Akarsh Prabhakara

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Website · Google Scholar · GitHub · LinkedIn

Interests

Sensing Systems, Signal Processing, Machine Learning, Radio Frequency Embedded Systems

Education

Carnegie Mellon University *2018 - 2023*

Ph.D. in Electrical and Computer Engineering — GPA: 3.9/4.0

Advisors: Prof. Anthony Rowe and Prof. Swarun Kumar

Committee Members: Prof. Aswin Sankaranarayanan and Prof. Mani Srivastava

Thesis: Pushing the limits of high resolution imaging with small form-factor mmWave radar

National Institute of Technology Karnataka *2014 - 2018*

B.Tech. in Electronics and Communication Engineering — GPA: 9.6/10.0

Professional Experiences

Carnegie Mellon University *Aug 2018 - May 2023*

Graduate Research Assistant at WiSE Lab and WiTech Lab

I am passionate about sensing systems. In my graduate research, I work on wireless sensing, that is, how wireless signals can help in sensing everyday objects better and provide new design operating points for classical sensing problems such as high resolution imaging, depth estimation, localization and robot navigation. My focus is on wireless sensing using **millimeter waves** which is at a sweet spot between low-frequency radio waves and high-frequency visible/infrared light. This brings in both pros and cons from these extreme frequency sensing worlds and presents opportunities and challenges to applications leveraging millimeter waves. My solutions tackle these challenges with new hardware and processing techniques and demonstrate new millimeter wave sensing capabilities with end-to-end system implementations. Read more here.

Zendar, Berkeley *May 2022 - Aug 2022*

Research Intern with Dr. Darsh Ranjan

I developed algorithms to tackle high-resolution sensing problems with automotive radar.

Optum, Pittsburgh *May 2021 - Aug 2021*

Corporate Startup Lab Fellow with Danita Kiser

I helped answer questions about large scale wireless connectivity technologies and build an actionable plan to bridge the urban/rural divide in accessing digital health solutions.

Texas Instruments, Dallas *May 2019 - Aug 2019*

Research Intern at Kilby Labs with Xiaolin Lu

I tackled the problem of wireless channel congestion and interference in IEEE 802.15.4 networks deployed in large industrial Internet of Things scenarios by devising machine learning pipelines that can predict the channel congestion ahead of time.

Microsoft Research, Bangalore *Aug 2017 - Dec 2017*

Research Intern with Dr. Harsha Simhadri

I built a real-time wake word detection pipeline to detect keywords like "Hey Cortana!" on extremely tiny, resource constrained IoT devices.

University of Lübeck, Germany *May 2017 - July 2017*

Research Intern with Dr. Alfred Mertins

I developed machine learning techniques to solve an audio processing problem of room impulse response interpolation.

Indian Institute of Science, Bangalore *May 2016 - July 2016*

Research Intern with Dr. GV Anand

I worked on fundamental signal processing estimation algorithms to determine direction of arrival of underwater acoustic signals in challenging noisy environments.

Research

Being a systems researcher, I enjoy leading large teams and collaborating with cross-university academics from diverse areas like circuits and theory, and researchers from various industries like semiconductors and transportation. My research, developed from working with these inter-disciplinary teams, has been published in major ACM/IEEE conferences - robotic venues such as IROS and sensing systems venues such as MobiCom, MobiSys and Ubicomp, as listed subsequently.

Highlighted Conference Publications

High Resolution Point Clouds from mmWave Radar.
A Prabhakara, T Jin, A Das, G Bhatt, L Kumari, E Soltanaghai, J Bilmes, S Kumar, A Rowe.
Under Submission

Exploring mmWave Radar and Camera Fusion for High-Resolution and Long-Range Depth Imaging.
A Prabhakara, D Zhang*, C Li, S Munir, A Sankaranarayanan, A Rowe, S Kumar.*
IEEE/RSJ IROS. 2022.

Millimetro: mmWave Retro-Reflective Tags for Accurate, Long Range Localization.
E Soltanaghaei, A Prabhakara*, A Balanuta*, M Anderson, J Rabaey, S Kumar, A Rowe.*
ACM MobiCom. 2021.

Osprey: A mmWave Approach to Tire Wear Sensing.
A Prabhakara, V Singh, S Kumar, A Rowe.
ACM MobiSys. 2020.
Best Paper Honorable Mention, ACM GetMobile Research Highlight
Press: Gizmodo, Hackster.io, TedX Innovation Expo and That's Cool News Podcast.

