Junheng Li

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Professional Experiences

2025/09-present ◇ **Postdoctoral Research Associate** (AMBER Lab; supervisor: Professor Aaron Ames.)
Dept. of Mechanical and Civil Engineering, California Institute of Technology.

2023/08-2025/08 ◇ **Teaching Assistant**
Dept. of Aerospace and Mechanical Engineering, University of Southern California.

Education

2022-2025/08 ◇ **Ph.D., University of Southern California** in Mechanical Engineering.
Advisor: Quan Nguyen, Ph.D.
Thesis: *Hierarchical-optimization-based Control for Dynamic Humanoid Loco-manipulation*

2020-2022 ◇ **M.S., University of Southern California** in Mechanical Engineering.

2016-2020 ◇ **B.S., Loyola Marymount University** in Mechanical Engineering.

Research Experiences

University of Southern California (2022/01 - 2025/08)

2024 – 2025 ◇ **Survey on Humanoid Loco-manipulation** [J1]

- Advisors: Quan Nguyen, Ph.D., Ye Zhao, Ph.D.
- Collaborating Institutes: Georgia Tech, CMU, TUM, Duke, Stanford, etc.
- Reviewed and analyzed the current technical and theoretical progress of humanoid loco-manipulation in control, planning, sensing, learning, and foundation models.

◇ **DiffTune and DiffCoTune for Cross-domain Control on Humanoid Robots** [C1,J2]

- Advisors: Quan Nguyen, Ph.D., Naira Hovakimyan, Ph.D., Sheng Cheng, Ph.D.
- Collaborating Institutes: UIUC, Standford University.
- Investigated differentiable-simulator-based optimal control parameter-tuning on humanoid MPC.
- Investigated differentiable co-tuning of control and system parameters jointly for cross-domain robot control deployment.

◇ **Scalable Control of Humanoid Tele-operation through ForceBot** [C2]

- Advisors: Quan Nguyen, Ph.D., Kaveh A. Hamed, Ph.D., Alexander Leonessa, Ph.D.
- Collaborating Institutes: Virginia Tech.
- Implemented long-distance tele-locomotion framework between ForceBot and Hector V2 humanoid with MPC and CoM reference command scaling.

2021 – 2025 ◇ **Dynamic Locomotion via Hierarchical Optimizations on HECTOR Humanoid** [P1, P2, J3, C3, C4, C8]

- Advisor: Quan Nguyen, Ph.D.
- Implementing and investigating dynamic locomotion control strategies on an in-house mini-humanoid robot platform, including MPC, WBC, trajectory optimization, and data-driven control. https://github.com/DRCL-USC/Hector_Simulation
- Proposed and realized the first-ever continuous dynamic jumping on bipedal robots with hierarchical optimization and variable modeling strategies.
- Proposed force-and-moment humanoid robot dynamics model and augmented the simplified model with Gait Network for variable-frequency walking control.

2023 – 2025 ◇ **Dynamic Humanoid Whole-body Loco-manipulation Control** [C5, C6, P2]

- Advisor: Quan Nguyen, Ph.D.
- Investigated kino-dynamic pose optimization for whole-body pose planning in heavy-weight humanoid pushing.
- Proposed multi-contact external force modeling for controlling humanoid robots perform dynamic object transfer.

2022 ◇ **Wheel-legged Robot Navigating High Obstacles via Pose Optimization** [C7]

- Advisor: Quan Nguyen, Ph.D.
- Proposed and developed kinematics-based pose optimization framework to optimize the driving pose when traversing high obstacles.

Teaching Experiences

2023-2025 ◇ **Teaching Assistant**, University of Southern California.

- AME 451: Linear Control Systems I (*Fall 2023, Spring 2024, and Spring 2025*)
- Led discussion sessions, lecture review, and coding sessions.
- Course covers Laplace transform, frequency domain analysis, compensator design, Root Locus, Bode plots, and Nyquist plot.

2024 ◇ **Invited Project Advisor**, University of Southern California.

- AME 556: Robot Dynamics and Control (*Fall 2024*)
- Participated in project advising, coding sessions, and project reviews.
- Course covers robot kinematics, dynamics, optimal control (LQR, QP, MPC, direct optimization), control barrier function, and input-output linearization.

Publications

Journal Articles

J1 Z. Gu, J. **Li**, W. Shen, *et al.*, "Humanoid locomotion and manipulation: Current progress and challenges in control, planning, and learning," *IEEE/ASME Transactions on Mechatronics (to appear)*, 2025.

J2 L. Krishna, S. Cheng, J. **Li**, Q. Chen, N. Hovakimyan, and Q. Nguyen, "Diffcotune: Differentiable co-tuning for enhanced cross-domain robot control," *IEEE Robotics and Automation Letters (RA-L)*, 2025.

J3 J. **Li** and Q. Nguyen, "Dynamic walking of bipedal robots on uneven stepping stones via adaptive-frequency mpc," *IEEE Control Systems Letters*, vol. 7, pp. 1279–1284, 2023.

