MOHAMMAD TAHA SHAH

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ABOUT ME

I recently completed my Ph.D. at IIT Delhi under the supervision of Prof. Gourab Ghatak. My research focuses on stochastic geometry based modeling and performance analysis of wireless networks, with a particular emphasis on radar enabled vehicular systems. My doctoral thesis introduces novel Line Cox process models for spatial network analysis and develops analytical tools to evaluate interference, detection performance, and reliability. I earned my master's degree from IIIT Delhi, where my industry-sponsored thesis focused on 5G PHY algorithms, particularly Initial Access and PRACH detection based on 3GPP standards. In addition to my ongoing work, I am actively pursuing research in Sharpe ratio optimization and information theoretic regret bounds for risk aware decision-making in online learning and multi-armed bandits. This combination of statistical modeling and learning theory enables me to tackle problems that require both rigorous mathematical analysis and adaptive algorithm design. My broader research interests include wireless communication systems, ISAC, sequential decision making, and risk-sensitive learning algorithms. I aim to bridge the gap between theoretical foundations and practical system design, contributing to the development of next-generation communication networks.

EDUCATION

Doctor of Philosophy	Aug. 2021 – July 2025
Indian Institute of Technology Delhi (IITD)	*CGPA: 8*	New Delhi, India
Master of Technology (ECE)	*Communication and Signal Processing*	July. 2019 – July 2021
Indraprastha Institute of Information Technology Delhi (IIITD)	*CGPA: 9.12*	New Delhi, India
Bachelor of Technology	*Electronics and Communication*	Sept. 2012 – March 2017
University of Kashmir	*78.3 %*	Srinagar, JK

PH.D. THESIS

Modeling and Statistical Analysis of Automotive Radar Networks Using Line Cox Processes

Supervisor: Prof. Gourab Ghatak   IIT Delhi

The rapid evolution of wireless and automotive radar systems demands more realistic spatial models. This thesis introduces the Binmoial Line Process (BLP) and its associated Cox process , the BLCP , to better capture urban and suburban network environments. Unlike classical models like the PLP and PLCP , which assume uniform street layouts, the BLP accounts for varying street densities, finite street lengths, and spatial heterogeneity. We derive key spatial metrics and validate the model using real-world data via the OSMnx tool. The BLCP is used to analyze wireless network performance, including transmission success probability and SINR meta distribution. In radar applications, we evaluate detection probability under varying conditions and propose optimization frameworks to enhance system reliability. These contributions offer actionable insights for designing robust communication and vehicular systems in complex urban environments.

WORK EXPERIENCE

Intern - 5G Wireless Engineering	Aug. 2020 – June 2021
VVDN Technologies	Noida, India
Research and Development on 5G PHY.	

- 5G NR PRACH Configuration and Detection • 5G NR CSI Generation, Configuration and Measurement
- MIMO-OFDM NR Channel Estimation and Timing Offset Correction • 5G NR Phase Compensation
- 5G NR Frequency Offset Correction • FlexRAN Algorithms • LTE PRACH — PUSCH LoPHY Processing

PUBLICATIONS

Journal

- **Shah, Mohammad Taha**, Gourab Ghatak, Souradip Sanyal, and Martin Haenggi. "Binomial Line Cox Processes: Statistical Characterization and Applications in Wireless Network Analysis." IEEE Transactions on Wireless Communications. 2024 Jun 7., *link*

- **Shah, Mohammad Taha**, Gourab Ghatak, and Shobha Sundar Ram. "Fine-Grained Analysis and Optimization of Large Scale Automotive Radar Networks". IEEE Transactions on Signal Processing. 2025 July 10., *link*

- **Shah, Mohammad Taha**, Gourab Ghatak, Ankit Kumar, and Shobha Sundar Ram. "Modeling and Statistical Characterization of Large-Scale Automotive Radar Networks". (Under review at IEEE TSP), *arXiv Preprint*

Conference

- **Shah, Mohammad Taha**, Gourab Ghatak, Souradip Sanyal, and Martin Haenggi. "Analyzing Wireless Networks Using Binomial Line Cox Processes." In 2023 21st International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt), pp. 1-8. IEEE, 2023., *link*

- **Shah, Mohammad Taha**, Ankit Kumar, Gourab Ghatak, and Shobha Sundar Ram. "Impact of Urban Street Geometry on the Detection Probability of Automotive Radars." In 2024 IEEE Radar Conference (RadarConf24) 2024 May 6 (pp. 1-6). IEEE., *link*

