Jeeseop Kim

Contact Information	126 Gates-Thomas Building California Institute of Technology 1200 E California Blvd Pasadena, CA 91125	Email: jeeseop@caltech.edu Homepage: https://jeeseop.com Github: https://github.com/jeeseop Youtube: https://www.youtube.com/@jeeseop
	Appointm	ients
Postdoctoral Scholar	Mechanical and Civil Engineering, California Institute of Technology (Caltech) Oct. 2022 - present Advisor: Prof. Aaron D. Ames	
Graduate Research Assistant	Mechanical Engineering, Virginia T Aug. 2017 - Aug. 2022 Advisor: Prof. Kaveh Akbari F	ech lamed
	Transdisciplinary Studies, Seoul Na Jan. 2014 - Jul. 2017 Advisor: Prof. Jaeheung Park	tional University, South Korea
	Educatio	<u>on</u>
Ph.D.	Mechanical Engineering Virginia Polytechnic Institute and S Dissertation: Collaborative Loco From Centralized Advisor: Prof. Kaveh Akbari Ha	August, 2022 State University (Virginia Tech) omotion of Quadrupedal Robots: Predictive Control to Distributed Control amed
M.S.	Intelligence and Information Seoul National University, South K Thesis: Improvement of Human using Actuator Deforma Advisor: Prof. Jaeheung Park	February, 2017 orea oid Gait Control tion Model
B.S.	Mechanical and Aerospace Enginee Seoul National University, South K	ring February, 2014 prea
	Research In	nterests
Areas of Interest	My primary academic interests sp cal systems, and machine learning. that extends the state-of-the-art m trol algorithms for a wide range of	ban robotics, control theory, optimization, dynami- My research goal is to establish a firm foundation aethods for designing resilient and intelligent con- collaborative work. This overview includes but is

control policies, 2) autonomous robot control and planning for various applications, 3) agile robots without compromising safety features.

not limited to 1) collaborative multi-agent systems with decentralized and distributed

My research follows a trajectory that bridges theoretical concepts and experimental application, aiming to achieve two key objectives: 1) Creating algorithms to systematically design robust and intelligent controllers for high-dimensional and complex hybrid dynamical systems; and 2) Transferring the control framework into practice with a highly dynamic robot platform. These algorithms advance knowledge in the design of feedback controllers for dynamical models arising from various collaborative works that I target. The theoretical innovations also offer a unique opportunity to advance human-robot interaction, robotic legged locomotion, autonomous robot with safety features.

Honors

Awards	\diamond 2023 IEEE ICRA Outstanding Paper Award	2023
	♦ ASME Dynamic Systems & Control Division Rudolf Kalman	2022
	Best Paper Award	
	\diamond The Best Presentation Award,	2016
	Institute of Control, Robotics and Systems 2016	
	♦ Darpa Robotics Challenge DRC Finalist	2015
	♦ The Best Presentation Award from Bachelor Thesis,	2012
	Seoul National University	
Fellowship	Research Assistant Scholarships, Virginia Tech, Blacksburg, USA	2017 - 2022
-	Gwan-ak Scholarship, Seoul National University, Seoul, South Korea	2014 - 2015

Teaching Experience

tte Oniversity

Transdisciplinary Studies, Seoul National University, South Korea
493.601: Convergent Robotics Technology (Spring, 2015)
493.611: Dynamics and Control of Robot-Environment Interaction (Fall, 2015)

National Scholarship from Korea Student Aid Foundation, South Korea 2009 - 2010

Publications

Journal Articles	[J6] J. Kim, R. T. Fawcett, V. R. Kamidi, A. D. Ames and K. Akbari Hamed, "Layered Control for Cooperative Locomotion of Two Quadrupedal Robots: Cen- tralized and Distributed Approaches," <i>IEEE Transactions on Robotics</i> , vol. 39, no. 6, pp. 4728-4748, Dec. 2023.
	 [J5] V. R. Kamidi, J. Kim, R. T. Fawcett, A. Ames, and K. Akbari Hamed, "Distributed Quadratic Programming-Based Nonlinear Controllers for Periodic Gaits on Legged Robots," <i>IEEE Control Systems Letters</i>, Vol. 6, pp. 2509-2514, Apr, 2022.
	 [J4] J. Kim, and K. Akbari Hamed, "Cooperative locomotion via supervisory predictive control and distributed non- linear controllers,"

ASME Journal of Dynamic Systems, Measurement, and Control, Vol. 144, Issue. 3, p. 031005, Mar, 2022.

