

Phillip Brush

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Perception | Autonomous Navigation | Onboard Control | Nano-drones

WPI Master's degree candidate in Robotics Engineering (est. May 2025) specializing in robot perception of nano-drones that facilitate autonomous navigation through only onboard computation and sensors (minimal-AI). Seeking a full-time position in the field of robotics that will allow me to contribute to a team of dedicated individuals creating and developing cutting edge robotic projects. Demonstrated capacity to learn quickly and apply new concepts and technologies to diverse projects both individually and within a team.

Professional Experience

WPI Perception and Autonomous Robotics (PeAR) Group | Student Researcher Spring 2024 – Current

The PeAR Group is led by Dr. Nitin J Sanket and focusses on tackling practical problems in robot perception on resource constrained, nano-drones using on-board sensing and computing. My thesis research in Dr. Sanket's lab is centered around using deep learning and ultrasound sensors for obstacle avoidances in environments where stereo cameras are ineffective.

- Designed a lightweight PCB with SPI communication and a voltage regulator to connect to 4 ultrasound sensors.
- Developed software and electrical architecture to collect data from sensors via 5 separate microcontrollers.
- Researched filtering noise from data via passive and active methods, including FFT & active noise cancelling.
- Optimized network via quantization for deployment on Google Coral Edge TPU for real-time inference.
- Ported our data loading and training pipelines from PyTorch to TensorFlow 2, trained networks on GPU Cluster.

Worcester Polytechnic Institute | Teaching Assistant | Worcester, Massachusetts Fall 2024

- TA for WPI's Deep Learning for Perception course; hosted office hours for students twice a week; graded assignments.

Alert Innovation | Automation Engineer Summer Intern | Andover, Massachusetts Summer 2023

Alert Innovation is the developer of the Alphabot®; a self-contained, robotic e-Grocery micro-fulfillment system that is practical and cost-effective today, while providing a platform for the future. Alert was acquired by Walmart in October 2022.

- Created a program with Kusto Query Language and Azure Database Explorer that allowed onsite technicians to proactively identify Alphabots® that repeatedly throw an error code, initiate repairs and significantly reduce system downtime.
- Refined design (PTC Creo) of onsite Alphabot® maintenance areas based on the limitations of the current layout.
- Optimized long-term functionality of Gen-1 and Gen-2 Alphabots® by identifying shared parts and inventory.

Worcester Polytechnic Institute | Peer Learning Assistant | Worcester, Massachusetts Winter 2023 | Spring 2023

- TA for WPI's Intro to SolidWorks course; hosted individual office hours for help outside of lab time.

Education

M.S. Robotics Engineering | WORCESTER POLYTECHNIC INSTITUTE, Worcester MA | GPA 3.68 | Est. May 2025.

B.S. Robotics/ Mechanical Engineering | WORCESTER POLYTECHNIC INSTITUTE, Worcester MA | GPA 3.68 | May 2024.

Extracurricular Activities

Rho Beta Epsilon | Robotics Honor Society | 2023 - 2024

WPI Combat Robotics Club | 2021 - 2024

Skills

Robotics Competencies:

C/C++ | Python | MATLAB | Java | ROS 1/2 | Gazebo | MuJoCo | Arduino | Git/Hub | PyTorch | TensorFlow 2 | Open Motion Planning Library | Design Patterns | Optimization | Modern Control | Computer Vision | Circuit Design | Agile Scrum

Mechanical Competencies:

SolidWorks 3D Modelling, Simulation/FEA, and Drawings | Fusion360 CAM | MATHCAD | 3D Printing | Laser Cutting | Machining | Soldering | Rapid Prototyping | Weight-Critical Design | Material Properties

Motion Planning - Planner Development and Benchmarking | Fall 2024

- Implemented Reachability Guided Rapidly-exploring Random Tree to generate paths that don't violate an agent's dynamic constraints with the Open Motion Planning Library.
- Developed a collision checker and a clearance metric for a mobile robot with a 4DOF manipulator to maximize the robot's distance from surrounding obstacles while also navigating through a narrow passage.
- Benchmarked various planners including RRT, RRT-connect, and PRM for efficiency; visualized paths using Matplotlib.

