

# Ninad Jadhav

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## Education

<b>Harvard University</b> <i>Ph.D. in Computer Science</i> , School of Engineering and Applied Sciences Thesis title: “Wireless signal directionality sensing on the edge for multi-robot systems” Thesis committee: Prof. Stephanie Gil, Prof. Robert J Wood, Prof. Swarun Kumar.	Cambridge, MA, USA Expected – Spring 2025
<b>Arizona State University</b> <i>M.S. in Computer Science</i> , Ira A. Fulton School of Engineering	Tempe, AZ, USA, 2019
<b>SRM Institute of Science and Technology</b> <i>B.Tech. in Computer Science and Engineering</i>	Chennai, TN, India, 2014

## Research Experience

<b>Harvard University</b> <i>Ph.D. Researcher in Computer Science</i> , School of Engineering and Applied Sciences	Cambridge, MA 2020 – present
<ul style="list-style-type: none"><li>• Advisor: Prof. Stephanie Gil</li><li>• Developed real-time WiFi-based signal directionality estimation capability for robots using onboard sensors and compute platforms, such as Raspberry Pi and UP Square board, leveraging MATLAB and C++.</li><li>• Development and theoretical analysis of algorithms to enable wireless signal directionality estimation by leveraging arbitrary 3D motion of a drone. Analyzed the impact of positional measurement errors from visual-inertial odometry (VIO) on directionality estimation.</li><li>• Designed and developed a battery-powered, waterproof drone payload with algorithm for real-time onboard very high frequency (VHF) signal directionality estimation using software-defined radio.</li><li>• Conducted field tests in the Caribbean Sea with VHF beacons used for marine wildlife tracking and demonstrated applicability with a reinforcement learning (RL) framework in simulation for rendezvous with underwater marine megafauna.</li><li>• Developed distributed algorithms for efficient exploration of unknown environments using a robot team under severe communication bandwidth constraints, utilizing heterogeneous sensing modalities such as LiDAR, Ultra-Wide Band, and WiFi, SLAM libraries such as Gmapping, RTAB-Map, and planners for navigation such as SBPL.</li><li>• Gained extensive hands-on experience building custom quadcopters, Pixhawk flight controllers, open-source firmware PX4 and ArduPilot, CAD, MAVSDK, interfacing with motion capture systems (Optitrack and Vicon), drone peripherals such as first-person-view, and enabling integration of computer vision algorithms required for autonomous deployment at sea.</li><li>• Performed extensive experimental validation using ROS-based SLAM and exploration algorithms on various customized ground robot platforms, including Turtlebot, ROSbot, LoCoBot, iRobot Create, and Leo Rover.</li></ul>	

<b>Project CETI</b> <i>Developing autonomous robot systems for sperm whale monitoring.</i>	Dominica 2023 – present
<ul style="list-style-type: none"><li>• Advisor: Prof. Stephanie Gil</li><li>• Gained experience in the design, development, and deployment of autonomous quadcopters with sensing payloads for tracking and the autonomous tagging of sperm whales in the Caribbean Sea.</li><li>• Conducted four scientific expeditions in Dominica, each spanning approximately 3 weeks, involving</li></ul>	

10 hours per day on a catamaran. Co-led two expeditions, managing day-to-day task planning and coordination with Project CETI's marine operations team.

- Gained experience in setting up and deploying autonomous drones with sensors to detect signals from VHF radio beacons, and underwater acoustic hydrophones at sea from a catamaran for real-time rendezvous with sperm whales during their surfacing periods.
- Collaborated with a multi-disciplinary team consisting of marine biologists and roboticist to develop novel solutions that leverage autonomous robots for scaling biological data collection and visual observations of sperm whales.
- Research published in *Science Robotics* and was covered by multiple outlets, including Harvard SEAS News, EurekaAlert, Yahoo, and Popular Science, among others.

#### **Arizona State University**

Tempe, AZ

*Graduate Researcher in Computer Science* Ira A. Fulton School of Engineering

2019 – 2020

- Advisor: Prof. Stephanie Gil
- Developed an active rendezvous approach using WiFi-based signal directionality sensing to minimize pose estimation errors during distributed mapping with a team of robots.

#### **Arizona State University**

Tempe, AZ

*M.S. in Computer Science*, Ira A. Fulton School of Engineering

2017 – 2019

- Developed a localization system using WiFi beacons for mobile ground robots under the supervision of Prof. Stephanie Gil.

### **Teaching and Mentoring**

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#### **Harvard University**

Cambridge, MA

*Undergraduate and Graduate mentor*

2023 – 2024

- Mentored an undergraduate student on their senior thesis “WiFi-Based Beaconless Human Rescue in Avalanche Disasters” which was featured in a project spotlight by Harvard’s School of Engineering and Applied Sciences.
- Supervised a visiting masters student from ETH Zurich for their thesis “Scalable Phase-Based VHF Tracking with Autonomous Drones: Distributed Data Collection and Multi-Tag Detection”.