- [J3] R. T. Fawcett, A. Pandala, J. Kim, and K. Akbari Hamed, "Real-time planning and nonlinear control for quadrupedal locomotion with ar- ticulated tails," ASME Journal of Dynamic Systems, Measurement, and Control, Vol. 143, Issue. 7, p. 071004, Jul, 2021.
 [2022 ASME DSCD Rudolf Kalman Best Paper Award]
- [J2] K. Akbari Hamed, J. Kim, A. Pandala, "Quadrupedal locomotion via event-based predictive control and QP-based virtual constraints," *IEEE Robotics and Automation Letters*, Vol. 5, Issue. 3, pp. 4463-4470, Jul, 2020.
- [J1] J. Kim, Y. Omori, A. Sifat, and T. Furukawa, "Adjustably designed torque controlled humanoid platform," *International Journal of Mechanical and Production Engineering*, Vol. 7, Issue. 2, pp. 52-57, May, 2019.

Conference Papers

- [C14] Y. Kim, J. Kim, A. D. Ames, and C. Sloth
 "Robust Safety-Critical Control for Input-Delayed System with Delay Estimation,"
 22nd European Control Conference (ECC24), Accepted to appear.
 - [C13] J. Kim, J. Lee, and A. D. Ames,
 "Safety-Critical Coordination of Legged Robots via Layered Controllers and Forward Reachable Set based Control Barrier Functions,"
 2024 IEEE International Conference on Robotics and Automation (ICRA 2024), Accepted to appear.
 - [C12] J. Lee, J. Kim, W. Ubellacker, T. G. Molnar and A. D. Ames,
 "Safety-critical Control of Quadrupedal Robots with Rolling Arms for Autonomous Inspection of Complex Environments,"
 2024 IEEE International Conference on Robotics and Automation (ICRA 2024), Accepted to appear.
 - [C11] J. Kim, R. T. Fawcett, V. R. Kamidi, A. D. Ames and K. Akbari Hamed, "Layered Control for Cooperative Locomotion of Two Quadrupedal Robots: Centralized and Distributed Approaches," 2024 IEEE International Conference on Robotics and Automation (ICRA 2024), Accepted to appear.
 - [C10] J. Lee, J. Kim, and A. D. Ames,
 "A Data-driven Method for Safety-critical Control: Designing Control Barrier Functions from State Constraints,"
 2024 American Control Conference (ACC 2024), Accepted to appear.
 - [C9] A. B. Ghansah, J. Kim, M. Tucker, and A. D. Ames,
 "Humanoid Robot Co-Design: Coupling Hardware Design with Gait Generation via Hybrid Zero Dynamics,"
 2023 IEEE Conference on Decision and Control (CDC 2023), Marina Bay Sands, Singapore, 13-15 Dec, 2023, pp. 1879-1885.

