Jemin Hwangbo

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Education & Research Experience	*Assistant Professor,* Korean Advanced Institute of Science and Technology Robotics & Artificial Intelligence (RAI) Lab	Feb 2020 - Present
	Postdoctoral researcher, ETH Zurich, Switzerland Supervisor: Prof. Dr. Marco Hutter Research lab: Robotic Systems Lab (RSL)	March 2019 - Feb 2020
	PhD in Mechanical Engineering, ETH Zurich, Switzerland Supervisor: Prof. Dr. Marco Hutter ETH Medal (Outstanding PhD thesis award) Research lab: Robotic Systems Lab (RSL)	Aug 2013 - Feb 2019
	Master of Science in Robotics, Systems and Control, ETH Zurich, Switzerland Willi Studer Preis 2013 (Best Graduate Award) in Robotics, Systems and Control, D-MAVT ETEL Best Master Thesis Award (in Mechatronics)	Sep 2011 - April 2013
	Bachelor of Science in Mechanical Engineering, University of Toronto, Canada Dean's list of honoured graduates	Sep 2006 - June 2011

Research Topics

*1. **Reinforcement learning using deep neural networks**:*
I am interested in learning-based control strategies for multi-body systems (nonlinear and non-smooth hybrid systems) using deep neural networks. Deep neural nets provide a rich parameterization for high dimensional control strategies and reinforcement learning provides a generic framework for training them. My focus is on sim-to-real transfer which utilizes a simulated environment for training control policies.

*2. **Rigid-body simulation**:*
Physics engine is perhaps the most important tool for robotics. I study necessary theories behind physics engines and develop a fast and accurate physics engine for robotics.

Publication

1. Lee, J., **Hwangbo, J.**, Hutter, M., *Robust Recovery Controller for a Quadrupedal Robot using Deep Reinforcement Learning*, 2019, arXiv:1901.07517.

2. **Hwangbo, J.**, Lee, J., Dosovitskiy, A., Bellicoso, D., Tsounis, V., Koltun, V., Hutter, M., *Learning agile and dynamic motor skills for legged robots*, Science Robotics, 4(26), eaau5872, 2019. **All-time most accessed paper in Science Robotics, featured as one of "Robots, hominins and superconductors: 10 remarkable papers from 2019"** by Nature Journal, related link: `https://youtu.be/aTDkYFZFWug`

3. **Hwangbo, J.**, Tsounis, V., Kolvenbach, H., Hutter, M., *Cable-driven actuation*

for highly dynamic robotic systems, International Conference on Intelligent Robots and Systems (IROS) (pp. 8543-8550). IEEE. 2018

4. **Hwangbo, J.**, Lee, J., Hutter, M. (2018). *Per-Contact Iteration Method for Solving Contact Dynamics*. IEEE Robotics and Automation Letters (RAL), 3(2), 895-902.

5. **Hwangbo, J.**, Sa, I., Siegwart, R., Hutter, M., *Control of a quadrotor with reinforcement learning*, IEEE Robotics and Automation Letters, 2(4), 2096-2103, 2017, **currently the thrid most popular paper in RAL (June, 2019)** related link: `https://youtu.be/zIi4yHYJdJY`

6. Bellicoso, C. D., Jenelten, F., Fankhauser, P., Gehring, C., **Hwangbo, J.**, Hutter, M. (2017, September). *Dynamic locomotion and whole-body control for quadrupedal robots*, In Intelligent Robots and Systems (IROS), 2017 IEEE/RSJ International Conference on (pp. 3359-3365). IEEE.

7. Bellicoso, C. D., Gehring, C., **Hwangbo, J.**, Fankhauser, P., Hutter, M., *Perception-less terrain adaptation through whole body control and hierarchical optimization*, In Humanoid Robots (Humanoids), 2016 IEEE-RAS 16th International Conference on (pp. 558-564). IEEE, 2016

8. **Hwangbo, J.**, Bellicoso, C. D., Fankhauser, P., Huttery, M., *Probabilistic foot contact estimation by fusing information from dynamics and differential/forward kinematics*. IEE/RSJ International Conference on Intelligent Robots and Systems (IROS), pp. 3872-3878. 2016.

9. **Hwangbo, J.**, Gehring, C., Bellicoso, D., Fankhauser, P., Siegwart, R., Hutter, M., *Direct state-to-action mapping for high DOF robots using ELM*. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2015.

10. **Hwangbo, J.**, Gehring, C., Sommer, H., Siegwart, R., Buchli, J. (2014, November). *ROCK⋆-Efficient black-box optimization for policy learning*. IEEE-RAS International Conference on Humanoid Robots (Humanoids), pp. 535-540, 2014 **(Finalist for the Best Paper Award, Oral)**

11. Bloesch, M., Omari, S., Fankhauser, P., Sommer, H., Gehring, C., **Hwangbo, J.**, Siegwart, R., *Fusion of optical flow and inertial measurements for robust egomotion estimation*. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), pp. 3102-3107, 2014

12. Digumarti, K. M., Gehring, C., Coros, S., **Hwangbo, J.**, Siegwart, R., *Concurrent optimization of mechanical design and locomotion control of a legged robot*. In Mobile Service Robotics, pp. 315-323, 2014

Invited talks	1. Learning agile and dynamic control policies for legged robots, Workshop presentation, 2019 International Conference on Robotics and Automation, Montreal, Canada 2. Learning agile and dynamic legged locomotion, 2019 ASRI Robotics Festival, SNU, Seoul, Korea 3. Deep reinforcement learning for legged robots, Seminar, 2019, KAIST, Daejeon, Korea 4. Learning locomotion policies in simulation, Seminar, 2019, UBC, Vancouver, Canada 5. Learning-based control of legged robots, Seminar, 2017, UBC, Vancouver, Canada
Patent	1. Marco Hutter, Karen Bodie, Andreas Lauber, and Jemin Hwangbo. "Joint unit, joint system, robot for manipulation and/or transportation, robotic exoskeleton system and method for manipulation and/or transportation." U.S. Patent Application

16/320,757, filed May 30, 2019.

| **Accepted Research proposals** | 1. Data-driven control approaches for advanced legged locomotion, SNF, Switzerland, ~450,000 USD, 2016 |