Akarsh Prabhakara

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Website : akarsh-prabhakara.github.io

Research

I am a wireless and cyber-physical systems researcher that builds **compact wireless systems with high quality sensing capabilities**. I achieve this by developing new hardware, leveraging machine learning and novel signal processing, and balancing system constraints on communication and sensing computation. I build end-to-end systems with transformative implications spanning cyber-physical systems, wireless communication and robotics.

Interests

Research: Cyber-Physical-Systems, Radio Frequency Sensing Systems, Next Gen Wireless Systems
Application Themes: Automotive, Robotics, Critical Infrastructure Monitoring
Core: Wireless Systems, Signal Processing, Embedded Systems, Computer Networks

Education

Carnegie Mellon University *2018 - 2024*
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

National Institute of Technology Karnataka *2014 - 2018*
B.Tech. in Electronics and Communication Engineering — GPA: 9.6/10.0

Professional Experiences

Zendar, Berkeley *May 2022 - Aug 2022*
Research Intern with Dr. Darsh Ranjan

Optum, Pittsburgh *May 2021 - Aug 2021*
Corporate Startup Lab Fellow with Danita Kiser

Texas Instruments, Dallas *May 2019 - Aug 2019*
Research Intern at Kilby Labs with Xiaolin Lu

Microsoft Research, Bangalore *Aug 2017 - Dec 2017*
Research Intern with Dr. Harsha Simhadri

University of Lübeck, Germany *May 2017 - July 2017*
Research Intern with Dr. Alfred Mertins

Indian Institute of Science, Bangalore *May 2016 - July 2016*
Research Intern with Dr. GV Anand

Awards

- Best Presentation Runner Up, Ph.D. Forum ACM/IEEE IPSN 2023
- Best Demo Runner Up, ACM/IEEE IPSN 2023
- Top 5 Best Demos, ACM MobiCom 2023
- Trailblazer Alumni - Kumarans Educational Council 2022
- ACM GetMobile Research Highlight for Quasar 2022
- Corporate Startup Lab Fellowship 2021
- ACM GetMobile Research Highlight for Osprey 2021
- CMU ECE Department Award for Exemplary Qualifying Exam Performance 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

Conference Publications (Peer Reviewed)

CAMIO: Millimeter Wave Imaging from a Single Antenna
A Prabhakara, Y Liu, A Rowe, A Sankaranarayanan, S Kumar.
In Preparation.

DART: Implicit Doppler Tomography for Radar Novel View Synthesis.
J Miller, T Huang*, A Prabhakara, T Jin, T Laroia, Z Kolter, A Rowe.*
In Submission to IEEE/CVF CVPR 2024.

Towards Programmable Wireless Coverage Using Soft Robotic Inflatable Surfaces.
Y Liu, J Zhu, A Prabhakara, S Kumar.
In Submission to USENIX NSDI 2024.

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.
IEEE ICRA 2023.

Platypus: Sub-mm μ-Displacement Sensing with Passive mmWave Tags As Phase Carriers.
T King, J. He, C. Yao, A Prabhakara, M Alipour, S Kumar, A Rowe, E Soltanaghai.
ACM/IEEE IPSN 2023.

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.

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.

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.

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

Symposiums (Peer Reviewed)

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 Phased Array Systems and Technology (PAST) 2022.

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Posters, Demos, Magazines (Peer Reviewed)

RadarHD: Demonstrating Lidar-like Point Clouds from mmWave Radar.
A Prabhakara, T Jin, A Das, G Bhatt, L Kumari, E Soltanaghai, J Bilmes, S Kumar, A Rowe.
ACM MobiCom Demo 2023.
Top 5 Best Demos

Pushing the Limits of High Resolution Sensing with Single-Chip mmWave Radar.
A Prabhakara.
ACM/IEEE IPSN Ph.D. Forum 2023.
Best Presentation Runner Up

Demo Abstract: Platypus: Sub-mm μ-Displacement Sensing with Passive mmWave Tags As Phase Carriers.
J. He, T King, C. Yao, A Prabhakara, M Alipour, S Kumar, A Rowe, E Soltanaghai..
ACM/IEEE IPSN Demo 2023.
Best Demo Runner Up

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.

