

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
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Appointments

Postdoctoral Research Associate	Mechanical and Civil Engineering, California Institute of Technology , Oct. 2022 - present. PI: Dr. Aaron D. Ames
Graduate Research Assistant	Mechanical Engineering, Virginia Tech , Aug. 2019 - Aug. 2022. PI: Dr. Kaveh Akbari Hamed Intelligence and Information (Major in Robotics), Seoul National University , South Korea, Mar. 2014 - Feb. 2017. PI: Dr. Jaeheung Park

Education

Postdoctoral Scholar	Mechanical and Civil Engineering California Institute of Technology (Caltech) Advisor: Dr. Aaron D. Ames	Oct. 2022 - present
Ph.D.	Mechanical Engineering Virginia Polytechnic Institute and State University (Virginia Tech) Dissertation: Collaborative Locomotion of Quadrupedal Robots: From Centralized Predictive Control to Distributed Control Advisor: Dr. Kaveh Akbari Hamed	August, 2022
M.S.	Intelligence and Information (Major in Robotics) Seoul National University, South Korea Thesis: Improvement of Humanoid Gait Control using Actuator Deformation Model Advisor: Dr. Jaeheung Park	February, 2017
B.S.	Mechanical and Aerospace Engineering Seoul National University, South Korea	February, 2014

Research Interests

Areas of Interest	My primary academic interests span robotics, control theory, optimization, dynamical systems, and data-driven methods. My research goal is to establish a firm foundation that extends the state-of-the-art methods for designing resilient and intelligent control algorithms for a wide range of collaborative tasks with legged robots. This overview includes but is not limited to 1) frameworks for collaborative tasks on heterogeneous robot teams, 2) safety-critical autonomous robot planning and control, and 3) intelligent legged-robot system with various reasoning architectures and decision making processes.
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My research aims bridging theoretical concepts and experimental applications, focusing on two key objectives: i) Developing algorithms for the systematic design of robust and intelligent controllers for high-dimensional, complex hybrid dynamical systems; and ii) Translating this control framework into practice using highly dynamic robotic platforms. These theoretical innovations and experimental insights offer unique opportunities to enhance our comprehension of interactions in dynamic environments, human-robot interaction, robotic legged locomotion, and autonomous systems with safety features. Furthermore, this efforts contributes to the development of intelligent and robust systems by incorporating various reasoning architectures and decision-making processes. Through this integrated approach, my research philosophy is to push the boundaries of both theoretical foundations and practical applications in the field of robotics and control systems.

Honors

Awards	◇ 2023 IEEE ICRA Outstanding Paper Award	2023
	◇ 2023 IEEE ICRA Outstanding Multi-Robot Systems Paper Award Finalist	2023
	◇ ASME Dynamic Systems & Control Division Rudolf Kalman Best Paper Award	2022
	◇ 2016 The 31st ICROS Annual Conference Best Paper Award	2016
	◇ DARPA Robotics Challenge (DRC) Finalist	2015
	◇ The Best Presentation Award for Bachelor Thesis, Seoul National University	2012
Fellowship	Research Assistant Scholarships, Virginia Tech, Blacksburg, USA	2017 - 2022
	Gwan-ak Scholarship, Seoul National University, Seoul, South Korea	2014 - 2015
	National Scholarship from Korea Student Aid Foundation, South Korea	2009 - 2010

Teaching Experience

TEACHING ASSISTANT	Mechanical Engineering, Virginia Polytechnic Institute and State University
	ME5524: Bayesian Robotics (Spring, 2019)
	ME5984: Advanced Experimental Robotics (Fall, 2018)
	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)

Publications

JOURNAL ARTICLES

- [J 7] 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,”
ASME Journal of Dynamic Systems, Measurement, and Control, Accepted to Appear 2024.
- [J 6] **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,”
IEEE Transactions on Robotics, vol. 39, no. 6, pp. 4728-4748, Dec. 2023.
- [J 5] 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,”
IEEE Control Systems Letters, Vol. 6, pp. 2509-2514, Apr, 2022.
- [J 4] **J. Kim**, and K. Akbari Hamed,
 “Cooperative locomotion via supervisory predictive control and distributed nonlinear controllers,”
ASME Journal of Dynamic Systems, Measurement, and Control, Vol. 144, Issue. 3, p. 031005, Mar, 2022.
- [J 3] R. T. Fawcett, A. Pandala, **J. Kim**, and K. Akbari Hamed,
 “Real-time planning and nonlinear control for quadrupedal locomotion with articulated 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
- [J 2] 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.
- [J 1] **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

- [C 17] 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,”
2024 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2024), Accepted to appear.
- [C 16] J. Lee, **J. Kim**, A. D. Ames
 “Safety-critical Autonomous Inspection of Distillation Columns using Quadrupedal Robots Equipped with Roller Arms,”
2024 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2024), Accepted to appear.
- [C 15] K. Li, **J. Kim**, X. Xiong, K. Akbari Hamed, Y. Yue, A. D. Ames
 “Data-Driven Predictive Control for Robust Exoskeleton Locomotion,”

2024 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2024),
Accepted to appear.

