

# Kartik Patel

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## Interests

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**Wireless networks:** MmWave networks, Cellular and adhoc networks, System design and Hardware-based prototyping

**Learning:** Bandits, Online learning, Reinforcement learning, Deep learning

## Education

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**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<sup>nd</sup>*

*July 2013 - May 2017*

## Publications

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- J. Andrews, K. Patel, E. Tekgul, and S. Shakkottai, "The power of ML-aided base station parameter optimization in 5G and 6G cellular networks," *Preparing for submission to IEEE Communication Magazine*
- K. Patel, J. Zhang, I. Kiminos, L. Kampionakis, M. Eggleston, and J. Du, "Analyzing scalability of bi-static backscatter networks for large-scale applications," *Submitted to IEEE RFID*, 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 (ACM MLNextG '24)*, ser. ACM MLNextG '24. New York, NY, USA: ACM, 2024
- —, "Predicting the performance of cellular networks: A latent-resilient approach," in *Proceedings of the 30th Annual International Conference on Mobile Computing and Networking*. New York, NY, USA: ACM, 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. Kampionakis, 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)*, 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)*, 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)*, 2018, pp. 1–5

## Industry Experience

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**Postdoctoral Researcher, Nokia Bell Labs, New Jersey**

*Design and Prototyping of a Large-scale Bi-static Backscatter Network*

*June 2024-Present*

**Communication Systems Intern, Nokia Bell Labs, New Jersey**

*MAC Layer Design of a Large-scale 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*

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**Research Talks**

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- 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 Networks" 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.

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**Selected Projects**

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**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

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- *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

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- 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

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

## Relevant Courses

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**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

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**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

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### Student Chair

*IEEE Student Chapter, IIT Roorkee*

2014-2017

- Coordinated Special Interest Groups, workshops, guest lectures and internship programs for undergraduate students.
- Initiated a Sixth Sense Lecture Series to explain fundamental concepts like information theory, transforms and linear algebra in intuitive manner.

### Chief Technical Lead, Information Management Group

*Institute Computer Center, IIT Roorkee*

2014-2017

- Maintained the full stack of institute's intranet and internet services and data centers.
- Initiated fundamental changes in server workflows based on network traffic to optimize the use of servers and reduce the communication between servers and databases.

### Mentor, Academic Reinforcement and Mentorship Program

*Dean of Student Welfare, IIT Roorkee*

2015-2017

- Conducted weekly tutorials for department freshmen to provide additional academic support.
- Mentored a group of students to aid the transition into the institute.