

Adam Heins

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CURRENT RESEARCH

I am interested in safe, probabilistic learning to improve robot control. In particular, I am interested in online and deep probabilistic learning methods and whether they can be applied with strong enough guarantees for use in safety-critical robotics applications like medicine and aerospace.

EDUCATION

Ph.D. in Aerospace Science and Engineering¹ since 09/2018
Institute for Aerospace Studies, University of Toronto, Canada
Advisor: Prof. Angela P. Schoellig
CGPA: 3.93/4.00

B.A.Sc. in Mechatronics Engineering (with Dean's Honours²) 2012 – 2017
University of Waterloo, Canada
CGPA: 88.23%

PUBLICATIONS

Journal Articles (submitted)

- [J1] 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*, submitted September 2018, submission 18-1106.

Conference Papers (appeared or accepted)

- [C1] 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.

AWARDS

International Experience Award, University of Waterloo 2017
Award (\$1,500) given to students who participate in an international study or work experience.

President's Scholarship of Distinction, University of Waterloo 2012
Entrance award (\$2,000) for students with a highschool average of 95%+.

¹Direct transfer from M.A.Sc. to Ph.D.

²Indicates a cumulative average of at least 80% and achievement of Dean's Honours list during at least two terms.

WORK EXPERIENCE

University of Toronto, Toronto, Canada since 01/2019
Teaching Assistant

- AER 1514 Mobile Robotics, instructed by Prof. Timothy D. Barfoot

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 performance and memory usage to increase frame rate by up to 20% and reduce critical path stack usage by 10% on the Pebble.
- Wrote default watch faces for Pebble Time Round; built 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.

RESEARCH PROJECTS

Safe and Robust Learning for Lagrangian Systems 2018 – 2019
Provably robust online learning approach for high-accuracy tracking control of Lagrangian systems using Gaussian processes (submitted to RA-L [J1]).

- Combines robust control with online learning of the model uncertainty to provide the least conservative control law while still maintaining robustness.
- Tracking error is guaranteed to converge to ball, the radius of which can be selected in the control design, with high probability.
- Implemented and tested in both simulation and experimentally on the UR10 industrial manipulator.

Monitoring of Indoor Construction Sites using Quadrotors 2017 – 2018
Autonomous inspection of indoor construction sites for progress monitoring using a quadrotor (presented in [C1]).

- Implemented EKF-based localization on Parrot Bebop drone using odometry and AprilTag observations.

COURSE PROJECTS

Improved State Estimation with Learning, State Estimation for Aerospace Vehicles 2018
Online motion model improvement with Gaussian processes and extended Kalman filters.

- Used a Gaussian process to learn unmodelled dynamics of motion model online using extended Kalman filter estimates as training inputs.

- Examined numerous aspects of Gaussian process learning within this context, including heterosketastic and correlated output observations, hyperparameter selection, and sparsification.

Nuclear Power Plant Inspection Robot, Capstone Design Project 2017

A mobile robot for semi-autonomous inspection of nuclear boiler rooms.

- Worked in a team of five to design and build a mobile manipulator for inspecting pipes within the boiler rooms of nuclear power plants.
- Developed ROS package to interface with and control ST Robotics R12 arm used to measure pipe thickness.
- Designed and implemented image processing software with OpenCV and ROS to identify pipe locations to measure.

Read My Lips, Machine Intelligence 2017

A neural network architecture designed to perform lip-reading.

- Developed LSTM-based network using Keras to read lips based on the difference between video frames.
- Achieved an average accuracy of 86.30% when reading the lips of a known speaker.

Autonomous Obstacle Course Traversal Robot, Mechatronics Design Workshop 2016

A mobile robot that autonomously traverses an obstacle course.

- Colloborated in a team of four to develop a ground robot that successfully completed an obstacle course, including ascending and descending a ramp and locating a dynamic end point.
- Designed and implemented robot's software, including control of movement, signal processing, and state machine.

SKILLS _____

Languages: English (native)

Programming: C, C++, Python, Matlab, bash/zsh

Tools: Linux, git, ROS, vim

OTHER INTERESTS _____

Climbing, Running, Camping, Cooking, Reading