Ruiqi Wang

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RESEARCH INTEREST

My research focuses on developing **adaptive human-robot systems** to facilitate the seamless integration of robots into daily human life. I investigate adaptation mechanisms across three key dimensions: the **inherent heterogeneity** of humans in terms of their cognitive and operational characteristics, **dynamic human states** such as cognitive load and fatigue throughout interactions, and **individual preferences** for personalized robot interactive behaviors. Spanning scales from *one-to-one human-robot interaction* to team-level coordination in *multi-human multi-robot teams*, my work aims to lay the foundation for a future where robots can naturally understand, adapt to, and collaborate with any human, in any context or situation.

Research Areas: Human-Robot Interaction, Human-in-the-Loop Robot Learning, Multi-Agent Human-Robot Teams, Multi-Modal Perception and Reasoning, Affective Computing, Foundation Models

EDUCATION

Ph.D. in Computer and Information Technology *Aug. 2021 – Present*
Purdue University, West Lafayette, IN, USA

- *Concentration*: Robotics and AI
- *Advisor*: Prof. Byung-Cheol Min
- *Dissertation*: "Adaptive Human-Robot Teaming and Interaction: Embracing Heterogeneity, Operational Dynamics, and Personalized Preferences"

B.E. in Robotics Engineering *Sept. 2016 – July 2020*
Beijing University of Chemical Technology (BUCT), Beijing, China

- *Thesis*: "Scene Recognition of Mobile Robot in Typical Home Environment"
- Recipient of Outstanding Undergraduate Thesis (ranked top 0.4% among all graduates in Beijing)

PUBLICATIONS

My research has been disseminated through leading venues in robotics, including IEEE Transactions, IEEE RA-L, and flagship conferences such as ICRA and IROS. A full chronological list of publications is provided below, with a categorized summary by research area available on my homepage.

†: Equal contribution, §: Mentored student

Journal Papers

[J.6] **PrefCLM: Enhancing Preference-based Reinforcement Learning with Crowdsourced Large Language Models**
Ruiqi Wang, Dezhong Zhao, Ziqin Yuan, Ike Obi, and Byung-Cheol Min
IEEE Robotics and Automation Letters (RA-L), vol. 10, no. 3, pp. 2486-2493, March 2025.

[J.5] **Cognitive Load-based Affective Workload Allocation for Multi-Human Multi-Robot Teams**
Wonse Jo, **Ruiqi Wang**, Baijian Yang, Dan Foti, Mo Rastgaar, and Byung-Cheol Min
IEEE Transactions on Human-Machine Systems (T-HMS), vol. 55, no. 1, pp. 23-36, February 2025.

[J.4] **Multimodal Audio-based Disease Prediction with Transformer-based Hierarchical Fusion Network**
Jinjin Cai[†], **Ruiqi Wang**[†], Dezhong Zhao, Ziqin Yuan, Victoria McKenna, Aaron Friedman, Rachel Foot, Susan Storey, Ryan Boente, Sudip Vhaduri, and Byung-Cheol Min
IEEE Transactions on Audio, Speech, and Language Processing (T-ASLP), vol. 33, pp. 1170-1182, February 2025.

[J.3] **Husformer: A Multi-Modal Transformer for Multi-Modal Human State Recognition**
Ruiqi Wang[†], Wonse Jo[†], Dezhong Zhao, Weizheng Wang, Baijian Yang, Guohua Chen, and Byung-Cheol Min
IEEE Transactions on Cognitive and Developmental Systems (T-CDS), vol. 16, no. 4, pp. 1374-1390, August 2024.

[J.2] **MOCAS: A Multimodal Dataset for Objective Cognitive Workload Assessment on Simultaneous Tasks**
Wonse Jo[†], **Ruiqi Wang**[†], Go-Eum Cha, Su Sun, Revanth Senthilkumaran[§], Daniel Foti, and Byung-Cheol Min
IEEE Transactions on Affective Computing (T-AFFC), vol. 16, no. 1, pp. 116-132, June 2024.

[J.1] **Initial Task Allocation in Multi-Human Multi-Robot Teams: An Attention-enhanced Hierarchical Reinforcement Learning Approach**
Ruiqi Wang, Dezhong Zhao, Arjun Gupte, and Byung-Cheol Min
IEEE Robotics and Automation Letters (RA-L), vol. 9, no. 4, pp. 3451-3458, April 2024.

Conference Papers

[C.8] **PrefMMT: Modeling Human Preferences in Preference-based Reinforcement Learning with Multimodal Transformers**
Dezhong Zhao[†§], **Ruiqi Wang**[†], Dayoon Suh, Taehyeon Kim, Ziqin Yuan, Byung-Cheol Min, and Guohua Chen
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Hangzhou, China, October 2025.

[C.7] **Modeling and Evaluating Trust Dynamics in Multi-Human Multi-Robot Task Allocation**
Ike Obi, **Ruiqi Wang**, Wonse Jo, and Byung-Cheol Min
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Hangzhou, China, October 2025.

