Bavin Saravanan

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Certificates

Education

- **Carnegie Mellon University** — Pittsburgh, United States
  MS Mechanical Engineering ; GPA: 3.89/4.0 — *August 2025 - December 2026*
  Courses: *Dynamics and Control, Reinforcement Learning and Deep Learning*

- **SSN College of Engineering** — Chennai, India
  BE Mechanical Engineering ; GPA: 8.74/10.0 — *July 2019 - May 2023*
  Courses: *Mechanics, Introduction to robotics, Mechatronics*

Publications

LatNav: Monocular Obstacle Avoidance for Quadrotors via Collision Latents and Learned Odometry
Under review, IEEE Robotics and Automation Letters (RA-L), 2026
Bavin Saravanan, Muqing Cao, Sebastian Scherer

AM-Bench: A Modular Simulation Suite and Benchmark for Aerial Manipulation Policy Learning
Conference on Robot Learning (CoRL), 2026 [view]
Yutong Wang, Dongjae Lee, Xiaofeng Guo, Yuanzhu Zhan, Yufei Jiang, **Bavin Saravanan**, Muqing Cao, Jia Xie, Chenyang Mao, Sebastian Scherer, Junyi Geng, Guanya Shi

Drone Soccer: Learning to Manipulate with Multicopter Downwash
IROS Workshop on Sim2Real and Classic Control, 2026 [view]
Neelay Joglekar, **Bavin Saravanan**, Yutong Wang, Varun Kandiyappan, Junyi Geng, Sebastian Scherer

Fly-by-Code: Embodied Coding Agents for Aerial Manipulation with Active Visual and Physical Feedback
Under review, International Conference on Learning Representations (ICLR), 2027 [view]
Jeongyeon Seo, Sihyun Cho, Jaewoo Lee, Gyeongrak Choe, Yutong Wang, **Bavin Saravanan**, Jia-Bin Huang, Furong Huang, Sebastian Scherer, Guanya Shi, H. Jin Kim, Seungjae Lee, Dongjae Lee

Experience

- **AirLab – CMU Robotics Institute, Prof. Sebastian Scherer** — Pittsburgh, PA
  Research Assistant — *Nov 2025 – Present*
  - **Monocular Quadrotor Navigation – LatNav**
    - Developed a **monocular navigation policy** that pairs **collision latents** from RGB images with **learned odometry**, running fully onboard a **Starling 2 Max** quadrotor.
    - Achieved **sim-to-real transfer** by modeling vehicle physics and delays in simulation, sustaining flights of up to **12 minutes** across diverse environments.
  - **Aerial Manipulation Benchmark – AM-Bench**
    - Built and integrated task environments for a **12-task benchmark** spanning multiple **multirotor embodiments**, and ran the benchmark experiments.
    - Found that the best fine-tuned policy averaged **52% success**, with failures concentrated in **contact-rich tasks** such as valve rotation.
    - Reduced near-ground **sim-to-real tracking error by 48%** by adding a **ground-effect model**.
  - **Downwash-Based Manipulation – Drone Soccer**
    - Trained, to our knowledge, the **first aerial manipulation policy** that actively uses **multicopter downwash** to move objects, reaching the goal in **3 of 4** hardware configurations.
    - Demonstrated **10 consecutive passes** with a human partner on hardware.
    - Identified unmodeled controller, ball, and downwash dynamics as the cause of failures at ball speeds above **1.5 m/s**.

- **Legged Systems Group – CMU Robotics Institute, Prof. Hartmut Geyer** — Pittsburgh, PA
  Research Assistant — *Jan 2026 – Present*
  - **Learning-Based Prosthesis Control**
    - Proposed and deployed a **reinforcement learning (RL)** policy for the **CMU prosthetic leg** that combines **human motion priors** with the user's **intact-leg femur pose** to produce human-like gait through **joint torque control**.
    - Learned **residual dynamics models** of the leg's **series elastic actuators** from only **6 minutes** of walking data, enabling **20 continuous minutes** of stable, natural level-ground walking.
    - Extending the policy with **intact-leg information** to anticipate gait-mode changes such as **stairs and slopes** under uncertainty in user intent and dynamics.