Conference Proceedings

C1 Q. Chen*, J. **Li***, S. Cheng, N. Hovakimyan, and Q. Nguyen, "Autotuning bipedal locomotion mpc with grfm-net for efficient sim-to-real transfer," in *2025 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, IEEE, 2025.

C2 A.-C. He*, J. **Li***, J. Park*, *et al.*, "A novel telelocomotion framework with com estimation for scalable locomotion on humanoid robots," in *2025 IEEE International Conference on Robotics and Automation (ICRA)*, 2025.

C3 J. **Li**, Z. Duan, J. Ma, and Q. Nguyen, "Gait-net-augmented implicit kino-dynamic mpc for dynamic variable-frequency humanoid locomotion over discrete terrains," in *Robotics: Science and Systems*, 2025.

C4 J. **Li***, Z. Le*, J. Ma, and Q. Nguyen, "Adapting gait frequency for posture-regulating humanoid push-recovery via hierarchical model predictive control," in *2025 IEEE International Conference on Robotics and Automation (ICRA)*, 2025.

C5 J. **Li** and Q. Nguyen, "Kinodynamic pose optimization for humanoid loco-manipulation," in *2023 IEEE-RAS 22nd International Conference on Humanoid Robots (Humanoids)*, 2023, pp. 1–8.

C6 J. **Li** and Q. Nguyen, "Multi-contact mpc for dynamic loco-manipulation on humanoid robots," in *2023 American Control Conference (ACC)*, 2023.

C7 J. **Li**, J. Ma, and Q. Nguyen, "Balancing control and pose optimization for wheel-legged robots navigating high obstacles," in *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, IEEE, 2022, pp. 8835–8841.

C8 J. **Li** and Q. Nguyen, "Force-and-moment-based model predictive control for achieving highly dynamic locomotion on bipedal robots," in *2021 60th IEEE Conference on Decision and Control (CDC)*, IEEE, 2021, pp. 1024–1030.

Preprint

P1 J. **Li**, J. Ma, O. Kolt, M. Shah, and Q. Nguyen, *Dynamic loco-manipulation on hector: Humanoid for enhanced control and open-source research*, 2023, arXiv.

P2 J. **Li**, O. Kolt, and Q. Nguyen, *Continous dynamic bipedal jumping via adaptive-model optimization*, 2024.

Invention Patents

I1 Q. Nguyen, J. **Li**, and J. Ma, "A bipedal robot for dynamic and robust locomotion in challenging environments," WO2025049602, March 6th, 2025.

I2 Q. Nguyen, J. **Li**, and J. Ma, "Design and control of wheel-legged robots navigating high obstacles," WO2023205766A1, October 26th, 2023.

Services

2025	◇ *Organizing Committee - Registration Technical Lead* of Robotics: Science and Systems (RSS)
	◇ *Reviewer* of IEEE International Conference Humanoid Robots (Humanoids)
	◇ *Reviewer* of IEEE International Journal of Robotics Research (IJRR)
	◇ *Reviewer* of Advanced Robotics Research
	◇ *Reviewer* of Frontiers in Mechanical Engineering
2024-2025	◇ *Reviewer* of IEEE Robotics and Automation Letters (RA-L)
	◇ *Reviewer* of IEEE Control System Letters (L-CSS)
2022-2025	◇ *Reviewer* of IEEE/ASME Transactions on Mechatronics (TMECH)
	◇ *Reviewer* of IEEE International Conference on Robotics and Automation (ICRA)
	◇ *Reviewer* of IEEE International Conference on Intelligent Robots and Systems (IROS)
2024	◇ *Reviewer* of International Journal of Robotics and Automation
2023-2024	◇ *Reviewer* of Robotics and Autonomous Systems (RAS)
2021-2024	◇ *Reviewer* of IEEE Conference on Decision and Control (CDC)
2022	◇ *Reviewer* of Autonomous Robots (AURO)

2022-2025 ◇ *Coordinator of Lab Outreach* for Dynamic Robotics and Control Lab, hosted more than 50 lab tours and outreach events.

Invited Talks, Presentations, and Demonstrations

2025/04 ◇ *"Hierarchial Optimization-based Control for Dynamic Loco-manipulation on Humanoid Robots"*
Invited talk, Caltech AMBER Lab

2024/11 ◇ *"HECTOR: A Novel Mini-humanoid Platform for Accessible and Accelerated Research and Development"*
Invited talk, USC Robotics Seminar

2024/06 ◇ *"Demonstration of Dynamic Loco-manipulation on HECTOR: Humanoid for Enhanced ConTrol and Open-source Research"*
Demonstration, IEEE International Conference on Robotics and Automation (ICRA)

2023/12 ◇ *"Kinodynamic Pose Optimization for Humanoid Loco-manipulation"*
Poster, IEEE International Conference on Humanoid Robots (Humanoids)