[C.6] **Personalization in Human-Robot Interaction through Preference-based Action Representation Learning**
Ruiqi Wang[†], Dezhong Zhao[†§], Dayoon Suh, Ziqin Yuan, Guohua Chen, and Byung-Cheol Min
IEEE International Conference on Robotics and Automation (ICRA), Atlanta, USA, May 2025.

[C.5] **Adaptive Task Allocation in Multi-Human Multi-Robot Teams under Team Heterogeneity and Dynamic Information Uncertainty**
Ziqin Yuan[†§], **Ruiqi Wang**[†], Taehyeon Kim, Dezhong Zhao, Ike Obi, and Byung-Cheol Min
IEEE International Conference on Robotics and Automation (ICRA), Atlanta, USA, May 2025.

[C.4] **Multi-Robot Cooperative Socially-Aware Navigation using Multi-Agent Reinforcement Learning**
Weizheng Wang, Le Mao, **Ruiqi Wang**, and Byung-Cheol Min
IEEE International Conference on Robotics and Automation (ICRA), Yokohama, Japan, May 2024.

[C.3] **Initial Task Allocation for Multi-Human Multi-Robot Teams with Attention-based Deep Reinforcement Learning**
Ruiqi Wang, Dezhong Zhao, and Byung-Cheol Min
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Detroit, USA, October 2023.

[C.2] **NaviSTAR: Socially Aware Robot Navigation with Hybrid Spatio-Temporal Graph Transformer and Preference Learning**
Weizheng Wang[§], **Ruiqi Wang**, Le Mao, and Byung-Cheol Min
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Detroit, USA, October 2023.

[C.1] **Feedback-efficient Active Preference Learning for Socially Aware Robot Navigation**
Ruiqi Wang, Weizheng Wang, and Byung-Cheol Min
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Kyoto, Japan, October 2022.

Pre-print/Under Review

[P.2] **SafePlan: Leveraging Formal Logic and Chain-of-Thought Reasoning for Enhanced Safety in LLM-based Robotic Task Planning**
Ike Obi, L.N Vishnunandan Venkatesh, Weizheng Wang, **Ruiqi Wang**, Dayoon Suh, Temitope Ibrahim Amosa, Wonse Jo, and Byung-Cheol Min
arXiv preprint, arXiv:2503.06892, 2025.

[P.1] **REBEL: Rule-based and Experience-enhanced Learning with LLMs for Initial Task Allocation in Multi-Human Multi-Robot Teams**
Arjun Gupte[†§], **Ruiqi Wang**[†], L. N. Vishnunandan Venkatesh, Taehyeon Kim, Dezhong Zhao, and Byung-Cheol Min
arXiv preprint, arXiv:2409.16266, 2024.

AWARDS AND HONORS

– **Conference Travel Grants** *2025*
ICRA 2025, Purdue University

– **Second Place, Graduate Student Poster Presentation Award** *2024*
Realizing the Digital Enterprise Research Impact Area, Purdue University

– **Conference Travel Grants** *2023*
Purdue University

– **Daniel & Martina Lewis Graduate Scholarship** *2022*
Merit-based recognition for outstanding academic achievement, Purdue University

– **Outstanding Undergraduate Thesis Award** *2020*
Beijing Municipal Education Commission (top 0.4% among all graduates)

- **Second Place, IJCAI-2019 Eldercare Robot Challenge** *2019*
  · Achieved as the only undergraduate team competing against graduate-level groups
  · Champion, 'Searching for Missing Object' Section
- **Third Prize, RoboCup 2019 China Open @Home** *2019*
  Home Service Robot League
- **Champion, Softbank Cup 2018 Robot Competition** *2018*
  · Innovation Section (1st place among 16 teams)
  · Second Prize, Field Robot Section
- **Outstanding Innovation and Technology Scholarship** *2018*
  BUCT (top 1% of undergraduate cohort)

RESEARCH EXPERIENCE

Graduate Research Assistant *Aug. 2021 – Present*
SMART Laboratory, Purdue University, West Lafayette, IN, USA
Leading research projects on adaptive multi-human multi-robot systems and human-in-the-loop robot learning. Research supported by National Science Foundation grants (#IIS-1846221, #DRL-2418688) and Purdue University.

Undergraduate Research Assistant *May 2019 – July 2021*
Key Laboratory of Machine Perception and Intelligence, Peking University, Beijing, China
Led a team of four to develop an AI-powered restaurant assistant system capable of actively recognizing guest characteristics, such as party size and seating preferences, to provide customized services.

Undergraduate Research Assistant *Sept. 2018 – July 2021*
ZhiYuan Intelligent Robot Laboratory, BUCT, Beijing, China
Led a team of five to develop a home service and elder-care robot capable of providing daily services such as activity monitoring, medication reminders, and deliveries in home environments.

Founder & President *Aug. 2018 – Dec. 2019*
Undergraduate Robot Innovation Center, BUCT, Beijing, China
Founded the university's first undergraduate robotics research center, securing $20,000+ in funding and managing 6 concurrent projects involving 20+ undergraduate researchers. The center's projects won multiple awards in national and international robotics competitions.

