Muhan Lin

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Education

Carnegie Mellon University
M.S. in Robotics

Aug 2023 – May 2025
GPA: 4.06/4.0

- **Courses**: Intro to RL **(A)**, Multi-robot Planning **(A)**, Mobile Manipulation **(A)**, Advanced Computer Vision **(A)**.

The Chinese University of Hong Kong (Shenzhen)
B.Eng. in Electronic Info Engineering (Computer Engineering), First-Class Honors

Sep 2019 – May 2023
GPA: 3.6/4.0

- **Core courses**: Machine Learning **(A)**, Design and Analysis of Algorithms **(A)**, C++ **(A)**, Python **(A)**, Linear Algebra **(A)**, Mechanics **(A)**.
- **Graduate course**: Programming for Robotics **(A-)**.

Publications

Speaking the Language of Teamwork: LLM-Guided Credit Assignment in Multi-Agent Reinforcement Learning

Muhan Lin, Shuyang Shi, Vinitha Marupeddi, Yue Guo, Vaishnav Tadiparthi, Behdad Chalaki, Ehsan Moradi Pari, Simon Stepputtis, Woojun Kim, Joseph Campbell, Katia Sycara
In submission

Enhancing Multi-Agent Teaming Efficiency Through Experience-Based Action Advising

Shuyang Shi, Yue Guo, **Muhan Lin**, Vaishnav Tadiparthi, Behdad Chalaki, Ehsan Moradi Pari, Simon Stepputtis, Woojun Kim, Joseph Campbell, Katia Sycara
In Submission

Navigating Noisy Feedback: Enhancing Reinforcement Learning with Error-Prone Language Models

Muhan Lin, Shuyang Shi, Yue Guo, Behdad Chalaki, Vaishnav Tadiparthi, Ehsan Moradi Pari, Simon Stepputtis, Joseph Campbell, Katia Sycara
Published - Conference on Empirical Methods in Natural Language Processing (EMNLP) 2024

Speed up Search for Switchable Temporal Planning Graph Optimization

He Jiang, **Muhan Lin**, Jiaoyang Li
Accepted - Association for the Advancement of Artificial Intelligence (AAAI) 2025

A Reward Analysis of Reinforcement Learning from Large Language Model Feedback

Muhan Lin, Shuyang Shi, Yue Guo, Behdad Chalaki, Vaishnav Tadiparthi, Simon Stepputtis, Joseph Campbell, Katia Sycara
Published - RLBrew Workshop, Reinforcement Learning Conference (RLC) 2024

Asymptotically Efficient Estimators for Range-based Robot Relative Localization

Yue Wang, **Muhan Lin**, Xinyi Xie, Yuan Gao, Fuqin Deng, Tin Lun Lam
Published - IEEE/ASME Transactions on Mechatronics (TMECH) 2023

Less Is More: A Robust Visual Inertial Odometry with Active Feature Selection

Muhan Lin, Shibo Zhao, Sebastian Scherer
Published - CMU RISS Working Papers Journal 2022

Research Experience

Student Researcher, Robotics Institute (RI), CMU – *Pittsburgh*, US

Project 1: Enhancing Reinforcement Learning with Error-Prone Language Models
Advisor: Prof. *Katia Sycara*, Dr. *Joseph Campbell* | RI, CMU   Sept 2023 – Present
RLBrew Workshop, EMNLP Paper

- Extended *RL from LLM Feedback* to handle small language models prone to incorrect rankings: proposed a potential-based reward specification method to scale down rewards based on LLM feedback uncertainty.
- Theoretically and empirically showed that uncertain LLM feedback leads to uninformative potential-based rewards, avoiding misleading rewards and enabling efficient training even with small error-prone LLMs.
- Extended the proposed method to multiagent collaboration tasks for credit assignment, decomposing team rewards into individual ones with LLM feedback.

Project 2: Enhancing Multi-Agent Teaming Efficiency by Experience-Based Action Advising
Advisor: Prof. *Katia Sycara*| RI, CMU   Aug – Oct 2024

- Accelerated multi-agent reinforcement learning by enabling agents with different levels of prior competency to cooperate effectively in solving a shared task.
- With a multi-armed bandit algorithm, the most-experienced agent evaluated teammates' skills, assigned suitable sub-tasks and adapted agents to tasks via an action-advising algorithm, improving learning and task efficiency.

Project 3: Plan-Graph Optimization Acceleration for Unexpected Delays in Execution of Multi-agent Path Plans
Advisor: Prof. *Jiaoyang Li* | RI, CMU   Feb – Aug 2024
AAAI Paper, Course Research Project

- Proposed an accelerated optimization algorithm for the Switchable Temporal Plan Graph (STPG) to address unexpected delays when executing a multiagent path plan with techniques like incremental searching.
- Achieved over 100% improvement in STPG reconstruction success rates within 0.5 seconds across maps with diverse agent densities, outperforming *Mixed-Integer Linear Programming* and *naive graph-based methods*.
- Developed a C++-based real-time visualization tool to display updated STPGs during the replanning process.