- [C 14] 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), Stockholm, Sweden, 25-28 Jun, 2024, pp. 2218-2223.
 - [C 13] **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), Yokohama, Japan, 13-17 May, 2024, pp. 3478-3484.
 - [C 12] 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), Yokohama, Japan, 13-17 May, 2024, pp. 3485-3491.
 - [C 11] **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), Yokohama, Japan, 13-17 May, 2024.
 - [C 10] 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), Toronto, Canada, 8-12 Jul, 2024.
 - [C 9] 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.
 - [C 8] **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.
 - [C 7] 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.
 - [C 6] 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

- [C 5] 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.
- [C 4] **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.
- [C 3] **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.
- [C 2] 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.
- [C 1] **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) Annual Conference, Seoul, Korea, 10-11 Mar, 2016.
 2016 The 31st ICROS Annual Conference Best Paper Award

PAPERS UNDER
REVIEW &
PREPRINTS

- [U 17] Y. Kim, **J. Kim**, A. H. Li, A. D. Ames, and C. Sloth
 “Robust Adaptive Safe Robotic Grasping with Tactile Sensing,” under review.
- [U 16] Y. Kim, E. Das, **J. Kim**, A. D. Ames, J. W. Burdick, and C. Sloth
 “Minimizing Conservatism in Safety-Critical Control for Input-Delayed Systems via Adaptive Delay Estimation,” under review.
- [U 15] A. B. Ghansah, **J. Kim**, and A. D. Ames
 “Design and Control of the Humanoid Robot ACHILLES: Real-Time Gait Generation for Dynamic Locomotion,” under review.
- [U 14] K. Li, **J. Kim**, M. Brunet, M. Petriaux, Y. Yue, and A. D. Ames
 “Hybrid Data-Driven Predictive Control for Robust and Reactive Exoskeleton Locomotion Synthesis,” under review.
- [U 13] J. Lee, M. Dai, **J. Kim**, A. D. Ames
 “Safety-critical Locomotion of Biped Robots in Infeasible Paths: Overcoming Obstacles during Navigation toward Destination,” preprint arXiv 2024.
- [U 12] 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,” preprint arXiv 2024.
- [U 11] J. Lee, **J. Kim**, A. D. Ames
 “Safety-critical Autonomous Inspection of Distillation Columns using Quadrupedal Robots Equipped with Roller Arms,” preprint arXiv 2024.
- [U 10] 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.

- [U 9] 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.
- [U 8] **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.
- [U 7] J. Lee, **J. Kim**, W. Uellacker, 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.
- [U 6] 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.
- [U 5] **J. Kim**, J. Lee, and A. D. Ames,
“Safety-Critical Coordination for Cooperative Legged Locomotion via Control Barrier Functions,” preprint arXiv 2023.
- [U 4] 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.
- [U 3] **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.
- [U 2] 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.
- [U 1] K. Akbari Hamed, **J. Kim**, A. Pandala,
“Quadrupedal locomotion via event-based predictive control and QP-based virtual constraints,” preprint arXiv 2020.

THESES & DISSERTATION

- [T 2] Jeeseop Kim
**Collaborative Locomotion of Quadrupedal Robots:
From Centralized Predictive Control to Distributed Control**
PhD Dissertation, Virginia Polytechnic Institute and State University, 2022.
- [T 1] Jeeseop Kim
Improvement of Humanoid Gait Control using Actuator Deformation Model
Master Thesis, Seoul National University, South Korea, 2017.

PATENT

- [P2-2] 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)
- [P1] Apparatus for automatic cardiovascular pulmonary resuscitation, 2016. Korea Patent No.10-2016-0172286.

Professional Activities

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| Associate Editor
(Conference) | <ul style="list-style-type: none"> ○ IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics (BioRob 2024) |
| Session Chair | <ul style="list-style-type: none"> ○ IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
Session on “Motion Control”, Detroit, MI, 2023 |
| Journal
Reviewer | <ul style="list-style-type: none"> ○ IEEE Transactions on Robotics (T-RO) ○ International Journal of Robotics Research (IJRR) ○ IFAC Automatica ○ IEEE Transactions on Industrial Electronics (T-IE) ○ IEEE Transactions on Control of Network Systems (TCNS) ○ IEEE /ASME Transactions on Mechatronics (TMECH) ○ ASME Journal of Dynamic Systems, Measurement and Control ○ IEEE Robotics and Automation Letters (RA-L) ○ IEEE Robotics & Automation Magazine (RAM) ○ IEEE Open Journal of Control Systems (OJCSYS) |
| Conference
Reviewer | <ul style="list-style-type: none"> ○ 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-RAS International Conference on Humanoid Robots (Humanoids) ○ IEEE International Conference on Safety, Security, and Rescue Robotics (SSRR) |

Invited Presentations

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| Presentations | <p>[P 2] Safety-ensured Collaborative Robot Team
<i>Department of Mechanical Engineering,
Robotics and Mechatronics seminar,
Virginia Tech, Blacksburg VA (virtually), Nov, 2023.</i></p> <p>[P 1] Collaborative Locomotion of Quadrupedal Robots:
From Centralized Predictive Control to Distributed Control
<i>Dept. of Mechanical and Civil Engineering, Control and Dynamical Systems,
AMBER Lab & Burdick group seminar,
California Institute of Technology, Pasadena CA (virtually), May, 2022.</i></p> |
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Professional Skills

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| Trained Area | <p>Domain:
Robotics, Collaborative Robot Team Control, Underactuated System Control,
Legged Locomotion, Loco-Manipulation, Multi-contact Locomotion,
Safety-Critical Control, Autonomy, Data-Driven Method,
Optimization, Mixed Integer Programming</p> |
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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, OOP-based controller development,
STMCubeIDE/MX, Embedded programming, real-time system,
Docker, ROS, MATLAB

Optimization Libraries/Tools:

OSQP, qpSWIFT, ECOS, ECOSQP, IPOPT, Casadi, C quadprog

Numerical Simulations:

Mujoco, RaiSim, Gazebo, MATLAB

Mechanical Design and Analysis:

Solidworks, Unigraphics (NX)

Circuit Design and Analysis:

Autodesk Eagle, KiCad Electronics Design Automation (EDA)