Simin Liu

Google scholar
Website

Education

Ph.D. in Robotics, Carnegie Mellon University
2020-2025 (expected)
Advised by Changliu Liu, John Dolan. Supported by the Qualcomm Innovation Fellowship. Researching reactive control and motion planning, with application to manipulators and drones.
Keywords: safety, control barrier functions (CBFs), handling differential constraints and uncertain models, adaptive and robust methods, estimation, trajectory optimization/design

B.S. in EECS and Mathematics, University of California, Berkeley
2015-2019
Graduated with high honors. Advised by Sergey Levine and researched adaptive control (meta-learning) for legged locomotion.

Publications

[1] "Synthesis and Verification of Robust-Adaptive Safe Controllers." S. Liu*, K. Yun*, J. Dolan, and C. Liu. arXiv preprint arXiv:2311.00822. *Under submission to 2024 European Controls Conference.*

[2] "Safe Control Under Input Limits with Neural Control Barrier Functions." S. Liu, C. Liu, and J. Dolan. In 2022 Conference on Robot Learning.

[3] "Safety Index Synthesis via Sum-of-Squares Programming." W. Zhao, T. He, T. Wei, S. Liu, and C. Liu. In 2023 American Controls Conference.

[4] "Learning to Adapt in Dynamic, Real-World Environments Through Meta-Reinforcement Learning." A. Nagabandi*, I. Clavera*, S. Liu, R. S. Fearing, P. Abbeel, S. Levine, and C. Finn. In 2018 International Conference on Learning Representations.

Project descriptions

Project A: automatically generating safe controllers for robotic systems

- Devised an optimization algorithm which can generate a safe controller (based on CBFs) given any polynomial-equivalent system
- Skills developed: reactive safe control, sum-of-squares programming
- Produced: publication [3]

Project B: automatically generating safe controllers for high-dimensional systems

1. Project A and popular alternatives can only scale to 5-7 D systems. We created a much more scalable technique with adversarial training of *neural* CBFs. Our method can scale to $\geq$20D and handle complex systems like a

balancing drone or a many-linked manipulator.

2. Skills developed: control for manipulators and drones, machine learning, model predictive control (MPC), trajectory optimization/design
3. Produced: publication [2], ongoing project

Project C: automatically generating safe controllers for uncertain systems

1. Project A and popular alternatives cannot handle uncertainty in the system model, which we often have in practice. We designed an optimization algorithm for generating robust-adaptive safe controllers, which can handle uncertainty without producing over-conservative behavior.
2. Skills developed: adaptive and robust control, estimation
3. Produced: publication [1], ongoing project

Programming

Languages: Python (advanced), C++, Java, and MATLAB (intermediate)
Tools & frameworks: PyTorch and Tensorflow (advanced), ROS (intermediate)

Awards & honors

Qualcomm Innovation Fellowship: 18 selected from 182 2023
UC Berkeley Undergraduate Research Honors: 20 selected from 500 2019
Computing Research Association GHC Scholarship 2018
Microsoft GHC Scholarship 2017
UC Berkeley College of Engineering Dean's List 2016–19
Member of Tau Beta Pi, Eta Kappa Nu, and Phi Beta Kappa:
the national engineering, computer science, liberal arts honor societies 2016
William Olson & Warren Taylor Science and Engineering Scholarship 2015
ACES-NM Young Asian-American Scholar Award 2015
Jane Street Unboxed Scholarship 2015

Teaching & mentorship

Graduate Research Mentor, CMU
Kai Yun (master's student), Tianrui Liu and Yulin Wan (undergrad students)

Graduate Student Instructor, CMU
Kinematics, Dynamics, and Control, Math for Robotics 2021-22

Undergraduate Student Instructor, UC Berkeley
Top 10% instructor by student ratings
Intro to Artificial Intelligence, Algorithms in Computer Science 2016-19

Hobbies

Outdoor activities, drawing, ceramics, reading fiction, swimming, running