

Yamini Shankar

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Research Summary

I am a Ph.D. scholar at SENSE Lab, IIT Madras. I am interested in investigating implications of Radio Frequency (RF) sensing on device battery, network performance, and privacy. My work focuses on adversarial use cases of wireless sensing and mitigation strategies for resource-constrained IoT devices. We explore efficient, privacy-preserving sensing frameworks and interference-aware designs for Integrated Sensing and Communication (ISAC).

Education

- 2022 – **Ph.D. in Computer Science**, IIT Madras, Chennai, Tamil Nadu.
- 2020 – 2022 **Master of Technology in Computer Science**, JNU, New Delhi.
- 2017 – 2020 **MCA**, Central University of Haryana.
- 2014 – 2017 **B.Sc. (Computer Science Hons.)**, St. Anthony's College, NEHU, Shillong.

Awards & Achievements

- Awarded as **Malathi Veeraraghavan (MV Fellowship) Scholar 2025**.
- Awarded travel grant for COMSNETS 2026.
- Selected for the **Samsung PrePARE Research Leadership Program**, a highly competitive national-level initiative aimed at grooming future research leaders.
- Awarded **"Star TA"** for exceptional teaching assistance in **CS3205** and **CS2300** at IIT Madras.
- Awarded **IEEE ComSoc Travel Grant** for IEEE ANTS 2024.
- Selected as the **State Representative (2 per state)** for the **UNDP National Youth Parliament**, chosen through an all-India competitive selection.
- **Rank 2 in MCA**, Central University of Haryana (CUH).
- **University Rank 4** in B.Sc. Computer Science (NEHU University), across all affiliated colleges.

Professional Research Experience

- Feb–Jul 2025 **Samsung Research Internship**, SRIB, Bangalore.
Designed a battery-oriented, coarse-grained Wi-Fi localization framework for smartphones. Worked on generalizing Wi-Fi sensing for multi-room setups, addressing robustness and scalability challenges. (2 papers: 1 published, 1 under review)

Academic Research Experience

- Aug **Ph.D. Research Experience**, IIT Madras, Chennai.
- 2022–Current **PhD Research Focus**: My doctoral research focuses on **RF-based sensing**, with an emphasis on **Wi-Fi sensing**, spanning three core directions: (i) **Power-efficient Wi-Fi localization** (published in *IEEE ANTS* and *COMSNETS*; journal under submission), (ii) **Network-efficient Wi-Fi sensing** (journal under minor revision; conference paper under review), and (iii) **Adversarial Wi-Fi sensing and defenses** (published in *IEEE ANTS*; additional conference paper under review).
- Dec **Master's Thesis**, JNU, New Delhi.
- 2020–June Developed optimization algorithms for computation offloading and service placement in Fog/Edge networks (1 journal publication).
- 2022

Jan **Research Internship**, MNNIT Allahabad, Prayagraj.
2020–June Hands-on expertise in network simulators and real systems.
2020

Publications

- [C4] **Yamini Shankar**, Aravindh Sriram and Ayon Chakraborty. Less is More: Improving WiFi Localization Accuracy with Fewer Scans, to appear in COMSNETS 2026.
- [C3] **Yamini Shankar**, Jayendra Reddy Kovvuri, Madhan Raj Kanagarathinam and Ayon Chakraborty. LiteTrack: Power-Efficient Wi-Fi-Based Indoor Localization for Smartphones, to appear in IEEE ANTS 2025.
- [C2] Snehadeep Gayen, **Yamini Shankar** and Ayon Chakraborty. Improving Network Resource Utilization for Distributed Wireless Sensing Applications, AIoT, ACM MobiHoc Workshops 2024.
- [C1] **Yamini Shankar** and Ayon Chakraborty. Practical Defense Against Adversarial WiFi Sensing, IEEE ANTS 2024.
- [J1] Dinesh Kumar, Gaurav Baranwal, **Yamini Shankar**, and Deo Prakash Vidyarthi. A survey on nature-inspired techniques for computation offloading and service placement in emerging edge technologies. World Wide Web, 2022.

