

Jemin Hwangbo

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Education & Research Experience

Postdoctoral researcher, Nov 2018 - 2019
ETH Zurich, Switzerland
Supervisor: Prof. Dr. Marco Hutter
Research lab: Robotic Systems Lab (RSL)

PhD in Mechanical Engineering, Nov 2013 - Nov 2018
ETH Zurich, Switzerland
Supervisor: Prof. Dr. Marco Hutter
Research lab: Robotic Systems Lab (RSL)

Master of Science in Robotics, Systems and Control, Sep 2011 - May 2013
ETH Zurich, Switzerland
Willi Studer Preis 2013 (Best Graduate Award) in Robotics, Systems and Control,
D-MAVT (1 out of 21)
ETEL Best Master Thesis Award (in Mechatronics)

Bachelor of Science in Mechanical Engineering, Sep 2006 - June 2011
University of Toronto, Canada
Dean's list of honoured graduates

Research Topics

1. **Reinforcement learning using deep neural networks:**

I am interested in a new type of optimal control strategies for multi-body systems (nonlinear and non-smooth hybrid-systems) using deep neural network policies. Deep neural nets provide a rich parameterization for high dimensional control strategies and RL provides an efficient framework for training them. My focus is on sim-to-real transfer which utilizes a simulated environment for training control policies for real robots.

2. **Rigid-body simulation:**

Rigid body simulation is used in a number of engineering fields. However, the existing simulators are inaccurate and slow, especially when simulating articulated systems (e.g. robots). I study on how to build a fast and accurate simulator which can be effectively used even for sim-to-real transfers.

Work Experience

Mechanical Engineering Intern May 2009 - August 2010
Thornhill Research Inc. (TRI), Toronto, Canada

- Member of the R&D team of MOVES, a portable life supporting system with an oxygen supply, patient monitoring, diagnostics, and drug infusion capabilities. I participated in design, engineering communication (drawings and instruction manuals) and quality control.
- I gained experience in designing fluid control systems, oxygen concentration systems, user interface, breathing circuits, and vibration damping systems.

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** related link: <https://youtu.be/aTDkYFZWug>
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, **in top 3 all-time most popular papers in RAL** 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., Hutter, M., *Probabilistic foot contact estimation by fusing information from dynamics and differential/forward kinematics*. IEEE/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). *ROCKEfficient 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

Research Grant

1. Data-driven control approaches for advanced legged locomotion, SNF, Switzerland, ~450,000 USD, 2016

Honors and awards

1. Willi-Studer Preis (Best Graduate Award), in Robotics Systems and Control, ETH

Zurich, ~2700 USD, 2013

2. ETEL Best Master Thesis (Mechatronics, ~3500 USD), 2014

3. Dean's honoured graduates 2011, mechanical engineering, University of Toronto

4. Academic Excellence Award, 2009, (awarded to 3 students among over 300 mechanical and industrial engineering students)

5. Millennium Scholarship, 2006, \$12,000 CAD.

6. Canadian association of physics certificate, CAP physics competition, 2006