Hae-Won Park, Ph.D.

Assistant Professor

Department of Mechanical Science and Engineering

University of Illinois at Urbana-Champaign

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Research Interests

Control, dynamics, and design of robot systems, with special emphasis on the establishment and experimental implementation of control and mechanical design principles for legged locomotion robots.

Education

The University of Michigan	Ann Arbor, MI	2007-2012

Advisor: Jessy W. Grizzle

Ph.D. Department of Mechanical Engineering, May 2012.
Thesis: Control of a Bipedal Robot Walker on Rough Terrain

Yonsei University	Seoul, Korea	2005-2007

Advisor: Young-Pil Park

Master of Science, Department of Mechanical Engineering, February 2007.
Thesis: Design, Analysis, and Experiment of a Dolphin Robot

Yonsei University	Seoul, Korea	1998-2005

Advisor: Hyun-Seok Yang

Bachelor of Science, Department of Mechanical Engineering, February 2005.
Thesis: Design of a Small Size Six-Legged Walking Robot Using Electromagnet Actuators

Professional Experience

Assistant Professor	U. of Illinois	Mechanical Science and Engineering	Urbana, IL	2015.9-
Research Scientist	MIT	Mechanical Engineering	Cambridge, MA	2014-2015
Post-doctoral Associate	MIT	Mechanical Engineering	Cambridge, MA	2012-2014

MIT Cheetah 2: Developed a high-speed running quadruped robot, the MIT Cheetah 2. Conducted modeling, simulation, control design of the robot, and real-time software and mechanical hardware design.

Smart Exotendon Suit: Designed a biologically-inspired quasi-passive, exotendon device to mitigate the risk of soldiers' musculoskeletal injuries caused by extended walking.

Research Assistant	The Univ. of Michigan	Mechanical Engineering	Ann Arbor, MI	2007-2012

Advisor: Jessy W. Grizzle

Studied walking controller design and experimental implementation of the bipedal robot MABEL.

Research Assistant	Yonsei University	Mechanical Engineering	Seoul, Korea	2005-2007

Advisor: Young-Pil Park

Bio-inspired underwater robot fish: Designed and developed a bio-inspired underwater robot fish.

Passive-link-type tracked vehicle for search-and-rescue operation: Developed a tracked vehicle using a passive link mechanism with compliant spring for rough terrains.

Military Service	Pocheon, Korea	2000-2003

Teaching Experience	**Instructor**, MECHSE, GE, EE, Univ. of Illinois Urbana, IL
	2017 Spring, GE422/ME446/ECE489, Robot Dynamics and Control
	Instructor, Department of Mechanical Science and Engineering, Univ. of Illinois Urbana, IL
	2016 Spring, ME 370, Mechanical Design I
	Instructor, MECHSE, GE, EE, Univ. of Illinois Urbana, IL
	2015 Fall, GE422/ME446/ECE489, Robot Dynamics and Control

Journals

[1] **Hae-Won Park,** Patrick Wensing, and Sangbae Kim, "High-Speed Bounding with the MIT Cheetah 2: Control Design and Experiments", *International Journal of Robotics Research*, published online, 2017

[2] **Hae-Won Park**, and Sangbae Kim, "Galloping Control for a Wide Range of Speed via Vertical Impulse Scaling," *Bioinsipiration & Biomimetics*, vol. 10, no. 5, Mar 2015.

[3] **Hae-Won Park,** and Sangbae Kim, "The MIT Cheetah, an Electrically-powered Quadrupedal Robot for High-speed Running," *Journal of the Robotics Society of Japan*, vol. 32, no. 4, pp. 323-328, May 2014.

[4] **Hae-Won Park**, Alireza Ramezani, and J.W. Grizzle, "A Finite-state Machine for Accommodating Unexpected Large Ground Height Variations in Bipedal Robot Walking," *IEEE Transaction on Robotics*, vol. 29, no. 2, pp. 331-345, Apr 2013.

[5] Koushil Sreenath, **Hae-Won Park,** and J.W. Grizzle, "Embedding Active Force Control within the Compliant Hybrid Zero Dynamics to Achieve Stable, Fast Running on MABEL," *International Journal of Robotics Research*, vol. 32, no. 3, pp. 324-345, Mar 2013.

[6] **Hae-Won Park**, Koushil Sreenath, Jonathan W. Hurst, and J.W. Grizzle, "Identification of a Bipedal Robot with a Compliant Drivetrain: Parameter Estimation for Control Design," *IEEE Control Systems Magazine*, vol. 31, no. 2, pp. 63-88, April 2011.

