Kartik Patel

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Interests

Wireless networks: MmWave networks, Cellular and adhoc networks, System design and Hardware-based prototyping
Learning: Bandits, Online learning, Reinforcement learning, Deep learning

Education

Ph.D., Electrical and Computer Engineering — **The University of Texas at Austin**
Advisors: Robert W. Heath Jr., Sanjay Shakkottai — *August 2017 - May 2024*
Thesis: *Enhancing Next Generation Networks with Security, Sensing and Management*

M.S., Electrical and Computer Engineering — **The University of Texas at Austin**
GPA: 4.00/4.00 — *August 2017 - May 2020*

B. Tech., Electronics and Communication Engineering — **Indian Institute of Technology Roorkee**
GPA: 9.25/10, Class Rank: 2^{nd} — *July 2013 - May 2017*

Professional Experience

Postdoctoral Researcher, Nokia Bell Labs, New Jersey
Deployment Planning for a Large-scale Bi-static Backscatter Network — *June 2024-Present*

Communication Systems Intern, Nokia Bell Labs, New Jersey
Scalability Analysis of a Bi-static Backscatter Network — *June-August 2022*

Research Intern, Qualcomm Wireless R&D, San Diego
On MmWave Beam Tracking Algorithm — *June-August 2020*

Research Intern, Cisco Innovation Lab, San Jose
Device Identification based on RF Fingerprints from Raw IQ Signals — *May-August 2019*

Student Developer, GNU Radio, Google Summer of Code 2017
Design of a Web-based Display for GNU Radio — *May-August 2017*

Project Assistant, Indian Institute of Science, Bengaluru
Energy Harvesting Wireless Sensor Network design with Bluetooth Low Energy protocol — *May-July 2016*

Publications

- **K. Patel**, J. Zhang, I. Kiminos, L. Kampianakis, M. Eggleston, and J. Du, "Analyzing scalability of bi-static backscatter networks for large-scale applications," *Submitted to IEEE Journal on Radio Frequency Identification*, June 2024
- **K. Patel**, C. Ge, A. Mahimkar, S. Shakkottai, and Y. Shaqalle, "CIPAT: Latent-resilient toolkit for performance impact prediction due to configuration tuning," in *Proceedings of the 1st ACM Workshop on Machine Learning for NextG Networks (with ACM Mobicom 2024)*, November 2024
- **K. Patel**, C. Ge, A. Mahimkar, S. Shakkottai, and Y. Shaqalle, "Predicting the performance of cellular networks: A latent-resilient approach," in *Proceedings of the 30th ACM Annual International Conference on Mobile Computing and Networking (Mobicom)*, November 2024
- **K. Patel** and R. W. Heath Jr., "Harnessing multimodal sensing for multi-user beamforming in mmWave systems," *To appear in IEEE Transactions on Wireless Communication*, October 2024
- **K. Patel**, J. Zhang, I. Kiminos, L. Kampianakis, M. Eggleston, and J. Du, "Evaluating scalability of a large-scale bi-static backscatter network," *IEEE RFID Conference (Poster)*, June 2024
- V. Shah and **K. Patel**, "Generative AI: Challenges and opportunities in the context of India," *Workshop on Ethical Considerations in Creative Applications of Computer Vision (with CVPR 2023)*, June 2023
- **K. Patel**, N. J. Myers, and R. W. Heath Jr., "Circulant shift-based beamforming for secure communication with low-resolution phased arrays," *IEEE Transactions on Wireless Communications*, vol. 22, no. 4, pp. 2295–2310, 2023
- I. Tariq, **K. Patel**, T. Novlan, S. Akoum, M. Majmundar, G. de Veciana, and S. Shakkottai, "Bandit learning-based online user clustering and selection for cellular networks," in *In Proceedings of IEEE 20th International Symposium on Modeling and Optimization in Mobile, Ad hoc, and Wireless Networks (WiOpt)*, September 2022

- **K. Patel**, N. J. Myers, and R. W. Heath Jr., "Physical layer defense against eavesdropping attacks on low-resolution phased arrays," in *2022 IEEE International Conference on Communications (ICC)*, May 2022, pp. 492–497
- Y. Zhang, **K. Patel**, S. Shakkottai, and R. W. Heath Jr., "Side-information-aided noncoherent beam alignment design for millimeter wave systems," in *20th ACM International Symposium on Mobile Ad Hoc Networking and Computing (Mobihoc)*, July 2019, pp. 341–350 **(Best Paper Finalist)**
- **K. Patel**, D. Patel, M. López-Benítez, and S. Chaudhary, "Distribution-free spectrum sensing for full duplex cognitive radio," in *2018 IEEE 88th Vehicular Technology Conference (VTC-Fall)*, August 2018, pp. 1–5

