TAYLOR A. HOWELL

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Education

PhD in Mechanical Engineering, 2017-2022
Stanford University

MS in Mechanical Engineering, 2017-2019
Stanford University

BS *summa cum laude* in Mechanical Engineering, 2013-2016
University of Utah

Industry Experience

Research Scientist Intern - DeepMind, London, UK. 2022.
Worked on the MuJoCo robotic simulation team with Yuval Tassa. Project lead - MuJoCo MPC. First author - Predictive Sampling: Real-time Behaviour Synthesis with MuJoCo.

Research Intern - Google, San Francisco, USA (remote). 2021.
Worked on planning with differentiable dynamical systems using JAX with Vikas Sindhwani. First author - Trajectory Optimization with Optimization-Based Dynamics.

Instructor - GREAT Summer Camp, Department of Computer Science, University of Utah, Salt Lake City, USA. 2017.
Taught basic programming and robotics skills.

Research Experience

Robotic Exploration Lab (Prof. Zachary Manchester), Stanford University | Carnegie Mellon University (remote). 2018-2022.

Telerobotics Laboratory (Prof. Jake Abbott), University of Utah. 2015-2016.

Utah Center for Excellence in Biomedical Microfluidics (Prof. Bruce Gale), University of Utah. 2014-2015.

Publications

Lead

Numerical Optimization For Things That Move: Simulation, Planning, and Control. **T.Howell**. Stanford University. 2022. [dissertation] [slides]

Predictive Sampling: Real-time Behaviour Synthesis with MuJoCo. **T. Howell**, N. Gileadi, S. Tunyasuvunakool, K. Zakka, T. Erez, Y. Tassa. arXiv. 2022. [paper] [code]

CALIPSO: A Differentiable Solver for Trajectory Optimization with Conic and Complementarity Constraints. **T. Howell**, K. Tracy, S. Le Cleac'h. Z. Manchester. ISRR. 2022. [paper] [code] [slides]

Dojo: A Differentiable Physics Engine for Robotics. **T. Howell** & S. Le Cleac'h, Z. Kolter, M. Schwager, Z. Manchester. arXiv. 2022. [paper] [code]

Trajectory Optimization with Optimization-Based Dynamics. **T. Howell**, S. Le Cleac'h, S. Singh, P. Florence, Z. Manchester, V. Sindhwani. RAL. 2022. [paper] [code] [poster]

Fast Contact-Implicit Model Predictive Control. S. Le Cleac'h & **T. Howell**, M. Schwager, Z. Manchester. (submitted to TRO). 2021. [paper] [code]

Direct Policy Optimization using Deterministic Sampling and Collocation. **T. Howell**, C. Fu, Z. Manchester. RAL. 2020. [paper] [code]

Scalable Cooperative Transport of Cable-Suspended Loads with UAVs using Distributed Trajectory Optimization. B. Jackson & **T. Howell**, K. Shah, M. Schwager, Z. Manchester. RAL. 2020. [paper]

ALTRO: A Fast Solver for Constrained Trajectory Optimization. **T. Howell** & B. Jackson, Z. Manchester. IROS. 2019. [paper] [code]

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

Contributions

RoboPianist: A Benchmark for High-Dimensional Robot Control. K. Zakka, L. Smith, N. Gileadi, **T. Howell**, X. B. Peng, S. Singh, Y. Tassa, P. Florence, A. Zeng, P. Abbeel. arXiv. 2023. [paper]

Differentiable Physics Simulation of Dynamics-Augmented Neural Objects. S. Le Cleac'h, HX Yu, M. Guo, **T. Howell**, R. Gao, J. Wu, Z. Manchester, M. Schwager. RAL. 2022. [paper]

Differentiable Collision Detection for a Set of Convex Primitives. K. Tracy, **T. Howell**, Z. Manchester. ICRA. 2023. [paper]

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. 2017. [paper]

Open Source

MuJoCo MPC- real-time behavior synthesis for robots using an interactive GUI and fast planners written in multi-threaded C++.

CALIPSO.jl - a differentiable optimizer for non-convex optimization problems with support for conic and complementarity constraints, implemented in Julia.

Dojo.jl - a differentiable physics engine for rigid-body dynamics with contact, implemented in Julia.

TrajectoryOptimization.jl - a tool for fast trajectory optimization with direct and indirect methods, implemented in Julia.

Additional work: [Github]

Skills

Programming: C/C++, Julia, Python

Computational: LaTeX, Git, Linux, SNOPT, Ipopt, CVX/Convex.jl, MeshCat, MuJoCo, JAX, Solidworks, VSCode, Arduino

Fabrication: Mill, Lathe, Vacuum Forming, Laser Cutting, Mold Making and Casting, Metal Sheet Fabrication

Teaching Experience

Course Assistant - Dynamics and Control of Aircraft (AA271a), Department of Aeronautics and Astronautics, Stanford University. 2021.

Awards and Honors

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.

Community

Reviewer - ICRA, IROS, RAL, 2018-2022.

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

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, 2016.

Science-fair judge - providing feedback to students, at local elementary school in Salt Lake City, on their projects, 2015.

Courses

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 · RL for Stochastic Control in Finance · State Space Control · Design of Experiments · Introduction to Finite Element Method · Programming for Engineers