[7] Koushil Sreenath, **Hae-Won Park**, Ioannis Poulakakis, and J.W. Grizzle, "A Compliant Hybrid Zero Dynamics Controller for Stable, Efficient and Fast Bipedal Walking on MABEL," *International Journal of Robotics Research*; vol. 30, no. 9, pp. 1170-1193, August 2011.

Conference Proceedings

[1] Yanran Ding and **Hae-Won Park,** "Design and Experimental Implementation of a Quasi-Direct-Drive Leg for Optimized Jumping," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* submitted, 2017.

[2] **Hae-Won Park,** Patrick Wensing, and Sangbae Kim, "Online Planning for Autonomous Running Jumps Over Obstacles in High-Speed Quadrupeds," *Robotics Science and Systems (RSS),* Rome, Italy, Jul., 2015.

[3] **Hae-Won Park,** Sangin Park, and Sangbae Kim, "Variable-speed Quadrupedal Bounding Using Impulse Planning: Untethered High-speed 3D Running of MIT Cheetah 2," *IEEE/RSJ International Conference on Robotics and Automation (ICRA),* Seattle, USA, May., 2015.

[4] **Hae-Won Park,** Meng Yee (Michael) Chuah, and Sangbae Kim, "Quadruped Bounding Control with Variable Duty Cycle via Vertical Impulse Scaling," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* Chicago, USA, Sep., 2014.

[5] **Hae-Won Park**, Koushil Sreenath, Alireza. Ramezani, and J. W. Grizzle, "Switching Control Design for Accommodating Large Step-down Disturbances in Bipedal Robot Walking," *International Conference on Robotics and Automation (ICRA)*, St.Paul, MN, USA, May 2012, pp. 45-50.

[6] Koushil Sreenath, **Hae-Won Park**, and J. W. Grizzle, "Design and Experimental Implementation of a Compliant Hybrid Zero Dynamics Controller with Active Force Control for Running on MABEL," *International Conference on Robotics and Automation (ICRA)*, St.Paul, MN, USA, May

2012, pp. 51-56.

[7] Koushil Sreenath, **Hae-Won Park**, Ioannis Poulakakis, and J. W. Grizzle, "Design and experimental implementation of a compliant hybrid zero dynamics controller for walking on MABEL," in *IEEE Conference on Decision and Control*, Atlanta, GA, USA, December 2010, pp. 280–287.

[8] J. Koncsol, **Hae-Won Park**, and K. Sreenath, "Real world issues with real-time control of mabel: A platform for experimental control of bipedal locomotion," in *IEEE-RAS International Conference on Humanoid Robots*, Nashville, TN, USA, December 2010, pp. 659–664.

[9] J.W. Grizzle, Jonathan Hurst, Benjamin Morris, **Hae-Won Park**, and Koushil Sreenath, "Mabel, A New Bipedal Walker and Runner," in *American Control Conference*, St. Louis, MO, June 2009, pp. 2030–2036.

[10] Seok-Woo Kim, **Hae-Won Park**, Kang-Jin Cho, No-Cheol Park, Hyun-Suk Yang, Young-Pil Park, "Straight Line Swimming Simulation and Experiment of Robotic Fish," *The Korean Society for Precision Engineering Conference*, 2008, pp. 569-570.

[11] Kang-Jin Cho, **Hae-Won Park**, Seok-Woo Kim, Hyun-Suk Yang, Young-Pil Park, No-Cheol Park, "Development of a robot with fish locomotion," *The Korean Society of Mechanical Engineers Conference*, 2007, pp. 40-45.

[12] **Hae-Won Park**, Sung-Hyun Kim, No-Cheol Park, Hyun-Seok Yang, Young-Pil Park, Seung-Ho Kim, Yong-Heon Park, and Young-Hwan Kang, "Design of Tracked Vehicle with Passive Mechanism for Uneven Terrain," SICE, pp. 3132-3136 *SICE-ICASE International Joint Conference*, 2006.

Technical Reports

[1] **Hae-Won Park**, Koushil Sreenath, Jonathan Hurst, and J. W. Grizzle, "Identification and Dynamic Model of a Bipedal Robot with a Cable-Differential-Based Compliant Drivetrain," University of Michigan *Control Group Report*, No. CGR 10-06, March, 2010.

