

Junheng Li, Ph.D.

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in LinkedIn

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Professional Experiences

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

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

California Institute of Technology (2025/09 - present)

- 2025 ◇ **Multi-modal motion planning and control of a flying humanoid**
- Advisors: Aaron Ames, Ph.D., Morteza Gharib, Ph.D.
 - Leading the model-based and model-guided learning of locomotion and manipulation planning and control for a flying humanoid robot.
- ◇ **Kino-dynamically feasible motion guidance for generalist humanoid WBC**
- Advisors: Aaron Ames, Ph.D.
 - Exploring closed-form kino-dynamic motion generation and guidance in humanoid RL for training generalist whole-body control.

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, Stanford 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, *Continuous 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

Organizing Committee ◇ Registration Technical Lead of Robotics: Science and Systems (RSS) 2025

Reviewer ◇ International Journal of Robotics Research (IJRR), IEEE Robotics and Automation Letters (RA-L), IEEE/ASME Transactions on Mechatronics (TMECH), IEEE Transactions on Automation Science and Engineering (T-ASE), Journal of Field Robotics (JFR), Autonomous Robots (AURO), IEEE Control System Letters (L-CSS), Robotics and Autonomous Systems (RAS), Advanced Robotics Research, Frontiers in Mechanical Engineering, International Journal of Robotics and Automation

- ◇ IEEE International Conference on Robotics and Automation (ICRA), IEEE International Conference on Intelligent Robots and Systems (IROS), *Reviewer* of IEEE International Conference Humanoid Robots (Humanoids), *Reviewer* of IEEE Conference on Decision and Control (CDC)

Outreach ◇ *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 ◇ *"Hierarchical 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](#)