roboto-mono

TAYLOR A. HOWELL

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I am an engineer and researcher interested in high-performance numerical optimization and its applications to simulation, control, and robotics.

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.

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 — Co-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.

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

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