infiltration in Cervical Cancer. Frontiers in Oncology, 2022.

13. **Z. Huang**, A. Hasan, K. Shin, R. Li, and K. Driggs-Campbell. Long-Term Pedestrian Trajectory Prediction Using Mutable Intention Filter and Warp LSTM. IEEE Robotics and Automation Letters (RA-L), 2021.

14. P. Du, **Z. Huang**, T. Liu, T. Ji, K. Xu, Q. Gao, H. Sibai, K. Driggs-Campbell, and S. Mitra. Online Monitoring for Safe Pedestrian-Vehicle Interactions. IEEE International Conference on Intelligent Transportation Systems (ITSC), 2020.

15. C. Chatar, **Z. Huang**, and P. Hadrovic. A Voice Interface for Drilling Systems. IADC/SPE International Drilling Conference and Exhibition, 2020.

16. L. T. Gan, L. H. Blumenschein, **Z. Huang**, A. M. Okamura, E. W. Hawkes, and J. A. Fan. 3D Electromagnetic Reconfiguration Enabled by Soft Continuum Robots. IEEE Robotics and Automation Letters (RA-L), 2020.

17. **Z. Huang**, H. Zhao, C. Liu, X. Chen, F. Kopsaftopoulos, and F. K. Chang. High Accuracy Flight State Identification of a Self-Sensing Wing via Machine Learning Approaches. International Workshop on Structural Health Monitoring: Enabling Intelligent Life-Cycle Health Management for Industry Internet of Things, 2019.

Preprints

1. M. Mansouri, **Z. Huang**, Y. Chen, K. Driggs-Campbell, W. R. Norris, J. Ramos, and E. T. Hsiao-Wecksler. Implementation and Validation of Obstacle Avoidance Algorithms on a Self-Balancing Ballbot. TechRxiv, 2024.

2. N. Chakraborty, Y. Fang, A. Schreiber, T. Ji, **Z. Huang**, A. Mihigo, C. Wall, A. Almana, and K. Driggs-Campbell. Towards Real-Time Generation of Delay-Compensated Video Feeds for Outdoor Mobile Robot Teleoperation. arXiv, 2024.

3. Y. J. Mun*, **Z. Huang***, H. Chen, Y. Niu, H. You, D. L. McPherson, and K. Driggs-Campbell, User-Friendly Safety Monitoring System for Manufacturing Cobots. arXiv, 2023.

Invited Talks and Demonstrations

- **Representing Interactions for Robot Navigation** (joint talk with Prof. Katherine Driggs-Campbell)
  - 5^{th} Robot Learning Workshop: Trustworthy Robotics (NeurIPS), 12/2022
- **Human Behavior Modeling in Autonomous Driving and Collaborative Manufacturing**
  - 9^{th} Wuhan University International Forum for Interdisciplinary Sciences and Engineering, 04/2022
- **Human-Robot Interaction Demo: Make a Fist Bump with Robot!**
  - Illinois Saturday Engineering for Everyone, 03/2022
- **Demo of Human-Robot Collaboration in Industrial Assembly Tasks**
  - Robotics Session at the Annual CSL Student Conference, 02/2022

Teaching Experience

- ECE598: Human-Robot Interaction (Graduate), University of Illinois at Urbana-Champaign, Fall 2023 (teaching assistant)
- ECE598: Human-Robot Interaction (Graduate), University of Illinois at Urbana-Champaign, Spring 2022 (teaching assistant)
- CS223A: Introduction to Robotics (Graduate), Stanford University, Winter 2019 (teaching assistant)

Professional Activities

- **Reviewer for Journals**
  - IEEE Transactions on Intelligent Transportation Systems (T-ITS) 2023/2024
  - IEEE Transactions on Network Science and Engineering (TNSE) 2023/2024
  - IEEE Transactions on Intelligent Vehicles (T-IV) 2022/2024
  - IEEE Vehicular Technology Magazine (VTM) 2022
  - IEEE Robotics and Automation Letters (RA-L) 2021/2023/2024
  - IEEE Signal Processing Letters (SPL) 2021
  - Frontiers in Neuroscience 2024
- **Reviewer for Conferences**
  - IEEE International Conference on Robotics and Automation (ICRA) 2024/2025
  - IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2021/2022
  - Robotics: Science and Systems (RSS) 2022/2024
  - AAAI Conference on Artificial Intelligence (AAAI) 2023/2024
  - IEEE International Conference on Automation Science and Engineering (CASE) 2023/2024
  - IEEE International Conference on Intelligent Transportation Systems (ITSC) 2020
  - IEEE-RAS International Conference on Humanoid Robots (Humanoids) 2022

Awards and Fellowships

- Spotlight Presentation on the 3rd Workshop on Computer Vision in the Wild at CVPR, 2024
- Spotlight Presentation on Workshop on Collaborative Robots and the Work of the Future at ICRA, 2022
- Best Robotics Demo at the Annual CSL Student Conference, 2022
- Chiang Chen Overseas Fellowship as one of ten recipients in China awarded $ 50,000, 2017
- Delivered the commencement speech at Xi'an Jiaotong University graduation ceremony as the representative of over 3,000 Bachelor's degree recipients, 2017
- Outstanding Student, Xi'an Jiaotong University, 2014-2016
- Pengkang Scholarship as top 2%, Xi'an Jiaotong University, 2015-2016
- China National Scholarship as top 1%, 2014
- National First Prize in China Undergraduate Mathematical Contest in Modeling as top 1%, 2014

Mentoring

- Fatemeh Cheraghi Pouria (UIUC ME PhD student)
- John Pohovey (UIUC ECE MS student)
- Aparna Srinivasan (UIUC ECE undergraduate student)
- Diego Nieto (UIUC CS undergraduate student)
- Hongyu Chen (UIUC ECE BS, 2024)
- Yiqing Xie (UIUC ECE MS, 2023)
- Xiang Li (UIUC ECE MS, 2023)
- Haoyuan You (UIUC ECE BS, 2023)
- Adithya Ramakrishnan (UIUC ME BS, 2023)
- Ninghan Zhong (UIUC CS BS, 2022)
- Yiqing Du (ZJU-UIUC ECE BS, 2022)
- Shilan He (ZJU-UIUC ECE BS, 2022)
- Shiqi Yu (ZJU-UIUC ECE BS, 2022)
- Linghao Zhang (ZJU-UIUC ECE BS, 2022)
- Kazuki Shin (UIUC ECE BS, 2021)
- Ruohua Li (UIUC ECE BS, 2021)
- Zhaoxu Deng (UIUC ECE BS, 2021)