In Submitted Stage

- [J2] **Yamini Shankar** and Ayon Chakraborty. AutoCompress: Improving Network Efficiency For Distributed Wireless Sensing Applications. *Under minor revision in Pervasive and Mobile Computing Journal (PMCJ)*.
- [C5] **Yamini Shankar** and Ayon Chakraborty. Unseen and Unheard: Minimal and Targeted Defense for Passive WiFi Inference.

Professional Contribution

- **Reviewer**: IEEE Wireless Communication Letters.
- **Teaching Assistant**:
 - **CS3205** : Introduction to Computer Networks(Awarded as Star TA)
 - **CS2300** : Foundations of Computer System Design (Awarded as Star TA)
 - **CS6120** : Wireless Communication and Networks
- **Volunteer** for ICDCN 2024 at IIT Madras, Chennai, where duties included handling all the guest registrations and managing ongoing events.
- **Institute Activities**:
 - Organizer of CSE Bits monthly event in the Department of CSE, IIT Madras- 2023.
 - Subject matter expert for GATE CS NPTEL- 2022(Operating Systems, Computer Networks)

Projects

- **Power Efficient WiFi Sensing**: WiFi-based indoor localization typically requires continuous scanning and dense measurements for accuracy, consuming more battery resource and making it impractical for resource-constrained mobile/IoT devices running background location services. Existing approaches treat scan frequency and AP selection independently, lacking unified optimization for deployment-time efficiency. Engineered two systems for power-aware positioning: LowFI - uses Sionna RT-based channel impulse response modeling, spatial CSI variance analysis for temporal fading prediction, and joint optimization of scan count (k^*) and AP subset (S^*) via Fisher score and correlation-based redundancy penalties; achieves nLoS error reduction from 8m to 2m with 7 scans. LiteTrack - implements motion-triggered scanning using pedometer integration, RMSE-based fingerprint matching against crowd-sourced database, and dynamic pseudo-labeling for unsupervised localization. Validated across 22 locations with 10+ Android devices and embedded platforms (ESP32, RPi), demonstrating 10-22 \times battery savings over continuous scanning while maintaining >80% classification accuracy.
- **Network Efficient WiFi Sensing**: Distributed WiFi sensing systems face severe scalability bottlenecks when multiple sensors stream high-dimensional Channel State Information (CSI) to edge devices. With just 5 nodes transmitting at 1000 packets/s, network throughput degrades by 77% due to CSMA-CA contention, causing latency spikes exceeding 30ms. Classical compression methods (PCA, uniform subsampling) ignore task relevance and cause 15-40% accuracy loss, while autoencoder approaches are too computationally expensive for

resource-constrained IoT devices. For this, we developed two-stage framework combining lightweight occupancy detection and SSPOC-based importance-guided compression. We achieved $>4000\times$ compression (0.26% data transmission) with 85% accuracy on 5-class real-world dataset, 35.5% throughput improvement, and $>90\%$ latency reduction.

- **Adversarial WiFi Sensing:** WiFi-based sensing systems leveraging Channel State Information (CSI) are vulnerable to adversarial attacks where malicious eavesdroppers can infer sensitive contextual information (activity recognition, localization) by observing RF signatures. Existing defense mechanisms use white-box approaches (FGSM, PGDM) requiring full access to attacker's model internals (weights, gradients, architecture)—an impractical assumption in real-world scenarios. Moreover, these methods ignore the critical impact of CSI perturbations on communication quality, potentially causing MCS (Modulation and Coding Scheme) degradation and throughput loss without considering SNR preservation. For this, we formulated black-box defense as constrained optimization balancing SNR preservation across OFDM subcarriers) with adversarial misclassification using Cross-Entropy loss-no model internals required. The perturbations are injected post-IFFT at transmitter. Validated on ESP32 testbed (100 locations, 64 subcarriers, 3000 samples/location): degraded adversarial localization accuracy from 98% to 17% while maintaining 1.8dB median SNR difference and 7m localization error. First to address SNR-communication tradeoffs in ISAC security.

Relevant courses done during Ph.D.

- Linear Algebra
- Wireless Communication and Networks
- Pattern Recognition and Machine Learning
- Smart Sensing for Internet of Things
- Communication Networks for IoT
- Introduction to Research

Faculty References

- Dr. Ayon Chakraborty(Ph.D. Supervisor), email: ayon@cse.iitm.ac.in
- Dr. Mukulika Maity, email: mukulika@cse.iitm.ac.in