

# Jeeseop Kim

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## Appointments

<b>Postdoctoral Scholar</b>	Mechanical and Civil Engineering, California Institute of Technology (Caltech) Oct. 2022 - present Advisor: Prof. Aaron D. Ames
<b>Graduate Research Assistant</b>	Mechanical Engineering, Virginia Tech Aug. 2017 - Aug. 2022 Advisor: Prof. Kaveh Akbari Hamed  Transdisciplinary Studies, Seoul National University, South Korea Jan. 2014 - Jul. 2017 Advisor: Prof. Jaeheung Park

## Education

<b>Ph.D.</b>	Mechanical Engineering Virginia Polytechnic Institute and State University (Virginia Tech) Dissertation: Collaborative Locomotion of Quadrupedal Robots: From Centralized Predictive Control to Distributed Control Advisor: Prof. Kaveh Akbari Hamed	August, 2022
<b>M.S.</b>	Intelligence and Information Seoul National University, South Korea Thesis: Improvement of Humanoid Gait Control using Actuator Deformation Model Advisor: Prof. Jaeheung Park	March, 2017
<b>B.S.</b>	Mechanical and Aerospace Engineering Seoul National University, South Korea	March, 2014

## Research Interests

<b>Areas of Interest</b>	My primary academic interests span robotics, control theory, optimization, dynamical systems, and machine learning. 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 work. This overview includes but is not limited to 1) collaborative multi-agent systems with decentralized and distributed control policies, 2) autonomous robot control and planning for various applications, 3) agile robots without compromising safety features.
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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

<b>Awards</b>	◇ 2023 IEEE ICRA Outstanding Paper Award	2023
	◇ ASME Dynamic Systems & Control Division Rudolf Kalman Best Paper Award	2022
	◇ The Best Presentation Award, Institute of Control, Robotics and Systems 2016	2016
	◇ Darpa Robotics Challenge DRC Finalist	2015
	◇ The Best Presentation Award from Bachelor Thesis, Seoul National University	2012
<b>Fellowship</b>	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	[ J6 ] <b>J. Kim</b> , 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," <i>IEEE Transactions on Robotics</i> , vol. 39, no. 6, pp. 4728-4748, Dec. 2023.
	[ J5 ] V. R. Kamidi, <b>J. Kim</b> , 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 ] <b>J. Kim</b> , 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 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

- [ 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

- [ 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. Otori, 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.

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PAPERS UNDER  
REVIEW &  
PREPRINTS

- [U11] 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.
- [U10] Y. Kim, **J. Kim**, A. D. Ames, and C. Sloth  
 “Robust Safety-Critical Control for Input-Delayed System with Delay Estimation,” 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.

- [U 7] 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.
- [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: Cen-  
tralized 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 vir-  
tual 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

#### Session Chair

- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)  
Session on “Motion Control”, Detroit, MI, 2023

<b>Journal Reviewer</b>	<ul style="list-style-type: none"> <li>◦ IEEE Transactions on Robotics (T-RO)</li> <li>◦ IEEE Robotics and Automation Letters (RA-L)</li> <li>◦ IEEE Open Journal of Control Systems (OJCSYS)</li> <li>◦ ASME Journal of Dynamic Systems, Measurement and Control</li> </ul>
<b>Conference Reviewer</b>	<ul style="list-style-type: none"> <li>◦ American Control Conference (ACC)</li> <li>◦ IEEE International Conference on Robotics and Automation (ICRA)</li> <li>◦ IEEE Conference on Decision and Control (CDC)</li> <li>◦ IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)</li> <li>◦ IEEE International Conference on Safety, Security, and Rescue Robotics (SSRR)</li> </ul>

### Invited Presentations

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

<b>Trained Area</b>	(cooperative) Robotics, Legged Robot Locomotion, Optimization
<b>Dynamic Sys. Modeling</b>	Nonlinear Systems, Hybrid Dynamical Systems, Multiagent Systems
<b>Theory</b>	Control Theory, Nonlinear Control, Optimal Control, Distributed Control
<b>Optimization Tools</b>	MATLAB Optimization Tool box, quadprog, ECOSQP, OSQP, qpSWIFT
<b>Programming Language</b>	MATLAB, Python, C/C++
<b>Mechanical Design and Analysis</b>	Unigraphics (NX), Solidworks
<b>Circuit Design and Analysis</b>	Autodesk Eagle, KiCad Electronics Design Automation (EDA)

*References available upon request*

*last Updated on February 7, 2024*