Taylor A. **Howell**

Optimization · Control · Robotics

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Summary

Currently, I am a Ph.D. candidate at Stanford University. I work on optimization-based tools for motion planning of complex, underactuated robotic systems. My expertise include: numerical optimization, technical computing, automatic control, and modeling of dynamical systems.

Education

Stanford University

Stanford, CA, USA

Ph.D. in Mechanical Engineering — *Sept. 2017 - June. 2022 (expected)*

- Automatic Controls, Robotics
- Advisors: Zachary Manchester, Allison Okamura

Stanford University

Stanford, CA, USA

M.S. in Mechanical Engineering — *Sept. 2017 - June. 2019*

- Automatic Controls, Robotics

University of Utah

Salt Lake City, UT, USA

B.S. in Mechanical Engineering — *May 2013 - Dec. 2016*

- Summa Cum Laude
- Capstone Project: Wireless Power for Aerial Robots

Research

Robotic Exploration Lab, Stanford University

Stanford, CA, USA

Research Assistant — *May 2018 - present*

My research is focused on developing optimization-based tools for motion planning of underactuated robotic systems. Currently, I am working on algorithms for fast contact-implicit model-predictive control and differentiable simulators for contact physics. Previously, I was co-leading development of `TrajectoryOptimization.jl`, an open-source Julia package for solving constrained trajectory-optimization problems.

Telerobotics Laboratory, University of Utah

Salt Lake City, UT, USA

Research Assistant — *Oct. 2015 - Dec. 2016*

I devised and implemented a control scheme to sort swarms of microrobots using rotating uniform magnetic fields for minimally invasive medical applications. This work included: applied physics, simulation, nonlinear optimization, fabrication of a scaled microrobot swarm, and writing C++ code to control a tri-axial Helmholtz-coil system.

Utah Center of Excellence for Biomedical Microfluidics, University of Utah

Salt Lake City, UT, USA

Research Assistant — *Sept. 2014 - Oct. 2015*

I designed and built a forty-eight-syringe pump for a medical microfluidic system, developed standard operating procedures for a high-throughput drug screening and cytotoxicity evaluation system, and performed statistical analysis for ovarian-cancer cell experiments.

Experience

Google Brain

San Francisco, CA, USA (remote)

Research Intern — *June. 2021 - Sept. 2021*

- differentiable optimization-based dynamics for trajectory optimization

Department of Aeronautics and Astronautics, Stanford University

Stanford, CA, USA

Course Assistant - Dynamics and Control of Aircraft (AA271A) — *Apr. 2021 - Jun. 2021*

- held office hours four times per week
- graded assignments and exams

Department of Computer Science, University of Utah — *Salt Lake City, UT, USA*

Instructor - GREAT Summer Camp — *Jun. 2017 - Jul. 2017*

- led a teaching team of three
- taught practical robotics and programming skills to elementary school students using the LEGO Mindstorm platform
- developed projects and challenges for FLL skills, telerobotics, and kinetic-art themed weeks

Cornaby-Howell LLC — *Salt Lake City, UT, USA*

Co-founder, Engineer — *Apr. 2015 - Oct. 2015*

- prototyped systems: touch-display module with GUI, Arduino C code, a lead-screw system, and syringe attachment modules for precision high-throughput syringe pumps
- designed hardware schematics for patent application

Ramada Limited Draper — *Draper, UT, USA*

Front Desk Clerk — *Apr. 2013 - Aug. 2013*

- manager on duty: checked in and out guests, made reservations, and ran breakfast
- developed communication and practical problem solving skills

Designer — *Draper, UT, USA*

Twisty Puzzles — *Aug. 2007 - Jan. 2011*

- designed and built twisty puzzles with selling prices ranging from $25 - $850
- exhibited my work at the community's premier international event: Dutch Cube Day 2008

Publications

2021 **Trajectory Optimization with Optimization-Based Dynamics**, T. Howell, S. Le Cleac'h, S. Singh, P. Florence, Z. Manchester, V. Sindhwani. *(arXiv)*.

Fast Contact-Implicit Model-Predictive Control, S. Le Cleac'h*, T. Howell*, M. Schwager, Z. Manchester. *(arXiv)*.

Direct Policy Optimization using Deterministic Sampling and Collocation, T. Howell, C. Fu, Z. Manchester. Robotics and Automation Letters.

2020 **Scalable Cooperative Transport of Cable-Suspended Loads with UAVs using Distributed Trajectory Optimization**, B. Jackson*, T. Howell*, K. Shah, M. Schwager, Z. Manchester. Robotics and Automation Letters.

2019 **ALTRO: A Fast Solver for Constrained Trajectory Optimization**, T. Howell*, B. Jackson*, Z. Manchester. International Conference on Intelligent Robots and Systems. Macao, China.

2018 **Sorting Rotating Micromachines By Variations in Their Magnetic Properties**, T. Howell, B. Osting, J. Abbott. Physical Review Applied.

2017 **Use of a highly parallel Microfluidic Flow Cell Array to determine therapeutic drug dose response curves**, J. Arellano, T. Howell, J. Gammon, S. Cho, M. Janat Amsbury, B. Gale. Biomedical Microdevices.

Skills

Programming	Julia, Python, C++, Matlab, R
Computational	LaTeX, Git, Linux, SNOPT, Ipopt, Convex.jl, MeshCat, JAX, Solidworks, ROS, Adobe Premiere Pro, Adobe Illustrator, Arduino
Fabrication	Mill, Lathe, Vacuum Forming, Laser Cutting, Mold Making and Casting, Metal Sheet Fabrication

Community Outreach

2019 **Co-organizer**, of Social Impact Night event at Stanford University to connect social-impact focused students and entrepreneurs

2016 **Mentor**, to three summer interns at the Telerobotics Laboratory and developed soft robots with potential as catheter tips that will increase insertion distance deep in the brain and other hard-to-reach locations in the body

2015 **Science-fair Judge**, for local elementary school to provide feedback to students about their projects

Fellowships & Scholarships

Stanford Graduate Fellowship (2017 – 2018) · University of Utah Undergraduate Research Opportunities Program Fellowship (2016) · The Boeing Company Scholarship (2016) · Shirley L. & Kathelyne O. Evans Endowed Scholarship (2016) · Big Ten+ Grad Expo Travel Scholarship (2016) · University of Utah Presidential Scholarship (2013 – 2016)

Coursework

Convex Optimization · Optimal Control · Nonlinear Control · Advanced Software Development · Engineering Design Optimization · Deep Learning · State Estimation · Principles of Robotic Autonomy · Introduction to Mechatronics · Linear Dynamical Systems · Introduction to Robotics · Machine Learning · Decision Making Under Uncertainty · Control Design Techniques · Advanced Robotic Manipulation · Advanced Feedback Control · Introduction to Optimization · Experimental Robotics · Multi-robot Systems · State Space Control · Design of Experiments · Introduction to Finite Element Method · Programming for Engineers · RL for Stochastic Control in Finance