

EDUCATION

WORCESTER POLYTECHNIC INSTITUTE, WORCESTER, MA

Master of Science in Robotics Engineering (2024 – 2028)

Master of Science in Applied Mathematics (2024 – 2028)

Bachelor of Science in Robotics Engineering (2024 – 2027)

EXPERIENCE

PeAR GROUP (WPI), WORCESTER, MA

The Perception and Autonomous Robotics (PeAR) group at WPI, run by Professor Nitin Sanket, pushes the boundaries of autonomy with extreme resource constrained tiny aerial robots using only on-board computation and sensing.

Student Researcher

June 2024 – Present

- Researching novel uses of sensors using AI models for small, resource constrained drones
- Designed (Onshape) and 3d-printed data collection rig for 4 depth cameras and 1 LiDAR
- Calibrated extrinsics of multi-camera setup using traditional methods and Iterative-Closest-Point
- Stitched pointclouds of 3 RealSense depth cameras to create a combined depth image with 170-degree FOV
- Developed a ROS2 pipeline for collecting data from a variety of sensors at 10GB/min
- Designing and building custom drone-demo for obstacle avoidance with novel ultrasonic sensor
- Implementing low-pass filter on ultrasound data to reduce signal noise produced by motor propellers
- Co-Authoring paper using ultrasonic sensors for novel depth estimation, submitting to Nature Robotics

FIRST ROBOTICS TEAM, CONCORD, MA

The FIRST Robotics Competition (FRC) is an international high school robotics competition. Robots up to 125lbs complete tasks such as scoring balls into goals, placing inner tubes onto racks, and hanging on bars.

Team Captain/Programming Lead

2023 – 2024 School Year

- Responsible for training and managing 10+ students in robotics software, managing a team of 40+ students
- Restructured code into fully logged, isolated subsystems enabling advanced debugging and simulations
- Developed code for in-depth motor and system characterization with precise velocity and positional control
- Utilized pose estimation through a Kalman filter to follow pre-generated, time-optimal trajectories given a set of kinodynamic constraints with error under 5cm at rest and 20cm while moving
- Implemented on-the-fly trajectory generation/following using A* obeying acceleration constraints
- Created a NVIDIA gstreamer pipeline for AprilTag detection on multiple time-synchronized global shutter CSI cameras on an NVIDIA Jetson platform, fused with ZED Stereo depth camera for in-motion localization
- Wrote robust simulation support for the entire robot code as well as for testing generated trajectories
- Designed and modeled a mechanism to intake a 12" foam ring and pass it through to an actuating arm with a flywheel shooter, as well as developed software using stator current signals to keep track of it in its path
- Developed and tested a robust autonomous routine to perform many picking-up and shooting tasks; written to be highly adaptable so a brand-new path could be created with just a few lines of code in ~10 minutes

Programming Team Lead

2022 – 2023 School Year

- Utilized a ZED Stereo depth camera and an NVIDIA Jetson for pose estimation by combining April Tag localization, VSLAM, and motor encoders in a Kalman filter, and real-time object detection with MobileNet-v2
- Used an IMU to stabilize robot heading and tilt, implemented an absolute-oriented drive
- Developed a PID + FF controller for two jointed arm using IK and autonomously balanced on a see-saw
- Created time-parameterized 2D motion profile with velocity and acceleration constraints for two jointed arm
- Set up communication from an Arduino to our controller over SPI to make rgb lights representing states

Team Member

2021 – 2022 School Year

- Controlled linear actuators, used an oscilloscope to debug PWM wave outputs
- Utilized Python with OpenCV to create an image recognition program to detect balls and robots on the field

SAKON, CONCORD, MA

Sakon provides a leading connectivity spend management and mobile operations platform (software).

Implementation and Data Analytics Intern, Client Services Team

Summers 2021, 2022

- Supported team to onboard new Fortune 500 client and provided QA for Salesforce processes
- Created training materials for future team members based on my prior work

INDEPENDENT STUDY IN COMPUTER SCIENCE AND MATHEMATICS, CCHS**Independent Study**

September 2021 – January 2022

- Self-taught the linear algebra, vector calculus, and optimization required for machine learning problems
- Implemented an A* algorithm with a heuristic using a neural network trained by genetic algorithm – performed significantly better than a distance heuristic on random setpoints with a fixed map
- Developed neural networks from scratch and compared training with gradient descent vs Newton's method

S U P P L E M E N T A L E D U C A T I O N**Mathematics Courses:****Probability Theory, Real Analysis (Harvard)**

- Statistical analysis of a dataset from mental health of medical students in Sweden in R
- Comprehensive presentation and discussion on further analysis using PCA

Advanced Group Theory (Northeastern)

- Included development of Lie Algebras and special groups $SO(3)$ and $SE(2)$

Computational Mathematics (Graduate, UMass – Lowell)

- Extensive use of MATLAB to implement computational methods discussed in class

Stochastic Control and Optimization (Graduate, MA 590 – Worcester Polytechnic Institute)

- Researching and solving a novel stochastic control problem, writing report and presenting results
- Presented two recent papers in stochastic control for reinforcement learning

Robotics Courses (Worcester Polytechnic Institute):**Deep Learning for Perception (RBE 474X)**

- Developed and trained CNNs from scratch with custom backprop implementation
- Employed adversarial attacks to improve network training
- Utilized Blender to generate simulated data for training a custom image segmentation model, verified network with inference on real-world data
- Work culminating in final project implementing a diffusion model

Unified Robotics: Sensing (RBE 2002)

- Implemented algorithms in computer vision and sensor fusion with sensors such as range finders, IMU, monocular cameras, navigated a cluttered dynamic maze with a small mobile robot