- **Shah, Mohammad Taha**, Gourab Ghatak, and Shobha Sundar Ram. "Optimization of Beamwidth in Automotive Radars Based on Statistics of Street Geometry." ICASSP 2025-2025 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP). IEEE, 2025., *link*

Technical Notes

- **Shah, Mohammad Taha.** "A Note on Exact State Visit Probabilities in Two-State Markov Chains." arXiv preprint arXiv:2502.03073 (2025)., *arXiv Preprint*

Working Papers

- **Shah, Mohammad Taha**, Sabrina Khurshid, and Gourab Ghatak. "Order Optimal Regret Bounds for Sharpe Ratio Optimization in the Bandit Setting." (Submitted to IEEE TIT), arXiv preprint arXiv:2508.13749 (2025)., *arXiv Preprint*

SKILLS

Expertise Area: Probability & Random Process, Statistical Signal Processing, Wireless Communication, Digital Communication System, Signals & Systems,
Technical Electives: Stochastic Geometry, Online Learning, LTE, 5G(NR), Speech Recognition & Understanding
Programming: MATLAB, Python, Mathematica, C
Document Creation: Microsoft Office Suite, LaTex, Prezi
Languages: English, Urdu, Kashmiri (Native), Hindi

M.TECH THESIS (VVDN SPONSORED)

On the Design and Performance Analysis of 5G Initial Access Physical Layer | *MATLAB*
Supervisor: Prof. Sumit J. Darak   IIITD
This thesis investigates 5G cell search (CS) in cellular networks, focusing on its critical role in enabling device connectivity. It explores physical layer design aspects, particularly synchronization and decoding challenges. The first contribution is a base station transmitter design for downlink synchronization, generating MIB and SIB as per 3GPP n78 band specifications, along with a novel computationally efficient PBCH detection and MIB decoding approach using down-sampling to reduce complexity and execution time. The second contribution addresses MIB-based SIB search and decoding, analyzing phase offset issues in 5G due to carrier frequency mismatch and proposing compensation techniques. The final contribution examines uplink synchronization via PRACH, where timing advance parameters are estimated by the base station. This work provides practical solutions for efficient 5G CS implementation.

PROJECTS AND RESEARCH

Modified Hard-Core Cluster Process | *MATLAB*   Oct. 2020 – Jan 2021
Supervisor: Prof. Gourab Ghatak   IIITD
  - A framework for the Rural Networks developed using stochastic geometry.

Speech Diarization | *Python*   Feb. 2020 – May 2020
Supervisor: Prof. Pravesh Biyani   IIITD
  - Speaker diarization is the process of partitioning an input audio stream into homogeneous segments according to the speaker identity. Basically, we determine in an audio file who spoke when.

Bootstrap Percolation in V2X Networks | *MATLAB*   March 2020 – May 2020
Supervisor: Prof. Gourab Ghatak   IIITD
  - Framework for a URLLC V2X network is developed using a 1D Poisson Point Line Process.
  - Network throughput is determined as the performance metric is consideration to interference.

Emotion Recognition Through Speech | *Python*   Sept. 2019 – Nov. 2019
Supervisor: Prof. Saket Anand   IIITD
  - Supervised learning method to train a model to recognize emotions expressed by a person.
  - MFCC and spectrogram are the extracted audio features from time series data for training.

Smart Shoe: Arduino based Android Controlled Automatic Temp. Regulation in a shoe with a Pedometer
Nov. 2016 – March 2017

PRESENTATIONS | TRAINING | HONORS AND AWARDS | POSITIONS OF RESPONSIBILITY

Recipient of the IEEE SPS Travel Grant for ICASSP 2025
Awarded by the IEEE Signal Processing Society (SPS), this competitive travel grant supports my participation in the ICASSP 2025 Conference , one of the most prestigious events in the field of signal processing.

BSNL Certified Advanced Vocational Training (Telecom)   Feb. 2016
Bharat Ratna Bhimrao Ambedkar Institute of Telecom Training Jabalpur

Teaching Assistant - IIT Delhi   Aug. 2023 –
Stochastic geometry and its application in wireless communication | Basic Electrical Engineering |
Online learning, prediction, and optimization | Reinforcement learning and Stochastic control   IITD

Teaching Assistant - IIIT Delhi   Aug. 2019 – Dec. 2020
Digital Circuits | Principles of Communication Systems | Digital Communication Systems   IIITD

GATE (Graduate Aptitude Test in Engineering)   March 2019
Score: 565

LoRa & LoRaWAN - Future of IoT Communication Standards   March 2017
UGC Sponsored National Seminar on Electronic Devices, Systems and Information Security (SEEDS-2017)