#### **Harvard University**

Cambridge, MA

*Teaching Assistant*, Multi-Robot Systems: Control, Communication, and Security

Spring 2022

- Awarded the Certificate of Distinction in Teaching for the Spring 2022 by Harvard’s Office of Undergraduate Education; featured in Harvard Magazine.
- Co-designed and co-developed three mini-workshops to teach students the basics of mobile robot control, navigation, mapping, and sensing using ROS with LoCoBot and Turtlebot ground robot platforms equipped with various LiDAR, RGBD Camera, and VIO sensors.
- Integrated “WiFi-as-a-sensor” for signal directionality estimation into the coursework, enabling students to utilize it in their final projects.
- Designed and evaluated a search-and-rescue-themed final project for the class, guiding multiple student teams toward successful deployment on robot platforms.

#### **Arizona State University**

Tempe, AZ

*Teaching Assistant*, Introduction to Artificial Intelligence

Spring 2020

- Gained experience teaching both in-person and online formats.

#### **Arizona State University**

Tempe, AZ

*Teaching Assistant*, Coordination and Control of Multi-Robot Systems

Fall 2019

## Service

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### Reviewer

- Robotics and Automation Letters (RA-L)
- IEEE International Conference on Robotics and Automation (ICRA)
- IEEE International Conference on Intelligent Robots and Systems (IROS)
- Autonomous Robots (AuRo)

## Publications

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### Refereed journal publications

- [J1] **N. Jadhav**, Meghna Behari, R.J. Wood, and S. Gil, “WiSER-X: Wireless Signals-based Efficient Decentralized Multi-Robot Exploration without Explicit Information Exchange”, *In preparation*, [Preprint copy available here](#).
- [J2] **N. Jadhav\***, S. Bhattacharya\*, D. Vogt, Y. Aluma, P. Tonessen, A. Prabhakara, S. Kumar, S. Gero, R.J. Wood, and S. Gil, “Reinforcement learning-based framework for whale rendezvous via autonomous sensing robots”, *Science robotics*, 9 95, eadn7299, 2024.
- [J3] A. Maalouf, **N. Jadhav**, K. Jatavallabhula, M. Chahine, D. Vogt, R.J. Wood, A. Torralba, and D. Rus, “Follow Anything: Open-Set Detection, Tracking, and Following in Real-Time”, *IEEE Robotics and Automation Letters (RA-L)*, 9, 3283-3290, 2023.
- [J4] **N. Jadhav\***, W. Wang\*, D. Zhang, O. Khatib, S. Kumar, and S. Gil, “A wireless signal-based sensing framework for robotics”, *The International Journal of Robotics Research (IJRR)*, 41, 955 - 992, 2022.

### Refereed conference papers

- [C1] S. Bhattacharya\*, **N. Jadhav\***, H Izhar, K. Li, K. George, R. Wood, and S. Gil, “Real-Time Sperm Whale Rendezvous Using an Autonomous Drone and In Situ Sensing.”, *under review*, *Robotics Science and Systems (RSS)*, 2025.
- [C2] B. Dijkstra, **N. Jadhav**, A. Sloot, M. Marcantoni, B. Jayawardhana, S. Gil, and B. Haghighat, “WiFi-CSI Sensing and Bearing Estimation in Multi-Robot Systems: An Open-Source Simulation Framework.”, *40th Anniversary of the IEEE International Conference on Robotics and Automation (ICRA@40)*, 2024. Available: <https://arxiv.org/pdf/2410.01398>.
- [C3] **N. Jadhav**, W. Wang, D. Zhang, S. Kumar, and S. Gil, “Toolbox Release: A WiFi-Based Relative Bearing Framework for Robotics”, *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 13714-13721, 2022.
- [C4] M. Cavorsi, **N. Jadhav**, D. Saldaña, and S. Gil, S “Adaptive Malicious Robot Detection in Dynamic Topologies”, *IEEE 61st Conference on Decision and Control (CDC)*, 2236-2243, 2022.
- [C5] S. Krishnan, Z. Wan, K. Bhardwaj, **N. Jadhav**, A. Faust and V.J. Reddi, “Roofline Model for UAVs: A Bottleneck Analysis Tool for Onboard Compute Characterization of Autonomous Unmanned Aerial Vehicles”, *2022 IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS)*, 162-174, 2022.
- [C6] W. Wang, **N. Jadhav**, P.A. Vohs, N. Hughes, M. Mazumder, and S. Gil, “Active Rendezvous for Multi-Robot Pose Graph Optimization using Sensing over Wi-Fi”, *International Symposium of Robotics Research (ISRR)*, 832-849, 2019.

## References

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**Prof. Stephanie Gil**

Assistant Professor of Computer Science

School of Engineering and Applied Sciences (SEAS), Harvard University, Cambridge, MA, USA

[sgil@seas.harvard.edu](mailto:sgil@seas.harvard.edu)

**Prof. Robert J. Wood**

Harry Lewis and Marlyn McGrath Professor of Engineering and Applied Sciences

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**Prof. Swarun Kumar**

Sathaye Family Foundation Professor

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**Prof. Shane Gero**

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