Project 4: RL-based Mobile Robot Painting on Large Vertical Canvas
Advisor: Prof. *Zackory Erickson* | RI, CMU   Feb – Apr 2024
Course Research Project

- Extended FRIDA—an algorithm controlling a robot with a fixed base to paint on a desktop small canvas—for a large canvas and a mobile manipulator based on efficient RL-driven stroke planning in real robot experiments.
- Coordinated the motion of the base and arm to move the end effector to a given stroke position by decomposing end-effector motion in horizontal and vertical directions.
- Utilized AR tags to realize coordinate system transformation between the robot and canvas.

Project 5: Active Feature Selection for Pose Estimation of Multi-spectral Odometry
Advisor: Prof. *Sebastian Scherer* | RI, CMU   May - Nov 2022
RISS Paper

- Developed a quality measurement metric to actively select visual feature points for the visual odometry.
- Improved the accuracy and efficiency of visual odometry pose estimation (13.036% of the original residuals, 58.832% of the original CPU usage) with filtered visual feature points in dark environments.
- Studied the multi-camera data fusion scheme for visual odometry.
- Integrated the active feature selection method into a multi-camera multi-spectral odometry system with C++ to assist multi-sensor data fusion and pose estimation in challenging environments with fewer features.

Research Assistant, CUHK-*Shenzhen* & Shenzhen Institute of *Artificial Intelligence and Robotics for Society* (AIRS) – China

Project 1: Initial Relative Pose Estimation with the Two-stage Extended Kalman Filter
Advisor: Prof. *Tin Lun Lam* | School of Science and Engineering, CUHK-Shenzhen   Jan - May 2022
Bachelor Thesis

- Developed a Two-stage Extended Kalman Filter for improved *robot-to-robot* initial relative pose estimation using multi-sensor data fusion, improving LIDAR map merging accuracy.
- Validated the method in simulated environments using ROS and Gazebo.

Project 2: Two-robot Relative Pose Estimation with UWB and Odometry Information

Advisor: Prof. *Tin Lun Lam* | Director of Center for Intelligent Robots, AIRS   Feb 2021 – Jan 2022
TMECH Paper

- Enhanced localization accuracy in multiagent systems, where robots communicated their odometry trajectories and relative distance with each other and then estimated their initial relative poses.
- Developed a real-time relative-pose estimation system structure compatible with multiple offline initial pose estimation algorithms, which adopt the particle filter and the Kalman filter to track subsequent poses.
- Led the design, assigned tasks to younger teammates, and performed the physical experiments of a novel relative localization algorithm with ROS, MATLAB, and a motion-capturing system.

Competition

The Smart Car and Real-time OS Application Development   Mar – Aug 2020
The RISC-V Challenge of China College IC Smart-car Competition   Shenzhen & Nanjing, China
Advisor: Prof. *Simon Pun* | *CUHKSZ-Stanford* Maker Lab
3rd National Prize (Top 10%)

- Programmed registers on a bare MCU and read and processed raw sensor signals to control a smart car with a linear CCD in C/C++.
- Applied a real-time operating system to the smart car to support multi-threading work to improve real-time performance and resource utilization efficiency.
- Designed a novel path-tracking algorithm in C for the paths bounded by dashed lines with infrared sensors. Increased the success rate of the original algorithm from approximately 50% to above 95%.

Selected Course Projects

Warehouse Robot Challenge   May 2022

- Automated the robot arm to pick randomly placed objects and put them into buckets with consistent colors.
- Realized object localization and classification with diverse colors, utilizing *OpenCV* and *Python*.
- Realized path planning and collision & obstacle avoidance with *Python*, *Moveit*, and *Rviz*.

Service Robot Delivery Challenge   Apr - May 2022

- Automated robot delivery to locations labeled by AR tags in a *Gazebo* environment with *ROS* and *OpenCV*.
- Searched AR tags and navigated to various delivery locations with SLAM algorithms.

Academic Activities

Reviewer: ICRA 2024 2025, IEEE Transactions on Games 2024

Conference Participation: EMNLP 2024, RLC 2024, IROS 2023

Awards

2019-2022 **Dean's List**, School of Science and Engineering, CUHK-Shenzhen

2019-2022 **Bowen Scholarship**, CUHK-Shenzhen

2020 **3rd National Prize (Top 10%)**, The RISC-V Challenge of China College IC Smart-car Competition

Skills

Programming: Python, C/C++, MATLAB, Verilog, VHDL, Mysql, Go, HTML, CSS
Software & Tools: ROS, PyTorch, RLlib, TorchRL, OpenAI Gym, Moveit, OpenCV, Django, FreeRTOS