Research Talks

- On "CIPAT: A two-stage configuration impact prediction analysis toolkit for cellular networks" (poster) in the 4th 6G@UT Forum at the University of Texas at Austin, April 2024.
- On "Harnessing multimodal sensing for multi-user beamforming in mmWave systems" (poster) in the 3rd 6G@UT Forum at the University of Texas at Austin, November 2023.
- On "Physical Layer Security with Low-resolution MmWave Phased Arrays" in Sabarmati Young Researchers Seminar at IIT Gandhinagar, Gujarat, September 2023.
- On "Bandit learning-based online user clustering and selection for cellular network" (poster) in IEEE ComSoc Summer School on 6G Communication and Wireless Technologies at Northeastern University, Boston, June 2023.
- On "Predicting the Performance Impact of Configuration Changes in LTE and 5G Neteworks" at AT&T ML-based Operations Seminar, New Jersey, April 2023.
- On "Physical Layer Security with Low-resolution MmWave Phased Arrays" in the intern research seminar at Nokia Bell Labs, Murray Hill, NJ, July 2022.
- On "Bandit learning-based online user clustering and selection for cellular network" (poster) in the 2nd 6G@UT Forum at the University of Texas at Austin, May 2022, with Isfar Tariq.
- On "Side-Information-Aided Noncoherent Beam Alignment Design for Millimeter Wave Systems" (poster) in the Texas Wireless Summit 2019 at the University of Texas at Austin, November 2019, with Yi Zhang.

Selected Projects

Predicting the Performance Impact of Configuration Changes in LTE and 5G Cellular Networks
Collaborators: C. Ge, S. Shakkottai, and A. Mahimkar, Y. Shaqalle from AT&T, New Jersey

- Developed a two-stage framework to predict the performance impact of configuration changes in the cellular networks purely from the dataset.
- Conducted the first real-world empirical causal study of a cellular network without requiring any assumptions on the underlying latents.

Physical Layer Security with Low-resolution MmWave Phased Arrays [Project Page]
Collaborators: N. J. Myers, R. W. Heath Jr.

- Proposed a physical layer defense using the circulant shifting of a beamformer on low-resolution phased arrays.
- Validated proposed defense using a fully configurable 60 GHz mmWave testbed.
- Designed an attack *AirSpy* on a V2I system using an aerial eavesdropper.

User Clustering and Selection in Cellular Network
Collaborators: I. Tariq, S. Shakkottai, and T. Novlan, S. Akoum, M. Majumndar from AT&T Labs

- Proposed a Bandit learning-based theoretically-provable approach to user clustering based on the similarity in channel distribution and the associated rate regions.
- Designed a heuristic-based approach to an online user selection to optimize the network throughput.

Side-information-aided Noncoherent Beam Alignment Design and Prototyping [Project Page]
Collaborators: Yi Zhang, S. Shakkottai, R. W. Heath Jr.

- Designed a side-information-aided channel estimation algorithm using non-coherent measurements.
- Prototyped a fully configurable 60 GHz mmWave testbed with custom phased arrays, USRP, and MATLAB.

Energy Harvesting Wireless Sensor Network design with Bluetooth Low Energy protocol
Supervisors: Neelesh Mehta, Professor, Indian Institute of Science *May - July 2016*

- Worked on designing a sensor network for a specific scenario using a Bluetooth Low Energy (BLE) protocol.
- Developed a BLE protocol module on NS3 [Documentation].

Web-based display for GNURadio - `gr-bokehgui`
GNU Radio, Google Summer of Code 2017 *May - August 2017*

- Implemented the functionality that allows remote web-based interaction with flowgraphs using Bokeh.
- Integrated with GNU Radio companion for convenient use.

Teaching Experience

- *Probability and Stochastic Processes I* by Prof. Gustavo de Veciana at UT Austin, Fall 2018, Eval. 4.6/5
- *Digital Logic Design* by Dr. Brijesh Kumar at IIT Roorkee, Spring 2017.

Awards

- Selected for IEEE ComSoc Summer School 2023 at Northeastern University, Boston with a full scholarship.
- Finalist for the best paper award in ACM MobiHoc 2019.
- Student travel grant for attending ACM MobiHoc 2019.
- Department Rank 2 among 76 students in ECE Department, IIT Roorkee.
- Won *IIT Roorkee Heritage Excellence Award* for two consecutive years.
- Ranked in the top 1% students of the country in JEE-Advance 2013.

Computer Skills

Programming Languages: C, C++, Python, Java **Softwares**: MATLAB, GNU Radio, NS3, CMake

Relevant Courses

Communication and Networks: Space-Time Communication, Wireless Communications Laboratory, Analysis and Design of Communication Network, Wireless Networks, Coding Theory, Advance Digital Communications

Machine Learning and Probability: Online Learning, Reinforcement Learning, Large Scale Optimization, Advanced Probability: Inference and Networks, Special Topics on Unsupervised Learning, Probability and Stochastic Processes

Service

Reviewer: IEEE Open Journal of Communications Society; IEEE Transactions on Wireless Communications; IEEE Transactions on Signal Processing; IEEE Wireless Communications Letters; IEEE ICC, Globecom 2023; IEEE PIMRC, Globecom 2022; IEEE VTC-Spring 2020

Committees: Departmental UG-Curriculum Revision Committee (as an alumni member), Dept. of Elec. and Commun. Engineering, IIT Roorkee, 2020; Department Student Committee, Dept. of Elec. and Commun. Engineering, IIT Roorkee, 2015-17.

Volunteer: IEEE WCNC 2022, Austin; 6G@UT 2021, 2022; Texas Wireless Summit 2017-19; IEEE SPCOM 2016, Bengaluru

Extra Curriculars

Student Chair
IEEE Student Chapter, IIT Roorkee *2014-2017*

Chief Technical Lead, Information Management Group
Institute Computer Center, IIT Roorkee *2014-2017*

Mentor, Academic Reinforcement and Mentorship Program
Dean of Student Welfare, IIT Roorkee *2015-2017*