- **Skytex Unmanned Aerial Solutions** Bengaluru, India
  AI and Robotics Engineer *Jul 2023 – Jul 2025*
  - **Decentralized VTOL UAV Swarm – Cactus Swarm**
    * Developed a **decentralized swarm of 12 VTOL UAVs** demonstrating flocking, foraging, and cooperative payload delivery, with fully onboard autonomy up to **2 km altitude** and **12 km range**.
    * Designed a **vector-field guidance algorithm** built on the aircraft's **turning limits**, supporting **15 autonomous long-range flights**.
    * Built a lightweight **inter-UAV communication stack** and a **Jetson Xavier NX–PX4** control pipeline using **ROS2** and **Micro XRCE-DDS**.
  - **GPS-Denied Autonomous Quadrotor – Bumblebee**
    * Developed a **palm-sized Jetson Orin NX quadrotor** for autonomous navigation in **GPS-denied forests**, combining **LiDAR-based SLAM** for real-time 3D mapping, **A* planning** over local obstacle maps, and a **Lissajous search** strategy.
    * Implemented real-time **detection, tracking**, and **Siamese-network target verification** in cluttered environments.

Projects

- **General Loco-Manipulation on Unitree G1**
  Isaac Lab, PPO, VLM, RGB-D/LiDAR *Sep 2025 – Dec 2025*
  - Built a modular **perception–language–control** stack for a **29-DOF humanoid**, fusing **RGB-D**, **LiDAR**, and **IMU** data for 3D scene understanding.
  - Grounded open-vocabulary instructions in the scene with a **VLM** and tracked objects through occlusion with a **ReID** module, removing the need for large-scale demonstration data.
  - Achieved **sim-to-real transfer** on the physical robot by training a **PPO** policy in **Isaac Lab** with a two-phase reward that switches from navigation to manipulation.
  - Diagnosed **unmodeled contact dynamics** as the main cause of grasp failures, motivating **domain randomization** and **tactile feedback** as next steps.
- **SimpleRL – RL Algorithms from Scratch** [code]
  PyTorch, Gymnasium, MuJoCo *Jul 2025 – Aug 2025*
  - Implemented **9 RL algorithms** from their original papers, including **DQN**, **PPO**, **SAC**, **TD3**, and **DDPG**, as readable single-file code for **discrete and continuous control**.
  - Structured **value-based**, **policy-gradient**, and **actor-critic** methods uniformly, exposing training behavior that off-the-shelf libraries hide and simplifying comparison and debugging.
  - Trained and evaluated policies on **MuJoCo** and **Box2D** benchmarks, including **Ant**, **HalfCheetah**, **Hopper**, and **BipedalWalker**.
- **Jaffa-Sparrow – Tamil Language Model** [code]
  Distributed training, 2×A6000 *Jun 2024 – Oct 2024*
  - Pre-trained a **130M-parameter language model from scratch** for low-resource **Tamil** on mC4, news, books, and Wikipedia using **multi-GPU data parallelism**.
  - Fine-tuned the model for **multi-turn dialogue** with **supervised fine-tuning**, producing coherent Tamil responses on held-out prompts under constrained compute.
- **AiRRo – RAG-Based Search Engine** [code]
  React, Flask, nomic-embed, Llama *Jan 2026 – Mar 2026*
  - Built a **retrieval-augmented generation** search engine with a crawler-built **vector database**, **semantic embedding** retrieval, and streaming **LLM** answers.
  - Architected the embedding model, vector store, and LLM as **independently swappable components** behind a **REST API**, grounding answers in retrieved documents to reduce **hallucination**.

Teaching Experience

- **Teaching Assistant, ML-AI for Engineers** *Fall 2026*
  Support students in applying ML and AI methods to engineering problems through office hours and assignment feedback.
- **Teaching Assistant, ML-AI Project for Engineers** *Spring 2026*
  Mentored student teams on experiment design, model implementation, evaluation, and technical communication.
- **Teaching Assistant, Trustworthy AI** *Fall 2025*
  Guided students in applying robustness, uncertainty, fairness, and evaluation concepts to practical ML workflows.

Skills Summary

Languages	Python, C++, JavaScript	**Tools**	Docker, Git, PostgreSQL, SQLite
Frameworks	PyTorch, TensorFlow, Keras, ROS2, Flask	**Platforms**	Linux, Web, Raspberry Pi, AWS, GCP