2023/11 ◇ *"Toward Dynamic Locomotion and Loco-manipulation on Humanoid Robots via Model Predictive Control with Linear Dynamics Models"*
Invited talk, LMU Department of Mechanical Engineering

2023/10 ◇ *"Toward Dynamic Locomotion and Loco-manipulation on Humanoid Robots via Model Predictive Control with Linear Dynamics Models"*
Invited talk, 42nd Southern California Control Workshop

◇ *"Demonstration of Dynamic Locomotion on Bipedal Robots via Force-and-moment-based Model Predictive Control"*
Demonstration, IEEE International Conference on Intelligent Robots and Systems (IROS)

2023/05 ◇ *"Multi-contact Mpc for Dynamic Loco-manipulation on Humanoid Robots"*
Oral Presentation, American Control Conference (ACC)

◇ *"Dynamic Walking of Bipedal Robots on Uneven Stepping Stones via Adaptive-frequency MPC"*
Oral Presentation, American Control Conference (ACC)

2023/02 ◇ *"Toward Dynamic Locomotion and Loco-manipulation on Humanoid Robots via Model Predictive Control"*
Invited talk, USC Robotics Seminar

2022/10 ◇ *"Balancing Control and Pose Optimization for Wheel-legged Robots Navigating High Obstacles"*
Oral Presentation, IEEE International Conference on Intelligent Robots and Systems (IROS)

2021/11 ◇ *"Force-and-moment-based Model Predictive Control for Achieving Highly Dynamic Locomotion on Bipedal Robots"*
Oral Presentation, IEEE Conference on Decision and Control (CDC)

Mentoring Experience

Graduate Students:

2024-2025 ◇ Dakota Mercer, M.S. in Mechanical Engineering, USC
Project: *Hierarchical-Optimization for Dynamic Stair Climbing on Bipedal Robots*

◇ Ziwei Duan, M.S. in Computer Science, USC
Project: *Gait-Net: A Data-driven Approach to Enhance Bipedal Locomotion Control*

2023-2024 ◇ Zhanhao Le, M.S. in Mechanical Engineering, USC
Project: *Bipedal Robot Push Recovery via Hierarchical-MPC*
Now: Prospective Ph.D. student

- Omar Kolt, M.S. in Mechanical Engineering, USC.
  Project: *Control and Software Infrastructure of HECTOR Humanoid*
  Now: Software Engineer at Tesla, Optimus Team
- Omar Berra, M.S. in Mechanical Engineering, USC
  Project: *Design and Whole-body Control of Bipedal Wheel-legged Robot*
  Now: Testing Engineer at the Boring Company

2022-2023
- Han Gong, M.S. in Mechanical Engineering, USC
  Project: *Terrain-aware Bipedal Robot Control and Simulation Design*
  Now: Ph.D. student at UMass Amherst

2021-2022
- Xinyu Zhu, M.S. in Mechanical Engineering, USC
  Project: *Uneven Terrain Locomotion of Wheel-legged Robots via Whole-body Control*
  Now: Engineer at Xiaomi Robotics Lab
- Tiansheng Wu, M.S. in Mechanical Engineering, USC
  Project: *Terrain-aware Trajectory Optimization and Control on Bipedal Robots*

Undergraduate Students:

2024-2025
- Rodrigo Andrade, B.S. in Mechanical Engineering, USC
  Project: *Design-control Co-optimization of Mini Humanoid Robot*
- Nathan Chun, B.S. in Mechanical Engineering, USC
  Project: *Optimal Control of High-degree-of-freedom Mechanical Systems*
- Bill Ouyang, B.S. in Mechanical Engineering, USC

2022-2024
- Mana Shah, B.S. in Mechanical Engineering, USC
  Project: *Design of a Mini Humanoid Robot Platform*

High School Students:

Summer 2024
- Chinmay Ramamurthy, Ethan Le, Ian Chen, Perceiver Summer Research
  Project: *Modeling and Control of Series Elastic Actuators for Knee Exoskeletons*
- Jonathan Li, Ted Han, Sophia Fu, Perceiver Summer Research
  Project: *Package Transferring with UAV and Passive Manipulation Mechanism*

Summer 2022
- Dylan Dharwadkar, USC SHINE Program
  Project: *Swing Trajectory Design and Control in Bipedal Robot Walking*

Media and Press

HECTOR Humanoid
- IEEE Spectrum: Continuous Dynamic Jumping on HECTOR
- IEEE RAM: The Next Generation of Robotics
- USC Today: HECTOR at the Ginsburg Hall's Grand Opening Ceremony

Wheel-legged Robot
- USC News: Navigate Terrain and Combat Obstacles
- Tech Briefs: Wheel-Legged Robots Navigating High Obstacles

Service
- IEEE TelePresence: RoboPalooza Event at Peterman Hill in Lucerne Valley
- USC Viterbi News: Robotics Open House 2024