Adam Heins

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Skills

Robotics: model predictive control, motion planning, object manipulation, state estimation
Numerical Optimization: convex programming, sequential quadratic programming
Machine Learning: Gaussian processes, reinforcement learning
Tools: ROS, PyTorch, JAX, Linux, git
Languages: C, C++, Python, bash/zsh

Education

Ph.D. in Aerospace Science and Engineering (Robotics) 2018 – present
Institute for Aerospace Studies, University of Toronto, Canada
Advisor: Prof. Angela P. Schoellig
Thesis: Robust Mobile Manipulation for Robotic Pushing and Nonprehensile Object Transportation

B.A.Sc. in Mechatronics Engineering 2012 – 2017
University of Waterloo, Canada

Research Projects

Upright [1, 3] 2022 – 2025
Online and offline planning for fast nonprehensile object transportation with a mobile manipulator.

Force Push [2] 2024
Robust quasistatic robotic planar pushing with single-point contact using force feedback.

Reactive Mobile Manipulation [4] 2019 – 2021
Optimization-based differential inverse kinematics control for mobile manipulation tasks.

Safe Robot Learning [5] 2018
Online learning for robust robot control with Gaussian processes.

Automated Site Monitoring [6] 2017 – 2018
Autonomous inspection of indoor construction sites for progress monitoring using a quadrotor.

Selected Publications

[1] **A. Heins** and A. P. Schoellig, "Robust Nonprehensile Object Transportation with Uncertain Inertial Parameters," *IEEE Robotics and Automation Letters*, under review, 2025. [pdf] [video] [code]

[2] **A. Heins** and A. P. Schoellig, "Force Push: Robust Single-Point Pushing with Force Feedback," *IEEE Robotics and Automation Letters*, vol. 9, iss. 8, pp. 6856–6863, 2024. [pdf] [video] [code]

[3] **A. Heins** and A. P. Schoellig, "Keep it Upright: Model Predictive Control for Nonprehensile Object Transportation with Obstacle Avoidance on a Mobile Manipulator," *IEEE Robotics and Automation Letters*, vol. 8, iss. 12, pp. 7986–7993, 2023. [pdf] [video] [code]

[4] **A. Heins**, M. Jakob, and A. P. Schoellig, "Mobile manipulation in unknown environments with differential inverse kinematics control," in *Proc. of the Conference on Robots and Vision*, 2021, pp. 64–71. [pdf] [video] [code]

[5] M. K. Helwa, **A. Heins**, and A. P. Schoellig, "Provably robust learning-based approach for high-accuracy tracking control of Lagrangian systems," *IEEE Robotics and Automation Letters*, vol. 4, iss. 2, pp. 1587–1594, 2019. [pdf]

[6] M. Nahangi, **A. Heins**, B. McCabe, and A. P. Schoellig, "Automated localization of UAVs in GPS-denied indoor construction environments using fiducial markers," in *Proc. of the International Symposium on Automation and Robotics in Construction*, 2018, pp. 88–94. [pdf]

Work

University of Toronto, Toronto, Canada — 2019 – 2022
Teaching Assistant

- ROB 301: Introduction to Robotics, instructed by Prof. G. M. T. D'Eleuterio (4 terms)
- ROB 310: Mathematics for Robotics, instructed by Prof. A. P. Schoellig (1 term)
- AER 1514: Mobile Robotics, instructed by Prof. T. D. Barfoot (2 terms)

Nest, Palo Alto, USA — Summer 2016
Embedded Software Developer Intern

- Implemented in-store demo application for Nest Secure alarm system using C++.
- Wrote Python scripts to analyse and correlate log data stored on the device and in BigQuery.
- Rewrote timer implementation of Nest Secure on top of Linux timer API.

Pebble, Palo Alto, USA — Spring, Fall 2015
Embedded Firmware Developer Intern

- Developed the dialog window system for the Pebble Time smartwatch in C.
- Optimized firmware code to increase frame rate by up to 20% and reduce critical path stack usage by 10% on the Pebble.
- Built default watch faces for Pebble Time Round and Golf and Sports apps for Pebble Time.
- Implemented screenshot and power calibration tools for automated testing in Python.

BlackBerry, Mississauga, Canada — Summer 2014
Software Developer Intern

- Built BBM simulator in Java to automate tests and reduce testing time by a factor of five.
- Created a REST API with a Cassandra backend to validate user and message statistics.
- Wrote a tool in Java to automatically configure files deployed from Jenkins.

Other Projects

Shadows [code] [demo] — 2024 – 2025
Custom game with computer agents trained using reinforcement learning.

Robotics Outreach [info] — 2022 – 2023
Organized and led two robotics workshops for Grade 6–11 students using Edison robots.

Read My Lips [code] — 2017
LSTM-based neural network to read lips from video frames using Keras, achieving 86% accuracy.