Ji Yin

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Education

Massachusetts Institute of Technology, visiting Ph.D. student (Advisor: Chuchu Fan) Aug 2023 – May 2025
Georgia Institute of Technology, Robotics Ph.D. student (Advisor: Tsiotras Panagiotis) Aug 2020 – May 2025
Columbia University, M.S. in Mechanical Engineering, Concentrating on Robotics Sept 2018 - Feb 2020
Royal Institute of Technology in Stockholm, M.S. in Vehicle Engineering Sept 2016 – Jun 2018
Shanghai Jiao Tong University, B.S. in Mechanical Engineering Sept 2013-Aug 2017

Skills

- **Computer and Programming:** Python, C++, C#, ROS, MATLAB, Simulink, Linux, Unity3D etc.
- **Motion Planning:** Control theories, sampling, learning and optimization-based motion planning methods.
- **Algorithms:** Deterministic MPCs, Stochastic MPCs, Reinforcement Learning, ILQR, ILQG, RRT, RRT*, PRM etc.
- **Dynamics and Kinematics:** Mobile robot, robotic arm, vehicle dynamics and kinematics.

Selected Publications

- **J. Yin**, **et al.** "Safe Beyond the Horizon: Efficient Sampling-based MPC with Neural Control Barrier Functions", Robotics: Science and Systems (RSS) 2025. (**Paper**)
- **J. Yin**, **et al.** "Chance-Constrained Information-Theoretic Stochastic Model Predictive Control with Safety Shielding", *Conference on Decision and Control (CDC),* 2024. (**Paper**)
- **J. Yin, et al**. "Shield Model Predictive Path Integral: A Computationally Efficient Robust MPC Method Using Control Barrier Functions", *Robotics and Automation Letters (RA-L), 2023*. (**Paper**)
- **J. Yin, et al**. "Risk-Aware Model Predictive Path Integral Control Using Conditional Value-at-Risk", International Conference on Robotics and Automation (*ICRA), 2023*. (**Paper**)
- **J. Yin, et al.** "Trajectory Distribution Control for Model Predictive Path Integral Control using Covariance Steering", *ICRA 2022*. (**Paper**) **Outstanding Planning Paper Award-Finalist**, *ICRA 2022* (**Website**)

Projects and Research

Optimal Control & Trajectory Planning for Autonomous Racing Atlanta, GA
Georgia Tech Dynamics and Control Systems Laboratory
Graduate Research Assistant Aug 2020 - Present

- Developed Shield-MPPI, an advanced MPC technique that ensures safe motion planning in challenging outdoor settings. It operates at less than 0.5% of the computational demand of the original MPPI, which lacked safety assurances and often needed expensive GPUs for real-time processing. This innovation allows real-time planning with just a standard laptop CPU and delivers safer control choices compared to many leading MPC methods that are more resource-intensive. (**Video Link**)
- Designed and Implemented the Covariance Controlled-Model Predictive Path Integral (CC-MPPI). The CC-MPPI is an information-theoretic MPC method that achieves online high-speed autonomous driving using GPUs given a cost map of the environment, improving lap time by 34.78% compared with the state-of-the-art algorithm. This work won the ICRA 2022 Outstanding Planning Paper Award-Finalist (top 1.1% of ICRA papers). (**Website, Video Link**)
- Created the Risk-Aware Model Predictive Path Integral (RA-MPPI) controller. The RA-MPPI is a risk-aware, robust nonlinear optimal control approach that accounts for dynamical noise or external disturbance. It reduces the risk of disastrous control scenarios by about 80% and performs computation in real-time (~82Hz) for autonomous racing tasks. (**Video Link**)

Motion Planning and Learning of Snake Robot (Video Link) New York, NY
Columbia Robotic Manipulation and Mobility Lab
Graduate Research Assistant Aug 2018 – Dec 2019

- Improved an iterative linear quadratic Gaussian (ILQG) controller of a snake robot to enable it to generate snake gaits that effectively avoid obstacles and adapt to different environments with various friction models.
- The algorithms were robust enough to automatically generate snake movements in different environments without changing parameters, enabling the snake robot to traverse in water, mud, ground while passing through obstacles or narrow passages.

Professional Experience

Symbotic LLC Wilmington, MA
Intern May 2024 – Aug 2024

I conducted research focusing on multi-agent planning for warehouse robot fleets. I designed AI algorithms that control robots to safely transport goods with enhanced efficiency, significantly improving the overall warehouse throughput in simulation.

Mitsubishi Electric Research Laboratories Cambridge, MA
Research Intern May 2023 – Aug 2023

I designed an artificial intelligence algorithm for robotic planning and control, which achieves optimal performance with user-specified risk-levels. I completed the theory derivation, implemented the method in code, and applied it to an autonomous driving vehicle.