

Michael Burgess

Robotic Manipulation @ MIT

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Education

2023 - 2025	Massachusetts Institute of Technology (MIT) <i>M.S. in Mechanical Engineering</i> <i>Advisor: Edward Adelson Focus: Robotic Manipulation & Tactile Sensing</i>	Cambridge, MA GPA: 5.0 / 5.0
2018 - 2023	Massachusetts Institute of Technology (MIT) <i>B.S. in Mechanical Engineering</i> <i>Courses: Underactuated Robotics, Bio-inspired Robotics, Nonlinear Control</i>	Cambridge, MA GPA: 5.0 / 5.0

Technical Skills

Software	<i>Concepts:</i> Machine Learning, Computer Vision, Controls, RL, Algorithms, App Dev <i>Languages:</i> Python, C++, Matlab, Drake, Isaac Gym, Javascript, Typescript, React
Hardware	<i>CAD:</i> Solidworks, Autodesk, ANSYS, Fluids, Statics, FEA / CFD Simulation <i>Machining:</i> CNC, Lathe, Waterjet, 3D Printing, Injection Molding, Laser Cutter <i>Electrical:</i> Arduino, Raspberry Pi, Circuit Analysis, Simulink, Soldering

Professional Experience

May 2023 - Aug. 2023	Commonwealth Fusion Systems / <i>Mechanical Engineering Intern</i> <ul style="list-style-type: none">- Modeled parts for magnet subsystems on a novel tokamak nuclear fusion reactor using NX and ANSYS software. Specifically designed supports for poloidal field (PF) coils.- Key takeaways from the internship were skills in electromechanical analysis, communication of results, modeling techniques.
Jan. 2022 - May 2023	MIT Biomimetic Robotics Lab / <i>Undergraduate Researcher</i> <ul style="list-style-type: none">- Performed research on locomotive trajectory planning over non-flat terrain for a quadruped (cheetah-like) robotic system.- Developing a novel controller that decouples kinematic and dynamic constraints to empower online planning over rough terrain.
May 2022 - Aug. 2022	Markforged / <i>Software Engineering Intern</i> <ul style="list-style-type: none">- Wrote simulated annealing based algorithm to improve printer bed packing, thereby increasing number of parts per print. All code was written in Typescript.- Learned communication-based soft skills through the responsibility of running meetings and giving presentations.

NASA Langley Research Center / *Engineering Intern*

- Jan. 2021 -
May 2021
- Optimized convolutional neural networks (CNN) that estimate where a fluid flow becomes turbulent along the surface of an airfoil.
 - Incorporated these models into flight simulation CFD solvers for practical use in minimizing viscous drag.

Scientific Systems Company, Inc. (SSCI) / *Robotics Intern*

- Sept. 2020 -
Jan. 2021
- Designed and tested a role-specific control system for UAV fleet with behavior responsive to user input.
 - Researched and developed state-of-the-art attention-based, reinforcement learning (RL) models using OpenAI gyms, Tensorflow, and PyTorch.

General Motors (GM) / *Controls Engineering Intern*

- May 2020 -
Aug. 2020
- Automated standard hardware-in-the-loop test cases for engine controller software using tools in Python and dSpace.
 - Built code libraries to locate and diagnose errors across cars' control communication infrastructure, written in C code.

Publications

- [1] **Michael Burgess**. “Decoupled Kinodynamic Planning for a Quadruped Robot over Complex Terrain”. In: *MIT dSpace* (2023). URL: <https://dspace.mit.edu/handle/1721.1/151851>.
- [2] Nicholas Ramirez, **Michael Burgess**. “Robotic Arm Manipulation to Perform Rock Skipping in Simulation”. In: *arXiv:2310.11599* (2023). URL: <https://arxiv.org/pdf/2310.14492.pdf>.
- [3] **Michael Burgess**. “Hybrid Trajectory Optimization of Simple Skateboarding Tricks through Contact”. In: *arXiv:2310.11599* (2023). URL: <https://arxiv.org/pdf/2310.11599.pdf>.

Teaching

- Sept. 2023 -
Dec. 2023
- Robotic Manipulation** / *Teaching Assistant (TA)*
Massachusetts Institute of Technology (MIT)
- Helped teach graduate course on robotic manipulation in the Fall 2023 alongside Prof. Russ Tedrake. Topics covered include motion planning, deep perception, and more.
 - Assisted students in project development, created homeworks, and held office hours.

Activities

- Jan. 2020
- MIT Global Teaching Labs (GTL)** Rho, Italy
- Spent a month in Rho, Italy teaching robotics concepts to high school students.
 - Created and taught my own curriculum of circuits and PID control systems, including lectures, exams, and experiments with Arduino / breadboarding.

Portfolio

Dec. 2022

Rock Skipping Robot

- Developed a control architecture and simulation environment to perform the task of rock skipping on a Kuka IIWA robot arm, using Drake.
- Project required knowledge in trajectory optimization, fluid physics, and robotic simulation techniques.

Dec. 2022

Hula Hooping Robot

- Designed, built, and controlled a 2 DoF robot system that was capable of hula hooping, in order to study how humans are able to hula hoop most effectively.
- Project required use of Matlab, embedded controls, and hardware design.

May 2022

Underactuated Skateboard Control System

- Created a trajectory planner using non-linear hybrid dynamic optimization to perform skateboard tricks in simulation on an abstracted skateboard-rider system.
- Project was written using Drake and required knowledge of non-linear controls.

For a full portfolio, please visit my website at mburgjr.github.io/portfolio/.