Zhaoyuan Gu

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EDUCATION

Georgia Institute of Technology Atlanta, GA
Doctor of Philosophy in Robotics Aug. 2020–present
Carnegie Mellon University Pittsburgh, PA
Master of Science in Mechanical Engineering Aug. 2018–Jul. 2020
Tsinghua University Beijing, China
Bachelor of Engineering in Mechanical Engineering Aug. 2014–Jul. 2018

SKILLS

Programming C++/C, Python
Software ROS2, Drake, Matlab
Languages English (Fluent), Chinese (Native)

PUBLICATIONS

Z. Gu, R. Guo, W. Yates, Y. Chen, Y. Zhao. **Walking-by-Logic: Signal Temporal Logic-Guided Model Predictive Control for Bipedal Locomotion Resilient to External Perturbations.** Submitted, 2023.

A. Shamsah, **Z. Gu**, J. Warnke, S. Hutchinson, Y. Zhao. **Integrated Task and Motion Planning for Safe Legged Navigation in Partially Observable Environments**. IEEE Transactions on Robotics, 2023.

Z. Gu, N. Boyd, Y. Zhao. **Reactive Locomotion Decision-Making and Robust Motion Planning for Real-Time Perturbation Recovery**. International Conference on Robotics and Automation, 2022.

WORK EXPERIENCE

Toyota Research Institute Robotics Engineering Intern May 2019–Aug. 2019

• Simulated and modeled dynamic locomotion of a wheel-based humanoid robot in Drake simulator.

• Integrated control framework with Optimal Tracking, Quadratic Programming, and Inverse Dynamics Controller for dynamics control of humanoid robot. Achieved high dynamic motion speed at 2m/s and peek acceleration 1m/s^2 with humanoid robot.

• Developed floating base system functions involving center of mass state and jacobian calculation in Drake.

Mechmind Robotics Software Engineering Intern Mar. 2018–Jul. 2018

• Integrated OMPL (Open Motion Planning Library) into Mechmind software and obtained optimal trajectory search with RRT-Star algorithm. Attained search algorithm for collision free pick-and-place trajectory within 1 second.

• Improved robot pick-and-place performance utilizing symmetry feature of end effector and objects. Enhanced robot motion efficiency by eliminating 70% unnecessary motion with optimal trajectory planning.

RESEARCH EXPERIENCE

Robust and Safe Bipedal Locomotion using Formal Methods LIDAR Group, Georgia Institute of Technology Mar. 2023–present

• Formulated an optimization-based model predictive controller (MPC) that provides formal guarantee of locomotion robustness.

• Proposed signal temporal logic-based locomotion specification to quantify the locomotion robustness.

• Integrated data-driven collision constraints into MPC to avoid leg self-collision and enable safe agile bipedal maneuvers.

Safe Navigation of Humanoid Robot LIDAR Group, Georgia Institute of Technology Jun. 2022–Feb. 2023

• Designed and built a loco-manipulation planning algorithm to perform box delivery tasks over challenging terrains such as stairs.

• Implemented a real-time passivity-based whole-body controller for a humanoid robot Digit operating at 1000Hz.

• Improved the rapid turning and velocity tracking performance through an ankle actuation strategy.

Hexapod Robot Locomotion Biorobotics Lab, Carnegie Mellon University Aug. 2018–May 2020

• Designed general control framework for multiple hexapod structured robots.

• Programmed wave gait for hexapod locomotion; generated natural step sequence online automatically.

• Implemented Grasp Map to regulate foot contact force using joint torque sensor and balance robot's centroidal momentum.

Adversary Training for Robust Reinforcement Learning Biorobotics Lab, Carnegie Mellon University Jun. 2017 - Sept. 2017

• Innovated Adversary Robust Reinforcement Learning algorithm and validated better performance and increased robustness compared to A3C (Asynchronous Advantage Actor Critic) algorithm.

• Trained robust reinforcement learning algorithm on different models in OpenAI gym, transferred policy learned from simulation to real world model and validated 2 times better algorithm performance.

ACADEMIC PROJECTS

Monkey Robot Build and Control Carnegie Mellon University Jan. 2019–Aug. 2019

• Devised three-link monkey robot with direct drive actuators. Manufactured robot parts and test stand. Fulfilled light weight goal of 2 kg and high dynamic motion capability of 5 rad/s.

• Implemented control framework for monkey robot using C on STM32F4 microcontroller. Developed motor current feedback control using DJI M6050 motor. Designed protocol for communication between robot and PC using Bluetooth.

• Collaborated on iLQR non-linear trajectory optimization. Achieved continuous swing across uneven spacing horizontal bar in 0.66s.