- [C8] J. Kim, J. Lee, and A. D. Ames,
 "Safety-Critical Coordination for Cooperative Legged Locomotion via Control Barrier Functions,"
 2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2023), Detroit, MI, USA, 01-05 Oct, 2023, pp. 2368-2375.
- [C7] J. Lee, J. Kim, and A. D. Ames,
 "Hierarchical Relaxation of Safety-critical Controllers: Mitigating Contradictory Safety Conditions with Application to Quadruped Robots,"
 2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2023), Detroit, MI, USA, 01-05 Oct, 2023, pp. 2384-2391.
- [C6] R. T. Fawcett, L. Amanzadeh, J. Kim, A. D. Ames and K. Akbari Hamed, "Distributed Data-Driven Predictive Control for Multi-Agent Collaborative Legged Locomotion," 2023 IEEE International Conference on Robotics and Automation (ICRA 2023), London, UK, 29 May- 02 Jun, 2023, pp. 9924-9930.
 [2023 IEEE ICRA Outstanding Paper Award]
 [2023 IEEE ICRA Outstanding Multi-Robot Systems Paper Award Finalist]
- [C5] V. R. Kamidi, J. Kim, R. T. Fawcett, A. Ames and K. Akbari Hamed, "Distributed Quadratic Programming-Based Nonlinear Controllers for Periodic Gaits on Legged Robots," 2022 IEEE Conference on Decision and Control (CDC), Cancun, Mexico, 6-9 Dec, 2022.
- [C4] J. Kim, Y. Omori, A. Sifat, and T. Furukawa, "Adjustably designed torque controlled humanoid platform," International Conference on Control, Automation, Robotics and Vision Engineering, Washington DC, USA, 21-22 Nov, 2018.
- [C3] J. Kim, M. Kim, and J. Park, "Improvement of humanoid walking control by compensating actuator elasticity," *International Conference on Humanoid Robots (ICHR)*, Cancun, Mexico, 15-17 Nov, 2016, pp. 29-34.
- [C2] J. Jung, J. Kim, S. Kim, W. Kwon, S. Na, K. Kim, J. Lee, G. Suh, and J. Park, "Application of robot manipulator for cardiopulmonary resuscitation," *International Symposium on Experimental Robotics (ISER)*, Tokyo, Japan, 3-6 Oct, 2016.
- [C1] J. Kim, M. Kim, and J. Park,
 "Improvement of humanoid gait stability using reduction gear deformation model," *The 31st Institute of Control, Robotics and Systems (ICROS)*, Seoul, Korea, 10-11 Mar, 2016.

Papers Under Review & Preprints

- [U13] A. B. Ghansah, J. Kim, K. Li, and A. D. Ames "Dynamic Walking on Highly Underactuated Point Foot Humanoids: Closing the Loop between HZD and HLIP," under review 2024.
- [U12] J. Lee, J. Kim, A. D. Ames "Safety-critical Autonomous Inspection of Distillation Columns using Quadrupedal Robots Equipped with Roller Arms," under review 2024.

- [U11] K. Li, J. Kim, X. Xiong, K. Akbari Hamed, Y. Yue, A. D. Ames "Data-Driven Predictive Control for Robust Exoskeleton Locomotion," preprint arXiv 2024.
- [U10] B. M. Imran, R. T. Fawcett, J. Kim, A. Leonessa, and K. Akbari Hamed "A Distributed Layered Planning and Control Algorithm for Teams of Quadrupedal Robots: An Obstacle-Aware Nonlinear MPC Approach," under review 2024.
- [U9] J. Lee, J. Kim, and A. D. Ames,
 "A Data-driven Method for Safety-critical Control: Designing Control Barrier Functions from State Constraints," preprint arXiv 2023.
- [U8] J. Kim, J. Lee, and A. D. Ames, "Safety-Critical Coordination of Legged Robots via Layered Controllers and Forward Reachable Set based Control Barrier Functions," preprint arXiv 2023.
- [U7] J. Lee, J. Kim, W. Ubellacker, T. G. Molnar and A. D. Ames, "Safety-critical Control of Quadrupedal Robots with Rolling Arms for Autonomous Inspection of Complex Environments," preprint arXiv 2023.
- [U6] A. B. Ghansah, J. Kim, M. Tucker, and A. D. Ames, "Humanoid Robot Co-Design: Coupling Hardware Design with Gait Generation via Hybrid Zero Dynamics," preprint arXiv 2023.
- [U5] J. Kim, J. Lee, and A. D. Ames, "Safety-Critical Coordination for Cooperative Legged Locomotion via Control Barrier Functions," preprint arXiv 2023.
- [U4] J. Lee, J. Kim, and A. D. Ames, "Hierarchical Relaxation of Safety-critical Controllers: Mitigating Contradictory Safety Conditions with Application to Quadruped Robots," preprint arXiv 2023.
- [U3] J. Kim, R. T. Fawcett, V. R. Kamidi, A. D. Ames and K. Akbari Hamed, "Layered Control for Cooperative Locomotion of Two Quadrupedal Robots: Centralized and Distributed Approaches,," preprint arXiv 2022.
- [U2] R. T. Fawcett, L. Amanzadeh, J. Kim, A. D. Ames and K. Akbari Hamed, "Distributed Data-Driven Predictive Control for Multi-Agent Collaborative Legged Locomotion," preprint arXiv 2022.
- [U1] K. Akbari Hamed, J. Kim, A. Pandala, "Quadrupedal locomotion via event-based predictive control and QP-based virtual constraints," preprint arXiv 2020.