Invited Talks

[1] **Hae-Won Park,** "Dynamic Walking, Running, and Jumping Robots," Coordinate Science Lab (CSL) Seminar Series, University of Illinois at Urbana-Champaign, Urbana, IL, Feb, 2016

[2] **Hae-Won Park,** "MIT Cheetah 2, A Fast Runner and Jumper," Korea University, Seoul, Korea, Sep. 2015

[3] **Hae-Won Park,** "Inspiration from Biology: Control Design for High-speed Running Legged Locomotion Robot," Yonsei University, Seoul, Korea, Aug. 2015

[4] **Hae-Won Park,** "Control Design for Bio-inspired Legged Locomotion Robot," NAVER Corp., Sungnam, Korea, Aug. 2015

[5] **Hae-Won Park,** "Control Design for Dynamic Legged Locomotion Robots," University of Waterloo, Waterloo, Ontario, Canada, Mar. 2015.

[6] **Hae-Won Park,** "Feedback Control Design for Dynamic Walking and Running on Legged Robots," University of Illinois at Urbana-Champaign, Urbana, IL, Mar. 2015.

[7] **Hae-Won Park,** "Achieving Dynamic Walking and Running on Legged Robots: a Feedback Control Design," Field Robotics Research Center, Korea Advanced Institute of Science and Technology (KAIST), Korea, Jan. 2015.

[8] **Hae-Won Park,** "Control Design for Dynamic Locomotion of Legged Robots," Sungkyunkwan University, Korea, Jan. 2015.

[9] **Hae-Won Park,** "Highly Dynamic Legged Locomotion Robot for Walking and Running," Chung-Ang University, Korea, Jan. 2015.

[10] **Hae-Won Park,** "Control Design for Agile and Robust Locomotion," Korea University, Korea, Jan. 2015.

[11] **Hae-Won Park,** "MABEL and MIT Cheetah 2: Dynamic Walker and Runner," Department of

Mechanical Engineering, Korea Advanced Institute of Science and Technology (KAIST), Korea, July. 2014.

[12] **Hae-Won Park,** "Bio-inspired Legged Robots for Robust and Highly-agile Locomotion," Columbia University, New York, New York, Mar. 2014.

[13] **Hae-Won Park,** "Robust Walking and High-speed Running of Bio-inspired Legged Robot," Daegu Gyeongbuk Institute of Science and Technology (DGIST), Korea, Nov. 2013.

[14] **Hae-Won Park,** "Control and Real-time Software Design for Highly Dynamic Bio-inspired Locomotion Robot," Sogang University, Korea, Nov. 2013.

[15] **Hae-Won Park**, and Sangbae Kim, "Galloping Control for Quadruped Robots: Application to the MIT Cheetah Robot," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* Workshop Presentation, Tokyo, Japan, Nov. 2013.

[16] **Hae-Won Park,** "Bio-inspired Legged Locomotion Robot: Bipedal Walker MABEL and High-speed Runner MIT Cheetah," Ulsan National Institute of Science and Technology (UNIST), Korea, Sep. 2013.

[17] **Hae-Won Park,** "Control and Design of Highly Dynamic Bio-inspired Locomotion Robot," Yonsei University, Korea, Sep. 2013.

[18] **Hae-Won Park,** "Control Design for Bipedal Robot Walking on Uneven Ground and High-Speed Running of Quadruped Robot," Korea Institute of Science and Technology (KIST), Korea, Jan. 2013.

[19] J.W. Grizzle, **Hae-Won Park,** and K. Sreenath, "Modeling, Feedback Control and Experimental Results for MABEL, a Planar Bipedal Robot," Control Seminar Series, University of Michigan, Ann Arbor, September 2010 (The second graduate student speaker in last 4 years.).

Posters	[1] **Hae-Won Park**, and Sangbae Kim, "Dynamic Quadruped Bounding Control with Duty Cycle Modulation Using Vertical Impulse Scaling," *Dynamic Walking Conference,* Zurich, Switzerland, Jun. 2014.

[2] **Hae-Won Park**, and Sangbae Kim, "Impulse-Based Gait Design and Control for Variable Speed Galloping on MIT Cheetah Robot," *Dynamic Walking Conference,* Pittsburgh, PA, USA, June 2013.

[3] **Hae-Won Park** and J. W. Grizzle, "Control of Bipedal Walking on Uneven Terrain," *The University of Michigan Engineering Graduate Student Symposium*, 2010.

