

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

RESEARCH INTERESTS

Humanoid Loco-manipulation, Diffusion Policy, Reinforcement Learning, Model-Predictive Control, Whole-body Control

PUBLICATIONS (out of a total of 14 in [Google Scholar](#))

Journals:

- **Z. Gu**, J. Li, W. Shen, W. Yu, Z. Xie, S. McCrory, X. Chen, A. Shamsah, R. Griffin, C. K. Liu, A. Kheddar, X. Peng, Y. Zhu, G. Shi, Q. Nguyen, G. Cheng, H. Gao*, Y. Zhao*. **Humanoid Locomotion and Manipulation: Current Progress and Challenges in Control, Planning, and Learning**. Submitted to Transactions on Mechatronics, 2025.
- H. Jung*, **Z. Gu***, R. Pathak, Y. Zhao, H. Park, S. Ha. **Robust-Locomotion-by-Logic: Perturbation-Resilient Bipedal Locomotion via Signal Temporal Logic Guided Model Predictive Control**. Submitted to Robotics and Automation Letters, 2025.
- **Z. Gu**, Y. Zhao, Y. Chen, R. Guo, J.K. Leestma, G.S. Sawicki, Y. Zhao. **Robust-Locomotion-by-Logic: Perturbation-Resilient Bipedal Locomotion via Signal Temporal Logic Guided Model Predictive Control**. Submitted to Transactions on Robotics, 2024.
- A. Shamsah, **Z. Gu**, J. Warnke, S. Hutchinson, Y. Zhao. **Integrated Task and Motion Planning for Safe Legged Navigation in Partially Observable Environments**. Transactions on Robotics, 2023.
- Y. She, **Z. Gu**, S. Song, H. Su, J. Wang. **Design, Modeling, and Manufacturing of a Variable Lateral Stiffness Arm Via Shape Morphing Mechanisms**. Journal of Mechanisms and Robotics, 2021.

Conferences:

- **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**. International Conference on Robotics and Automation, 2024.
- F. Wu, **Z. Gu**, H. Wu, A. Wu, Y. Zhao. **Infer and adapt: Bipedal locomotion reward learning from demonstrations via inverse reinforcement learning**. International Conference on Robotics and Automation, 2024.
- F Liu, **Z Gu**, Y Cai, Z Zhou, S Zhao, H Jung, S Ha, Y Chen, D Xu, Y Zhao. **Opt2skill: Imitating dynamically-feasible whole-body trajectories for versatile humanoid loco-manipulation**. Submitted to International Conference on Robotics and Automation, 2024.
- **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.
- Y. She, **Z. Gu**, S. Song, H.J. Su, J. Wang. **A Continuously Tunable Stiffness Arm with Cable-Driven Mechanisms for Safe Physical Human-Robot Interaction**. International Design Engineering Technical Conferences, 2020.

INVITED TALKS

Planning and Learning of Robust Bipedal Locomotion and Humanoid Loco-manipulation	
Beijing Institute for General Artificial Intelligence (BIGAI). <i>Hosted by Xiaojian Ma,</i>	2025
Reactive Locomotion Decision-Making and Robust Motion Planning for Real-Time Perturbation Recovery	
Center for Brain-Inspired Computing Research (CBICR), Tsinghua University. <i>Hosted by Mingguo Zhao,</i>	2022

SERVICE

Reviewer for T-RO (2), RA-L (5), Humanoids (2), ICRA (8), ICAR (1), IROS (2).
Co-organizer of Humanoids workshop on **Generalizable and Robust Decision Making, Planning, and Control for Humanoid Loco-Manipulation**, 2023.
Co-organizer of IROS workshop on **Reflection of the Past Advancements in Cassie and Bipedal Robots and Vision of the New Era of Humanoids**, 2024.

