

# ARYAN NAVEEN

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## EDUCATION

### Harvard University

Bachelor's in Computer Science & Applied Math, GPA: 3.84

### Greenville Technical College

Associate in Science (Completed concurrently with High School), GPA: 4.00

Cambridge, MA

Expected May 2025

Greenville, SC

May 2021

## RESEARCH INTERESTS

- Advance localization and perception capabilities for autonomous systems
- Enable general intelligence for robotic systems
- Design robust controllers to enable higher degrees of autonomy for various robotic platforms

## PUBLICATIONS & PRESENTATION

### Peer Reviewed Journal Articles

**Naveen, A.**, Morris, J., Chan, C., Mhrouss D., Helbling E. F., Hyun P., Hills G., & Wood, R. J. (2024). *Hardware-in-the-Loop for Characterization of Embedded State Estimation for Flying Microrobots*. International Journal of Robotics Research. Under Review.

Paschalidis, P., **Naveen, A.**, Zhang R., Li N. (2024). *Cooperative Multi-Agent Graph Bandits: UCB Algorithm and Regret Analysis*. IEEE Transactions on Automatic Control. Submitted.

### Conference Proceedings

Morris, J., Chan, C., Kyriazidis, G., Batra, A., **Naveen, A.**, Arcarese, M., El-Rayess, J., Hernandez, A., Wood, R. J., & Hills G. (2024). *Electro-Mechanical Co-Design for Size, Weight, and Power-Constrained Autonomous Micro-Scale Robots*. DATE. Under Review.

**Naveen, A.**, Coltin, B., Moreira, M., & Smith T. (2023). *Progress toward detection & pose estimation of arbitrary object types by space robotic caretakers*. ISSRDC, August 2023, Seattle, WA.

*[Oral presentation delivered by Brian Coltin (NASA) on my behalf at International Space Station Research & Design 2023]*

**Naveen, A.**, & Taylor, C. (2021). *Decentralized Data Fusion with Probabilistically Conservative Ellipsoidal Intersection*. <https://doi.org/10.23919/acc50511.2021.9483177>

*[Paper & oral presentation at American Control Conference 2021]*

**Naveen, A.**, Luo, H., Chen, Z., & Li, B. (2020). *3D Mapping and Stability Prediction for Autonomous Wheelchairs*. <https://doi.org/10.1109/cyber50695.2020.9279115>

*[Paper & oral presentation at IEEE Cyber Technology in Automation, Control, and Intelligent Systems 2020]*

**Naveen, A.**, Luo, H., Chen, Z., & Li, B. (2020b). Predicting Wheelchair Stability While Crossing a Curb Using RGB-Depth Vision. In *Lecture notes in computer science* (pp. 394–401). [https://doi.org/10.1007/978-3-030-58805-2\\_47](https://doi.org/10.1007/978-3-030-58805-2_47)

*[Paper & oral presentation at International Conference on Computers Helping People with Special Needs 2020]*

Luo H., Chen Z., **Naveen A.**, Li B., “Dynamic Modeling and Prediction of Rollover Stability for All-Terrain Vehicles”, In Proceedings of the Ground Vehicle Systems Engineering and Technology Symposium (GVSETS), NDIA, Novi, MI, Aug. 11-13, 2020.

### Media Coverage

S. Srinivasan, "Wearable Assistive Devices for the Visually Challenged [Student's Corner]," in *IEEE Robotics & Automation Magazine*, vol. 27, no. 1, pp. 12-15, March 2020, doi: 10.1109/MRA.2020.2967975.

## RESEARCH/WORK EXPERIENCE (UNDERGRADUATE)

### Harvard University

#### Research Assistant with Professor Robert Wood's Microrobotics Lab

Researched integration of onboard sensing for Harvard's Microrobotics Lab flapping wing micro-aerial vehicle (Robobee)

- Implemented state estimation algorithm utilizing Extended Kalman Filter to estimate attitude and altitude of the RoboBee.
- Designed sensor suite to satisfy the RoboBee's limited payload that carries a 9-axis IMU and TOF sensor.

Cambridge, MA

September 2021 - Present

- Evaluated algorithm and hardware designs using a hardware-in-the-loop pipeline that recreated Robobee flight dynamics with a UR5e arm, achieving less than 2-degree and 1 mm error.
- Helped design and fabricate flex-PCB sensor suite with 10 mm footprint.
- Secured funding for the project through a successful research proposal awarded by the **Harvard College Research Program**.

### **Research Assistant with Professor Na Li**

January 2024 – Present

Investigated multi-agent RL algorithms for Multi-Armed Graph Bandit Problem

- Created robust RL algorithm based on UCB estimations that enabled agents to learn optimal allocation to minimize observed regret
- Designed simulations to evaluate proposed algorithm performance against measurement noise and failures
- Implemented algorithm in ROS2 on TurtleBot's for robotic demonstration

Developing multi-skill learning framework for collaborative drone learning **[Thesis]**

- Leverage representation learning to allow agents to collaboratively learn and share diverse skills
- Designed NVIDIA IsaacSim Environment to train initial controller policies in simulation

## **MIT Lincoln Laboratory**

**Lexington, MA**

### **Research Intern with Advanced Technologies Group**

May 2024 – Present

Training object navigation RL policy to optimize task-driven exploration leveraging semantically embedded scene graphs

- Working with MIT SPARK Lab's CLIO Pipeline that in real time maps the environment and generates task driven semantically embedded scene graphs
- Utilizing GAN to predict unobserved areas of the environment to inform robot exploration policy
- Optimizing training efficiency through pretraining GNN policy with imitation learning based on sample trajectories from Meta's habitat baseline policy.