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.

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

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

Research Talks

- ICRA 2023 — 2023
  High resolution point clouds from mmWave radar
- IPSN 2023 Ph.D. Forum — 2023
  Pushing the limits of high resolution sensing with single-chip mmWave radar
- Microsoft Research India — 2022
  Pushing the limits of high resolution sensing with single-chip mmWave radar
- IROS 2022 — 2022
  Exploring mmWave radar and camera fusion for high-resolution and long-range depth imaging
- DARPA/SRC CONIX Annual Review — 2022
  RF Sensing: CONIX and beyond ...
- TedX CMU Innovation Expo — 2021
- MobiSys 2020 — 2020
  Osprey: A mmWave approach to tire wear sensing
- DARPA/SRC CONIX Student Seminar — 2020
  Osprey: A mmWave approach to tire wear sensing

Press Articles

- Pioneering Minds
  "Low Power, High Accuracy Tag That Can Improve Autonomous Driving"
- That's Cool News Podcast
  "Osprey: Utilizing mmWaves to Sense Vehicle Tire Wear and Tear — Akarsh Prabhakara"
- Hackster.io
  "Researchers Develop System That Monitors Tire Wear in Real-Time"
- Gizmodo
  "Researchers Find That Radar Can Be Used to Detect a Nail in a Tire Long Before It Goes Flat"
- Weibold
  "Radar to monitor tire wear developed by American engineers"
- Wonderful Engineering
  "This Radar Based Device Can Detect Tire Punctures Along With Wear And Tear"
- Interesting Engineering
  "Radar Can Be Used to Detect Tire Wear and Tear, Nail Punctures"
- Tyrepress.com
  "Measuring tyre wear with on-car radar"

Engineering Team Competitions

DARPA Subterranean Challenge 2019
As part of the winning 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!

Research Mentoring

- John Martins (CMU UG) 2023
- Priyadarshini Kulkarni (CMU Masters) 2022
- Tao Jin (CMU Masters → CMU Ph.D.) 2021-2022
- Chao Li (CMU UG → MIT Ph.D.) 2021-2022
- Thomas Horton King (CMU UG → Stanford Ph.D.) 2020-2021

Teaching

- Graduate Teaching Assistant at CMU: Developed course material, gave lectures, and worked with students through assignments.
  - Wireless Communication Fall 2021
  - Computer Networks Spring 2020
- Guest Lectures
  - Intro to Computer Systems, CMU ECE Spring 2023
  - Advanced Topics in Communication, UW EE Spring 2023

Peer Reviewing

- 2024: IEEE ICRA
- 2023: Transactions on Networking (ToN), Intelligent Vehicles (TIV), Sensor Networks (ToSN)
- 2022: IMWUT, Transactions on Sensor Networks (ToSN)
- 2021: Shadow Program Committee ACM Compass

Organization and Leadership

- Co-chair S3 workshop at ACM MobiCom 2023
- Member of CMU ECE student council for faculty candidate interviews 2023
- Treasurer of CMU ECE Graduate Student Organization 2019-2022
- Joint-Secretary of IEEE Chapter at NITK 2017-2018

Societal Outreach

- Mentored 5 Masters and early Ph.D. students as part of CMU ECE's Peer Mentor Program organized by the Diversity, Inclusion and Outreach Committee.
- Worked with Optum Inc. about large scale wireless connectivity technologies and built an actionable plan to bridge the urban/rural divide in accessing digital health solutions.
- Developer and Instructor at CMU ECE Outreach program. I developed lab sessions and organized hardware building for middle and high school students in the Pittsburgh region.