PEDRAM RABIEE

(859) 608-5230 ◇ pedram.rabiee[at]gmail.com
pedram-rabiee ◇ pedramrabiee ◇ Google Scholar ◇ https://pedramrabiee.com

Robotics Engineer with deep expertise in robotics, deep reinforcement learning and deep learning. Experienced in sequential decision-making and uncertainty estimation with strong programming skills in C++ and Python. Proven ability to research and develop advanced ML models for trajectory prediction, trajectory optimization and motion planning, with excellent problem-solving skills and collaborative abilities.

EDUCATION

Ph.D., Mechanical Eng., University of Kentucky, Lexington, KY, GPA: 3.7 2018 – 2024

Dissertation Title: Provably Safe Motion Planning For Input-Constrained Robotic Systems

- Selected Courses: Robotics Control, Robust Control, Advanced Control System Analysis, Nonlinear Systems and Control, Deep Reinforcement Learning, Deep Learning, Machine Learning, Convex Optimization, Model Predictive Control

M.Sc., Mechanical Eng., Sharif University of Technology, Iran, GPA: 4.0 2015 – 2018

B.Sc., Mechanical Eng., Sharif University of Technology, Iran, GPA: 3.3 2009 – 2014

SKILLS

Programming: Python, C++/C#, MATLAB

Robotics: ROS2 (Nav2, MoveIt, ros2_control), Gazebo, MuJoCo, CARLA

Packages: PyTorch, TensorFlow/Keras, JAX, OpenCV, CasADi, Gurobi, CVX

Misc.: Linux, Git, Docker, Shell Scripting, SolidWorks, CATIA, AutoCAD, Blender, Unity, Unity ML Agent

Knowledge-Based: Motion Planning, Trajectory Optimization, Robotics Control, Data-Driven Safety-Critical Control, Model-Based Safe Reinforcement Learning, Model Predictive Control (MPC), Kinematics and Dynamics, Decision Making, Safe Exploration in Reinforcement Learning, Control Barrier Functions, Risk-Aware Control, Nonlinear System, Robotics Manipulation, Kalman Filter, State Estimation, Sensor Fusion, SLAM

PROFESSIONAL EXPERIENCES

University of Kentucky, Lexington, KY May 2019 – Present
Graduate Research Assistant

Safe Reinforcement Learning

- Developed **STOP**, a safety-embedded trajectory optimization algorithm that integrates embedded control barrier functions for planning in safe regions, utilizing data-driven model predictive control and model-free policies.
- Developed **RLBUS**, RL Backup Shield, an algorithm to learn backup control barrier functions with zero training-time safety violations, enabling safe exploration in reinforcement learning.

Safe Motion Planning using Control Barrier Functions

- Developed a closed-form safe optimal control for safe motion planning under multiple safety and input constraints with differing relative degrees through a smooth composition of multiple control barrier functions.
- Developed an algorithm for smooth composition of multiple backup control barrier functions using trajectory predictions under backup controls, enabling exploration within an expanded control forward invariant subset of the safe set while ensuring safety and feasibility of control optimization under actuation constraints.

Human Learning and Human-Robot Interaction

- Modeled human learning behavior to control dynamical systems through system identification in human-in-the-loop experiments.

· Collaborated with Ford Motor Company on a project aimed at classifying and distinguishing between human and autonomous agent behaviors in multi-agent game scenarios.

University of Kentucky, Lexington, KY — Sep 2018 – May 2019
Graduate Teaching Assistant — Control Systems

Sharif University of Technology, Tehran, Iran — Sep 2016 – Jan 2018
Graduate Research Assistant

· Developed a two-step modeling approach combining physics-based battery thermal models via subsystem identification and a linear parameter varying reduced-order model approximating CFD simulations, enabling computationally efficient design exploration of battery thermal management systems.

Sharif University of Technology, Tehran, Iran — Jan 2016 – Jun 2016
Graduate Teaching Assistant — Internal Combustion Engine

Mega Motor, Tehran, Iran — August 2012
Internship

OPEN-SOURCE PROJECTS

· Developed **safe_rl**, a unified framework integrating model-free, model-based, and data-based methods for safe reinforcement learning using safety filters.

· Developed **hocbf_composition**, a library to facilitate easy creation of higher-order control barrier functions using PyTorch autodiff and to compose multiple CBFs as constraints for optimal control problems.

· Developed **obstacle_reach_env**, a Gym-style safe navigation environment for ground robots, providing composite barrier functions derived from map, velocity constraints, and sensor data for safe reinforcement learning.

PUBLICATIONS

· **P. Rabiee** and J. B. Hoagg. STOP: Safety-Embedded Trajectory Optimization Framework Integrating Embedded Control Barrier Functions for Planning in Safe Regions Using Data-Driven MPC and Learned RL Policies. 2024. *(In Preparation)* [github]

· **P. Rabiee** and A. Safari. Safe Exploration in Reinforcement Learning: Training Risk-Aware Backup Control Barrier Functions for Fast Exploration. 2024. *(In Preparation)*

· **P. Rabiee** and J. B. Hoagg. A Closed-Form Control for Safety Under Input Constraints Using a Composition of Control Barrier Functions. *IEEE Open Journal of Control Systems*, 2024. *(Under Review) Available here*[github]

· **P. Rabiee** and A. Safari. Safe Exploration in Reinforcement Learning: Training Backup Control Barrier Functions with Zero Training-Time Safety Violations. In *2024 Learning for Dynamics and Control (L4DC)*, 2023. *(Under Review) arXiv:2312.07828* [github]

· **P. Rabiee** and J. B. Hoagg. Composition of Control Barrier Functions with Differing Relative Degrees for Safety Under Input Constraints. In *2024 American Control Conference (ACC). (Accepted) arXiv:2310.00363* [github]

· **P. Rabiee** and J. B. Hoagg. Soft-Minimum and Soft-Maximum Barrier Functions for Safety with Actuation Constraints. *Automatica*, 2023. *(Accepted) arXiv:2305.10620*

· **P. Rabiee** and J. B. Hoagg. Soft-Minimum Backup Barrier Functions for Safety-Critical Control Subject to Actuation Constraints. In *2023 American Control Conference (ACC)*. IEEE, 2023. *arXiv:2304.00693*

· **P. Rabiee**, S. A. S. Mousavi, A. J. S. Sheffler, E. Hellström, M. Jankovic, M. A. Santillo, T. M. Seigler, and J. B. Hoagg. The Impact of Reference-Command Preview on Human-in-the-Loop Control. *(Under Review) arXiv:2308.15633*

· **P. Rabiee** and M. H. Saidi. Implementation of Linear Parameter Varying System to Investigate the Impact of Varying Flow Rate on the Lithium-ion Batteries Thermal Management System Performance. In *26th Annual International Conference of Iranian Society of Mechanical Engineers. arXiv:2403.01334*

HONORS AND AWARDS

· Awarded to the top 5 students in Mechanical Engineering M.Sc. (Class of 2015). — 2016
· Ranked in top 0.4% out of 350K+ participants in Iranian nationwide university entrance exam. — 2009
· Achieved a bronze medal in the Iranian National Astronomy Olympiad. — 2006