Working with robot foundation models to build imitation learning pipeline for UR5 arm

- Working with Stanford IRIS Lab's OCTO Foundation Model to finetune policies for specialized tasks for UR5 arm (such as assembling drone)
- Collaborated with other interns to build Berkeley Robot Learning Lab's GELLO interface for intuitive UR5 arm control
- Implementing ROS wrapper for generated policies for UR5 arm

## **Boston Dynamics**

**Waltham, MA**

### **Software Development Intern with Warehouse Robot Perception Team**

May 2023 – August 2023

Implemented calibration policies for the LiDAR, perception mast, and robot arm joints on Boston Dynamics' Stretch

- Derived calibration optimization function that adjusts joint offsets and camera extrinsic to minimize reprojection error between camera estimated pose and LiDAR estimated pose of calibration target
- Implemented safety policies to ensure no moving targets are within pre-defined region of Stretch while in operation

## **NASA Ames Research Center**

**Mountain View, CA**

### **Research Intern with Intelligent Robotics Group**

May 2022 – August 2022

Implemented object pose estimation pipeline on Astrobee, a free-flying robot onboard the International Space Station

- Trained Mask-RCNN to segment handrails from RGB-D input streams and utilized point cloud registration techniques to estimate object's orientation compared to reference point cloud
  - Wrote ROS plugin to generate training data from gazebo worlds to improve model performance
  - Finetuned model on real annotated data to improve sim2real transition of pipeline
- Achieved  $< 0.05m$  and  $< 0.08^\circ$  errors in handrail pose estimation in noisy, cluttered environments, outperforming prior algorithms that failed initial detection.
- Outputted pose estimation was utilized to perform depth odometry as Astrobee approached and grasped handrail

## **TEACHING EXPERIENCE**

## **Harvard University**

**Cambridge, MA**

### **Teaching Fellow for Graduate Level - Advanced Introduction to Robotics**

August 2024 – December 2024

Introduction to computer-controlled robotic manipulators.

- Will assist students with completing labs to implement forward kinematics, inverse kinematics, and various control/perception algorithms on UR5 robot arm
- Hold office hours to review material presented in lecture and provide assistance on competition of problem sets and labs

### **MakerFellow at Harvard's Makerspace**

January 2024 – Present

Helped oversee Harvard's Active Learning Lab Makerspace by assisting student projects, fixing broken tools, and ensuring student safety

## **Shanti Bhavan's Children Project**

**Hosur, India**

### **Middle School Programming Teacher**

August 2023 – December 2023

Took a gap semester and stayed at residential school to teach 3rd grade through 10th grade children from underprivileged backgrounds

- Developed computer science curriculum and taught 6<sup>th</sup> and 7<sup>th</sup> grade students to begin to grow their logical thinking abilities in preparation for high-school computer science classes
- Designed fun robotics projects with EV3 for my students to practice their programming skills and grow their passion
- Tutored high school students for computer science board exams and tutored elementary school students in math and english

## **Code Ninjas**

**Greenville, SC**

### **Code Sensei**

March 2019 – May 2021

Worked as a programming instructor for children between ages 5 to 15 for Scratch, Python, JavaScript, and C.

- Guided students through tutorials to introduce them to both logical programming concepts as well as syntax
- Ran summer camps and helped get more children passionate about computer science

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## PROJECTS/INVOLVEMENTS

- **LimbX:** Developed continuum robot arm that intends to serve as a supernumerary limb & controlled by a novel eye-tracking interface.
- **FaceID Dorm Unlock:** Designed, fabricated, & programmed system using Raspberry Pi & Arduino that upon facial recognition unlocks the door by twisting the door handle
- **Member of Harvard Sports Analytics Collective:** Co-authored several sports publications & led a Harvard team for the Big Data bowl NFL sports analytics competition.
- **AR NFL Helmet:** Designed helmet with inbuilt AR display utilizing laser cut acrylic and phone
- **Member of Harvard's Ultimate Frisbee Club Team:** Served as treasurer for 2 years and played for the team all 4 years
- **Harvard Homeless Shelter:** Volunteered night shifts at Harvard Homeless Shelter to support food arrangements, sleeping accommodations, and laundry needs for the homeless community.

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## RELEVANT RESEARCH/WORK EXPERIENCE (HIGH SCHOOL)

### Air Force Research Lab

Dayton, OH

#### *Wright Research Scholar*

March 2020 – August 2021

Developed novel correlation agnostic data fusion algorithm and implemented on GPS localization for drones

- Introduced an additional probabilistic constraint to pre-existing ellipsoidal intersection based on the means of the independent distribution to produce more probabilistically likely fused results

### Clemson University International Center for Automotive Research

Greenville, SC

#### *Research Assistant with Professor Bing Li*

May 2019 – April 2021

Explored implementation of perception and autonomy to help enable greater independence for handicapped communities

- Utilized SLAM to perform real-time stability prediction for path planning on autonomous wheelchairs
- Investigated various edge computing devices to detect door handles for visually impaired individuals and provide guidance
- Assisted in PhD student's research through design and fabrication of various sensor mounts

### NASA Ames Research Center

Durham, NH

#### *Research Volunteer with the Aviation Systems Department*

June 2020 – August 2020

Conducted literature reviews and proposed machine learning applications to address the impact of COVID-19 on airspace operations.

### University of New Hampshire Interoperability Lab

Durham, NH

#### *Software Development Intern*

July 2019 – August 2019

Worked on various automated cyber-security protocols for industry clients of the lab

- Developed an automated firewall controller to manage access to the lab network for clients