MENTORSHIP

Master Students: Yipu Chen (Gatech CS), Yuntian Zhao (Gatech ECE), William Yates (Gatech Robotics)
Undergraduate Students: Rongming Guo (Gatech ME), Sixing Chen (President's Award), Wei Pao (President's Award), Kasia Fadeeva (President's Award), James Ni (President's Award), Zimeng Chai (Gatech CS), Qize Tao (Gatech ME)

RESEARCH EXPERIENCE

Humanoid Loco-manipulation Survey, Georgia Institute of Technology Apr. 2024–Jan. 2025

- Authored a journal manuscript compiling a comprehensive survey of state-of-the-art algorithms for humanoid robotics.
- Assembled and led a team of 18 humanoid robotics experts from 15 institutes across 5 countries.
- Featured headline coverage in major robotics media, such as [Humanoid Robotics Technology](#), [Robotics Lecturer](#).

Humanoid Locomotion via Behavior Cloning and Reinforcement Learning, Georgia Institute of Technology Mar. 2024–Feb. 2025

- Trained a behavior-cloning policy using DAGger, imitating a model-based controller for humanoid locomotion.
- Fine-tuned the behavior-cloning policy to further improve the locomotion performance over rough terrain.
- Deployed the policy on humanoid hardware, Digit, for rough terrain such as stairs, ramps, and slippery surfaces.

Reinforcement Learning of Humanoid Loco-manipulation Skills, Georgia Institute of Technology Mar. 2024–Sept. 2024

- Trained reinforcement learning (RL) policy with imitation reward for humanoid loco-manipulation tasks.
- Optimized loco-manipulation reference trajectories using full-body dynamics and differential dynamic programming (DDP).
- Deployed the RL policy on humanoid hardware, Digit, for box pick-up and multi-contact table-top manipulation.

Robust and Safe Bipedal Locomotion using Formal Methods, Georgia Institute of Technology Mar. 2023–Mar. 2024

- Formulated an optimization-based model predictive controller (MPC) with a formal guarantee of locomotion robustness.
- Proposed signal temporal logic-based locomotion specification to quantify the locomotion robustness.
- Enable safe agile bipedal maneuvers by integrating data-driven collision constraints into the MPC to avoid leg self-collision.
- Led a team of ten undergraduate students. Four of them won the president's research reward.

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

- Designed and built a loco-manipulation planning algorithm to perform box delivery tasks over stairs.
- Implemented a real-time passivity-based whole-body controller (WBC) for a humanoid robot operating on hardware at 1000Hz.
- Improved the rapid turning and velocity tracking performance through a novel ankle actuation strategy.

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

- Designed a general control framework for multiple hexapod-structured robots.
- Devised a stable gait for hexapod locomotion; generated real-time natural step sequence for stair climbing.
- Implemented Grasp Map to regulate foot contact force using joint torque sensor and balance robot's centroidal momentum.

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

- Devised and manufactured a three-link monkey robot. Fulfilled the lightweight goal of 2 kg and achieved highly dynamic swing motion across horizontal bars in 0.66s.
- Implemented control framework for monkey robot using C on an STM32F4 microcontroller. Developed motor current feedback control using direct-drive actuators. Designed a communication protocol between the robot and a PC for wireless remote control.

WORK EXPERIENCE

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

- Modeled the dynamic locomotion of a wheel-based humanoid robot from 1X in the Drake simulator.
- Integrated a control framework using Optimal Tracking, Quadratic Programming, and Inverse Dynamics Controller for humanoid dynamics control. Achieved highly dynamic movement at 2m/s and peak acceleration 1m/s² with humanoid robot.
- Contributed to the open-source simulator Drake by implementing a center of mass and Jacobian function for a floating-base system.

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

- Integrated an Open Motion Planning Library (OMPL) as a planning module into Mechmind's control stack for industrial robots.
- Implemented a fast trajectory searching algorithm (RRT-Star) that obtains collision-free pick and place within 1 second.
- Improved robot pick-and-place performance using the symmetry feature of end effector and objects. Enhanced robot motion efficiency by eliminating 70% unnecessary motion with optimal trajectory planning.

TEACHING

System Dynamics, ME-3017, Undergraduate-level Summer 2022

SKILLS

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