Other Conference Publications

Long-range Sub-mm Displacement Sensing with Passive mmWave Backscatter Tags.
T King, A Prabhakara, C Yao, M Alipour, S Kumar, A Rowe, E Soltanaghai.
Under Submission

Zoom Out: Abstractions for Efficient Radar Algorithms on COTS architecture.
TM Low, Y Chi, J Hoe, S Kumar, A Prabhakara, L Shi, U Sridhar, N Tukanov, C Wang, Y Wu.
IEEE ARRAY. 2022.

A Community-Driven Approach to Democratize Access to Satellite Ground Stations.
V Singh, A Prabhakara, D Zhang, O Yağan, S Kumar.
ACM MobiCom. 2021.
ACM GetMobile Research Highlight

TagFi: Locating an Ultra-Low Power Tag Using Existing WiFi Infrastructure.
E Soltanaghaei, A Dongare, A Prabhakara, S Kumar, A Rowe, K Whitehouse.
Ubicomp. 2021.

Underwater Acoustic Source Localization by Vector Sensor Array using Compressive Sampling.
PV Nagesha, GV Anand, S Gurugopinath, A Prabhakara.
MTS/IEEE Oceans. 2016.

Posters, Demos, Magazines

Long-range Accurate Ranging of Millimeter-wave Retro-reflective Tags in High Mobility.
TH King, E Soltanaghai, A Prabhakara, A Balanuta, S Kumar, A Rowe.
ACM MobiCom Demo. 2021.

A Community-Driven Approach to Democratize Access to Satellite Ground Stations.
V Singh, A Prabhakara, D Zhang, O Yağan, S Kumar.
ACM GetMobile Magazine. Mar 2022.

OSPREY: A mmWave Approach to Tire Wear Sensing.
A Prabhakara, V Singh, S Kumar, A Rowe.
ACM GetMobile Magazine. Dec 2020.

Osprey Demo: A mmWave Approach to Tire Wear Sensing.
A Prabhakara, V Singh, S Kumar, A Rowe.
ACM MobiSys Demo. 2020.
Best Demo

* - coprimary authors

Patents

Methods, Systems And Low Power Retrodirective RF Tags for Localization.
E Soltanaghaei, A Rowe, S Kumar, A Prabhakara, A Balanuta
US 2022/0244374A1

Tire Sensing Systems and Methods.
A Prabhakara, V Singh, S Kumar, A Rowe, T Wei, H Dorfi
WO 2021/231381

Engineering Team Competitions

DARPA Subterranean Challenge
As part of the CMU team, I performed initial experimentation on wireless mesh networking for consistent communication among robots, access points and base station in mines and caves.

IEEE Signal Processing Cup 2017
We built a real-time beat tracking algorithm running on an embedded device reacting to a variety of music signals. Check out our trippy visualizations here!.

IEEE Signal Processing Cup 2016
We developed a solution to extract power signal leaking into recorded audio signals and geolocate the power grid where audio was recorded. We finished top 15 in the world!

Teaching

As a graduate teaching assistant at CMU, I have developed course material, given lectures and recitations, and worked with students through homework assignments.

- Wireless Communication — Fall 2021
- Computer Networks — Spring 2020

Other Positions of Responsibility

- As the treasurer of CMU ECE Graduate Student Organization for 2020-2022, I was responsible for financial planning, budgeting and expense reporting for the organization's activities.
- Through CMU ECE Outreach program, I developed classes and conducted hardware building sessions to get high school students excited about basic electronics.
- I managed several projects, conducted talks, workshops and technical fests as the joint-secretary of IEEE Chapter at NITK.

Awards

- ACM GetMobile Research Highlight for Quasar — 2022
- Corporate Startup Lab Fellowship — Summer 2021
- ACM GetMobile Research Highlight for Osprey — 2021
- CMU ECE Department Award for Exemplary Qualifying Exam Performance — Spring 2020
- Best Paper Honorable Mention, ACM MobiSys — 2020
- Best Demo, ACM MobiSys — 2020
- Carnegie Institute of Technology Dean's Fellowship — 2018-2019
- DAAD WISE Fellowship — 2017
- Indian Academy of Sciences' Summer Research Fellowship — 2016
- Final Fifteen of the IEEE Signal Processing Cup — 2016
- Best Outgoing Student Award — 2014 and 2012

Tools Used

Hardware		Software	
• RF Circuits Simulation	Ansys HFSS	• Programming Languages	C · C++ · Python · Matlab
• PCB Design	Eagle	• Distributed and Parallel API	OpenMP · MPI
• Radios	mmWave radars (TI & Infineon) · Ettus USRP · IoT LoRa pHAT	• ML Frameworks	PyTorch · Tensorflow · Keras
• Cameras	FLIR · Optitrack · Intel T265	• Miscellaneous	ROS · PCL · MQTT · Docker · Cartographer
• Lidars	Ouster · Velodyne		