[4] **Hae-Won Park**, Koushil Sreenath, Jonathan Hurst, and J. W. Grizzle, "System Identification and Modeling of MABEL, A Bipedal Robot With a Cable-Differential-Based Compliant Drivetrain," *Dynamic Walking Conference,* July 2010.

[5] Koushil Sreenath, **Hae-Won Park**, Jonathan Hurst, and J. W. Grizzle, "Hybrid Zero Dynamics Based Control Design for Efficient Walking," *Dynamic Walking Conference,* July 2010.

[6] **Hae-Won Park**, Koushil Sreenath, and J. W. Grizzle, "Parameter Identification of MABEL, a New Bipedal Robot with Differential-Based Compliant Drivetrain," *The University of Michigan Engineering Graduate Student Symposium*, 2009
 (**This paper won the second prize in the Control Session.**).

[7] Koushil Sreenath, **Hae-Won Park**, and J. W. Grizzle, "Nonlinear Feedback Control of a Novel Robotic Bipedal Walker," *The University of Michigan Engineering Graduate Student Symposium*, 2009.

Robot Demonstration	Jumping Robot Demo at Robotics Demonstration Session at CSL Student Conference 2017. This demonstration won the **Robotics Demonstration Award**.
Awards	**Finalist**, The 2015 World Technology Awards, IT Hardware, 2015

Cover Article, "Identification of a Bipedal Robot with a Compliant Drivetrain: Parameter Estimation for

Control Design," *IEEE Control Systems Magazine*, vol. 31, no. 2, pp. 63-88, April 2011.

Scholarship, ILJU Academy and Culture Foundation Scholarship for the students studying abroad

Second-Place Award in a Poster Presentation Competition in the Design & Control Session at the University of Michigan Engineering Graduate Student Symposium, 2009

Scholarship, Half Tuition Waiving for Student Excellence, Yonsei University, Seoul, Korea, 2005-2007

Publicity	**Project MIT Cheetah 2**

DARPA Robotics Challenge: Dynamic Demonstration of MIT Cheetah Robot (Jun. 4-6, 2015)

TIME: New Robot Cheetah Can Run (And Jump) Without a Tether (Sep. 30, 2014)

Washington Post: New algorithm could help 'cheetah' robot outrun humans soon. (Sep. 15, 2014)

IEEE Spectrum: MIT Cheetah Robot Bounds off Tether, Outdoors. (Sep. 15, 2014)

MIT News: Bound for robotic glory – New algorithm enables MIT cheetah robot to run and jump, untethered, across grass. (Sep. 14, 2014)

Project MABEL

Chicago Field Museum Exhibition: MABEL on Exhibit (Jan. 2014)

IEEE Spectrum: Video Tuesday: BigDog, MABEL, and Quadrotors (Sep. 20, 2011)

CNN newsroom: Fast-moving bipedal robot with knees (Sep. 19, 2011)

ESPN Road Trip (Sep. 14, 2011)

The Discovery Channel Canada: Daily Planet (Mar. 28, 2011)

Chicago Tribune: "U-M robot Mabel clears stacked wood, may jog soon" (Jun. 13, 2010)

Engadget: "University of Michigan's MABEL robot hits a stride, breaks a leg" *(May. 25, 2010)*

Professional Activities	Associate Member, IEEE

Member, ASME

NSF review panel for Robust Intelligence Program

Program Committee member, Robotics Science and Systems 2017

International Program Committee member, 14th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI 2017)

Associate Editor, Journal of Intelligent Service Robotics (JISR) 2016-2019

Associate Editor, IEEE International Conference on Robotics and Automation 2016-2017

Associate Editor, IEEE International Conference on Robotics and Automation 2015-2016

Reviewer of

Journals: IEEE Transactions on Robotics, IEEE Transactions on Mechatronics, International Journal of Robotics Research, IEEE Control Systems Technology, IEEE Robotics and Automation Magazine, Journal of Field Robotics, Control Engineering Practice, Robotica, Bioinspiration & Biomimetics, Nonlinear Dynamics, ASME Journal of Mechanisms and Robotics, ASME Applied Mechanics Review, International Journal of Control, Automation and Systems

Conferences: IEEE International Conference on Robotics and Automation, IEEE International Conference on Intelligent Robots and Systems, IEEE Humanoids, IEEE American Control Conference, IEEE Conference on Decision and Control