TEACHING EXPERIENCE

Graduate Teaching Assistant, Purdue University

- CNIT 105: Introduction to C Programming *Fall 2024*
  208 students · TA Evaluation: 4.5/5.0
- CNIT 355: Mobile Programming *Fall 2024*
  30 students · TA Evaluation: 4.7/5.0
- CNIT 315: Systems Programming *Spring 2024*
  91 students · TA Evaluation: 4.5/5.0
- CNIT 355: Software Development for Mobile Computers *Fall 2022*
  15 students · TA Evaluation: 4.8/5.0

Undergraduate Teaching Assistant, BUCT

– Electromechanical Actuation Control *Fall 2020*
  45 students

Instructor, Undergraduate Robot Innovation Center, BUCT

– Practice of Robot Operating System (ROS) *Fall 2019, Spring 2020*
  20+ students per semester

RESEARCH MENTORING EXPERIENCE

Graduate Researchers and Visiting Scholars

– **Ziqin Yuan** *Fall 2024 – Present*
  Ph.D. Student, SMART Laboratory, Purdue University
  Research Focus: Generative AI for Robotics & Multi-Human Multi-Robot Teams

– **Dezhong Zhao** *Fall 2023 – Fall 2024*
  Visiting Scholar, SMART Laboratory, Purdue University
  Ph.D. Student, Beijing University of Chemical Technology
  Research Focus: Preference Learning in Human-Robot Interaction & Multi-Human Multi-Robot Teams

– **Weizheng Wang** *Fall 2022 – Spring 2023*
  Ph.D. Student, SMART Laboratory, Purdue University
  Research Focus: Social Robot Navigation

Undergraduate Research Students

– **Arjun Gupte** *Spring 2023 – Present*
  B.S., Computer Engineering, Purdue University
  Achievement: 2025 Class of Astronaut Scholarship;
  First Place, Oral Presentation, 2024 Fall Purdue Undergraduate Research Conference

– **Dayoon Suh** *Fall 2024 – Spring 2025*
  B.S., Data Science & Applied Statistics, Purdue University
  Achievement: Co-authored one ICRA 2025 paper;
  Mary-Ann Neel Computer Science Scholarship, 2024
  Next Position: M.S.E. in Robotics, Computer and Information Science, University of Pennsylvania

– **Revanth Krishna Senthilkumaran** *Spring 2022 – Fall 2022*
  B.S., Computer Engineering, Purdue University
  Achievement: Third Place, Oral Presentation, 2022 Spring Purdue Undergraduate Research Conference
  Next Position: M.S. in Robotics, Robotics Institute, Carnegie Mellon University

SERVICE AND OUTREACH

Journal Reviewer

– *IEEE Robotics and Automation Letters* (RA-L)

– *IEEE Transactions on Audio, Speech, and Language Processing* (T-ASLP)

– *IEEE Transactions on Computational Social Systems* (T-CSS)

- *IEEE Transactions on Human-Machine Systems* (T-HMS)
- *Nature Scientific Reports*
- *The Journal of Supercomputing*

Conference Reviewer

- *IEEE International Conference on Robotics and Automation* (ICRA 2025)
- *IEEE/RSJ International Conference on Intelligent Robots and Systems* (IROS 2025)
- *IEEE International Conference on Biomedical Robotics and Biomechatronics* (BioRob 2024)
- *International Symposium on Technological Advances in Human-Robot Interaction* (TAHRI 2024)

Educational Outreach

- **West Lafayette Jr./Sr. High School, West Lafayette, IN, USA** *Apr. 2025*
  One-day seminar on generative AI for robotics
  Impact: 23 students, 1 teacher
- **West Lafayette Jr./Sr. High School, West Lafayette, IN, USA** *Dec. 2023*
  One-day robotics seminar on human-robot interaction, multi-robot systems, and robot design
  Impact: 47 students, 1 teacher
- **West Lafayette Jr./Sr. High School, West Lafayette, IN, USA** *May 2023*
  Five-day hands-on robotics program with practical applications and experimental activities
  Impact: 15 students, 1 teacher
- **Macau Anglican College, Macau, China** *Dec. 2022*
  One-day workshop (virtual) on human-in-the-loop RL and affective robotics
  Impact: 20 students, 4 teachers

GRANT WRITING EXPERIENCE

- **Enabling Next-Generation HyFlex Field Laboratories through an Innovative Learner-In-The-Loop Multi-Robot System**
  National Science Foundation (NSF), Award #DRL-2418688, $900,000 (Sep 2024 – Aug 2027)
  Contributed to technical sections on the human-robot interface and the proposal rebuttal.
- **FW-HTF-P: Interactive Multi-Human Multi-Remote-Robot Operations for Future Construction Field**
  National Science Foundation (NSF), Award #CMMI-2222838, $150,000 (Oct 2022 – May 2025)
  Contributed to technical sections on human-robot interaction.
- **CAREER: Adaptive Human Multi-Robot Systems**
  National Science Foundation (NSF), Award #IIS-1846221, $500,000 (Feb 2019 – Jan 2025)
  Prepared annual reports and the extension proposal.