Ethan Chandler

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Education

- **Worcester Polytechnic Institute** — *Bachelor, Master of Science: Robotics Engineering* *Expected May '25*

  Related Coursework: *Legged Robotics, Robot Control, Motion Planning, Robot Dynamics, Swarm Robotics, Artificial Intelligence*

Skills Summary

- **Software**: Proficient in C++, C, Python, MATLAB, OpenCV, ROS/ROS2, Linux, Bash; Familiar with Java, JS, HTML
- **Hardware**: Skilled in CAD/CAM (Fusion360, Inventor & SOLIDWORKS), PLC, 3D Printing, Breadboarding
- **Aptitudes**: Experienced in Legged Robotics, Optimal Controls, Machine Learning, Motion Planning

Related Experience

- **Optimal Control of Legged Robots** — *Graduate Research, WPI* *Aug '22 – Present*
  - **Pseudospectral Collocation for Legged Robots**: Developed Galileo, a lightweight C++ library for trajectory optimization by leveraging Gauss-Legendre Pseudospectral collocation — capable of solving complex problems such as bimanual manipulation, legged robot acrobatics, and mobile robot navigation. Solved backflips and corkscrew maneuvers of a Solo12 quadruped in seconds. Pitched framework effectiveness in simulation, and successfully acquired $4.5k research stipend for real-time locomotion on Unitree Go1 hardware
  - **Push Recovery by Stepping**: Designed a reactive push recovery controller for WPI's bipedal robot, HURON. Derived centroidal momentum dynamics and a QP-based whole-body controller to track CoP trajectories, allowing push recovery from external disturbances of 300 $\mathrm{N} \cdot \mathrm{s}$
  - **Robust Perceptive Locomotion**: Implemented perceptive locomotion on a Unitree Go1 by building elevation maps with depth cameras, which are segmented into convex regions using computer vision and steppability classification. Computed optimal trajectories with NMPC by processing steppable regions as linear constraints and using centroidal momentum dynamics. Delivered 50Hz real-time hardware performance with hierarchical whole-body controller

- **Graduate Teaching Assistant** — *WPI* *Dec '23 – Present*
  - **RBE 521 Legged Robotics**: Redesigning and teaching a graduate course in legged robotics for 18 students, covering 14 weeks of state-of-the-art loco-manipulation topics and techniques

- **Swarm Robotics** — *Graduate Project, WPI* *Dec '22 – May '23*
  - **Intermittent Communication**: Created a connectivity dynamics controller, allowing agents to communicate between disjoint groups, merging/splitting from clusters to optimize network throughput, while adhering to physical signal range constraints. Emergent behavior with 20 Khepera IV robots in ARGoS intuitively formed a 'bridge' between clusters

- **Motion Planning and Controls** — *Undergraduate Research, WPI* *Nov '21 – May '23*
  - **Composability of Complex Behaviors**: Modeled behaviors as sets of trajectories and enabled a differential drive robot to traverse nonconvex obstacles in simulation. Composed a sequence of behaviors with linear constraint satisfaction and multi-phase collocation, and discovered solutions that were infeasible with single-phase collocation
  - **Multi-Resolution Field D* for Mobile Robot Mapping and Navigation**: Established a C++ mobile robot framework for autonomous mapping and navigation in large, multi-resolution, dynamic environments. Represented the environment with quadtrees enumerated on an adaptive Hilbert curve for maximum locality, and developed a novel mesh refinement algorithm for GPU parallelization. Researched memory-based heuristics and improved cost estimation to optimize Field D* for path planning. Achieved faster and more robust mapping and navigation for large maps using locally expanding RRTs and hierarchical clustering for frontier detection

- **Manipulators** — *Undergraduate Projects, WPI* *Aug '21 – Mar '22*
  - **Serial Arm**: Programmed 3-DOF arm with Matlab & Java, and applied image segmentation and filtering techniques to detect object centroids. Generated feasible trajectories to track and manipulate objects, sorting by color
  - **Rigid Body Library**: Created a Matlab library to derive symbolic rigid body kinematics and dynamics automatically from URDF models, and tested extensively on a 6-DOF AR4 robot arm. Researched spatial vector algebra to implement PoE kinematics, as well as RNEA and Lagrange's method for dynamics

- **BattleBots** — *Builder for Axolotl, Captain of Tempest* *Aug '20 – Nov '21*
  - **Axolotl**: Designed and manufactured 250 lb. combat robot *Axolotl* with Fusion360 & Solidworks. Raised $8k to purchase hardware, and competed in S5 of Discovery Channel's BattleBots