Legged - Walking Gait Generation | Summer 2024

- Computed the smooth trajectories of a quadruped's feet at the maximum walking speed without losing stability.

Legged - Design of Humanoid Robot | Summer 2024

- Redesigned a 2-year senior capstone project across 10 weeks to reduce system weight from 34kg to 27kg.
- Performed relevant finite element analysis, determining parts were overdesigned with a factor of safety of 41.
- Designed custom cycloidal gearboxes to replace the previous off-the-shelf planetary, reducing size, inertia, and cost.

Computer Vision & Machine Learning - Hand Gesture Recognition GUI | Spring 2024

- Compared performance of multiple CNN architectures such as ResNet18 against a Vision Transformer using PyTorch.
- Performed live inference/real-time gesture recognition from video data for each network with OpenCV.

Dynamics - Robot Arm Simulator | Spring 2024

- Created a simulator in MATLAB that used the Recursive Newton-Euler algorithm to simulate the torques generated on a 6 DOF robot arm with a wrench applied to the end-effector based on user inputs.
- Developed a dynamics library that implemented forward kinematics through product of exponentials and inverse kinematics via a variety of methods including Newton-Raphson and Levenberg-Marquardt (Least Squares).

Swarm - Robot Swarm Manufacturing and Deployment | Fall 2023 | Winter 2024

- Developed a swarm of robots to autonomously combine to fulfill tasks that robots cannot complete individually.
- Designed a locking mechanism for cubes to support the weight of other robots without straining the motor.
- Programmed on Raspberry Pi Zero 2 W's using ROS Noetic, Ubuntu Server, OpenCV, and Python.

Navigation - SLAM in Complex Environment | Fall 2023

- Programmed a Turtlebot with Python and ROS in Linux to perform SLAM in a static environment.
- Developed a custom frontier detection and exploration algorithm and performed mapping via the gmapping package.
- Created an algorithm using the AMCL package allowing the robot localize when placed in a random position.

Perception - Fitting Shape Primitives to Simulated Point Clouds | Fall 2023

- Analyzed point-cloud data from simulated objects to identify and project approximate shape primitives with ROS 2.
- Performed Euclidean Clustering on groups of objects to differentiate between and identify individual objects.

Industrial Implementation and Computer Vision - Palletizing Operation | Spring 2023

- Programmed an ABB IRB1600 in Robot Studio and configured a PLC to autonomously pick and place a set of cubes at certain positions identified by a Cognex camera and In-Sight software.

Computer Vision & Manipulation - Color-sorting Pick and Place | Winter 2023

- Used MATLAB to program an arm to pick and place colored balls in respective bins and follow a marker in real time.
- Developed robust forward and inverse kinematics, cubic and quintic trajectory planning, inverse velocity kinematics, singularity detection, and ball-detection algorithm with a variety of colors and live updates.

MakerSpace - Remote Interactive Qualifying Project (Santa Fe, N.M.) - | Fall 2022

- Worked with the Santa Fe Indian School to develop an on-campus MakerSpace and overall STEAM initiative.
- Wrote a report determining our research at the school and a guide with recommendations based on our research.

Robot:Robot Interaction - Romeo and Juliet | Fall 2021 | Fall 2022

- Used C++/Arduino to program robots with specialized sensor-suites to perform scenes from Romeo and Juliet.
- Responsible for developing embedded code for rangefinders, an IMU, I2C/UART communication, PID controllers for wall-following and standoff control, complementary filter for Gyroscope and Accelerometer, and AprilTag Detection.

Motion Planning - Path Navigation | Fall 2021 | Winter 2022

- Used Java and object-oriented programming principles to make a GUI to direct a robot along the shortest path using Dijkstra's algorithm in an environment with unknown obstacles.