Theses & Dissertation

- [T2] Jeeseop Kim
 Collaborative Locomotion of Quadrupedal Robots:
 From Centralized Predictive Control to Distributed Control
 PhD Dissertation, Virginia Polytechnic Institute and State University, 2022.
- [T1] Jeeseop Kim
 Improvement of Humanoid Gait Control using Actuator Deformation
 Model
 Master Thesis, Seoul National University, South Korea, 2017.

Patent	$\left[P2\text{-}2\right]$ Automatic cardiopulmonary resuscitation device and control method therefor, 2021. No. US11071686B2 (US Patent)
	[P2-1] Automatic cardiopulmonary resuscitation device and control method therefor, 2020. No. 108697572B (CN Patent), No. 3409258B1 (EU Patent)
	$\left[P1\right]$ Apparatus for automatic cardiovascular pulmonary resuscitation, 2016. Korea Patent No.10-2016-0172286.

Professional Activities

Associate Editor (Conference)	\circ IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics (BioRob 2024)	
Session Chair	 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) Session on "Motion Control", Detroit, MI, 2023 	
Journal Reviewer	 • IEEE Transactions on Robotics (T-RO) • IEEE Robotics and Automation Letters (RA-L) • IEEE Transactions on Industrial Electronics • IEEE Open Journal of Control Systems (OJCSYS) • ASME Journal of Dynamic Systems, Measurement and Control 	
Conference Reviewer	 American Control Conference (ACC) IEEE International Conference on Robotics and Automation (ICRA) IEEE Conference on Decision and Control (CDC) IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) IEEE International Conference on Safety, Security, and Rescue Robotics (SSRR) 	
	Invited Presentations	
Presentations	 [P2] Safety-ensured Collaborative Robot Team Department of Mechanical Engineering, Robotics and Mechatronics seminar, Virginia Tech, Blacksburg VA (virtually), Nov, 2023. [P1] C. B. L. L.	

[P1] Collaborative Locomotion of Quadrupedal Robots:
 From Centralized Predictive Control to Distributed Control
 Dept. of Mechanical and Civil Engineering, Control and Dynamical Systems,
 AMBER Lab & Burdick group seminar,
 California Institute of Technology, Pasadena CA (virtually), May, 2022.

Professional Skills

Trained Area	Domain: Robotics, Collaborative Robot Team Control, Legged Locomotion, Underactuated System Control, Safety-Critical Control, Autonomy, Data-Driven Method, Optimization, Mixed Integer Programming
	Theory: Control Theory, Nonlinear Control, Optimization & Optimal Control, Distributed/Decentralized Control
	Dynamic System Modeling: Nonlinear Systems, Hybrid Dynamical Systems, Underactuated Systems, High-DoF Systems, Multiagent Systems
Skill set	Programming Language/Tools/domains: C/C++, Python, CMake, MATLAB, STMCubeIDE/MX, vim, VScode, ROS OOP-based controller development, Embedded programming, real-time system
	Optimization Libraries/Tools: OSQP, qpSWIFT, ECOSQP, C quadprog, MATLAB Optimization Tool box
	Numerical Simulations: Mujoco, RaiSim, Gazebo, MATLAB
	Mechanical Design and Analysis: Unigraphics (NX), Solidworks
	Circuit Design and Analysis: Autodesk Eagle, KiCad Electronics Design Automation (EDA)

 $References\ available\ upon\ request$

last Updated on March 30, 2024