Ethan J. Musser

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Education

University of Pennsylvania, School of Engineering & Applied Science Graduated May 2022
Master of Science in Engineering, Robotics GPA: 3.73/4.00

Temple University, College of Engineering Graduated May 2020
Bachelor of Science, Mechanical Engineering *cum laude*

Relevant Coursework:

- Model Predictive Control
- Nonlinear Control
- Robotic Manipulation
- Legged Locomotion
- Advanced Dynamics
- Autonomous Racing
- Mobile Robotics
- Mechatronics

Experience

Postgraduate Researcher March 2021 – Present
*Kod*Lab (GRASP Laboratory subsidiary)* *Philadelphia, PA*

- Implementing a MuJoCo-based simulation environment that interfaces with the Kod*Lab Mjbots SDK — the lab's open-source BLDC motor driver and control framework written in C++ 17 — and supports custom robot configurations
- Implemented single rigid body model for controlling an axially spined quadruped via toe contact forces and body wrenches
- Refactored the Kod*Lab Mjbots SDK to use an object-oriented architecture where the user specifies their system through robot, limb, joint, control loop, and hardware abstract classes and interfaces
- Created a framework for implementing robot behaviors and transitioning between states, including several example control implementations, enabling rapid behavior development in the Kod*Lab Mjbots SDK
- Designed, for manufacture and assembly, a novel, axially-spined 13-degree-of-freedom quadrupedal robot capable of executing highly dynamic, active-spine transitional behaviors
- Updated initial legged robot design to interface with surplus lab actuator modules and accept new Mjbots brushless DC motor drivers, reducing manufacturing costs by 60 percent and making the design compliant with a new lab hardware standard
- Coached three MS and two BS students in hardware and software development, conducting code reviews and hardware testing, leading to the production of research-ready software and robots

Research Assistant May 2019 – March 2021
Temple Robotics and Artificial Intelligence Laboratory (TRAIL) *Philadelphia, PA*

- Collaborated with PI to develop an optimal, 3D quadrotor path-planner using the Open Motion Planning Library (OMPL) and Google OR-Tools in ROS for use in at-sea inspection of ship substructure and superstructure
- Created a follower controller that mimicked vehicle acceleration and braking profiles while following another vehicle on the Duckiebot mobile robot platform

Projects

Dynamic Local Trajectory Optimization with Graph Planning | *ROS 2, Python, Docker, Git* April 2022 – May 2022

- Integrated opponent pose estimation with the TUM local graph planner on an F1Tenth RC racecar, successfully avoiding the opponent vehicle and static obstacles in a head-to-head autonomous race
- Implemented lightweight, 2D LiDAR-based dynamic obstacle detection and opponent pose estimation via point cloud clustering

Quadrotor Trajectory Generation & Control | *Python, Trajectory Generation* January 2021 – February 2021

- Leveraged an optimized Dijkstra path planning algorithm, a custom graph-simplification and interpolation procedure, and continuity constraints to generate traversable minimum-jerk trajectories in Python
- Executed minimum-jerk trajectories on a robotic quadrotor in simulation, successfully planning and executing a trajectory through narrow, sharp-cornered 3D corridors without colliding
- Implemented a nonlinear geometric controller on the simulated quadrotor, with gains estimated from isolated step response characteristics

Technical Skills

Languages: C++ 17, Python, MATLAB, Bash, Java, CMake
Technologies: Robot Operating System (ROS & ROS2), Git, Docker, Linux, Wolfram Mathematica, MuJoCo, Doxygen, LaTeX
Design: SolidWorks, PTC Creo Parametric, Simulink, ANSYS Mechanical & Fluent, NI LabVIEW, MotionGenesis Kane, AutoCAD, Design for Manufacture & Assembly (DFMA)
Fabrication: Haas CNC Vertical Mill & Lathe, CNC Router, Manual Vertical Mill & Metalworking Lathe, Fused Deposition Modeling (FDM) 3D Printing, TIG Welding, Carbon Fiber Layup, General Shop Tools