

Anish Pradhan

Direct Ph.D. Student (ECE)

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CONTACT INFORMATION

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RESEARCH INTERESTS

Wireless communications; MIMO; Reconfigurable intelligent surfaces; Optimization theory; Probability theory; Channel modeling; Terahertz (THz) communications for AR/VR applications; Device-to-device (D2D) communications; 5G NR; Beyond 5G (B5G) and 6G; 4G LTE/LTE-A; Machine learning.

EDUCATION

Virginia Tech, Blacksburg, Virginia. Aug. 2019 - Present
Master of Science (M.Sc.) and Direct Doctor of Philosophy (Ph.D.) in Electrical Engineering.

- Expected graduation: December 2024
- Advisor: Harpreet S. Dhillon
- Current GPA 3.87/4.0

National Institute of Technology Durgapur (NITD), India. 2014 - 2018
Bachelor of Technology (B. Tech.) in Electronics and Communication Engineering.

- Advisor: Sanjay Dhar Roy
- Final Year Project Topic: Implementation of Relay Hopper Model for Reliable Communication of IoT Devices in LTE Environment through D2D Link
- GPA 9.6/10.0 (Ranked 1st among 95)

ACADEMIC EXPERIENCE

Virginia Tech, Blacksburg, Virginia.

Graduate Research Assistant

- **Reconfigurable Intelligent Surface-aided (RIS) Systems** Aug. 2019 - Present

- * Developed a framework optimizing RIS-assisted THz communication by adjusting RIS configuration and beamformer weights for maximum throughput iteratively, incorporating a THz channel model that considers scattering and noise in re-radiated signals.
- * Developed a novel probabilistic optimization technique for discrete RIS optimization and maximized signal-to-interference-and-noise-ratio (SINR), overhead-aware rate and energy efficiency (EE) as case studies.
- * Currently working on RIS-aided coexistence with minimal information and developing hardware constrained optimization algorithms for the RIS.

- **Channel Modeling** Aug. 2019 - Aug. 2022

- * Developed a line-of-sight (LOS) THz channel model reflecting real-world conditions with radiation trapping effects, and compared its capacity and symbol error rate (SER) to conventional fading channels.
- * Developed a novel geometry-based stochastic channel model (GSCM) with dual visibility regions (VR) that is capable to imitate more complicated GSCMs and utilized stochastic geometry tools to derive channel propagation characteristics.

Indraprastha Indian Institute of Technology Delhi (IIIT-D), India. May 2018 - Oct. 2018
Research Intern

- **MIMO Communication in presence of Non-ideal Amplifiers**

- * Simulated phase noise (Wiener and Gaussian) and high power amplifiers in multi-user MIMO OFDM systems, confirming SER and capacity findings against theory.
- * Studied basics of Universal Software Radio Peripheral (USRP) Rio and LTE application framework.

PUBLICATIONS

Journals

- [J6] **A. Pradhan** and H. S. Dhillon, "RIS-Aided Coexistence in Wireless Networks Using Angular Information," 2023, submitted
- [J5] —, "A probabilistic reformulation technique for discrete ris optimization in wireless systems," *IEEE Trans. on Wireless Commun.*, 2023
- [J4] **A. Pradhan**, J. K. Devineni, A. F. Molisch, and H. S. Dhillon, "Novel los $\beta - \gamma$ thz channel unifying molecular re-radiation manifestations," *arXiv:2308.09821*, 2023
- [J3] **A. Pradhan**, M. A. Abd-Elmagid, H. S. Dhillon, and A. F. Molisch, "Robust optimization of ris in terahertz under extreme molecular re-radiation manifestations," *IEEE Trans. on Wireless Commun.*, 2023
- [J2] P. Aggarwal, **A. Pradhan**, and V. A. Bohara, "A downlink multiuser mimo-ofdm system with nonideal oscillators and amplifiers: Characterization and performance analysis," *IEEE Systems Journal*, vol. 15, no. 1, pp. 715–726, 2020
- [J1] S. Basu, **A. Pradhan**, and S. Dhar Roy, "Radial sub-band allocation with downlink interference mitigation in macro-femto environment," *Wireless Personal Commun.*, vol. 106, pp. 955–969, 2019

Conference Proceedings

- [C5] **A. Pradhan** and H. S. Dhillon, "Novel probabilistic reformulation technique for unconstrained discrete ris optimization," in *IEEE PIMRC*, 2023
- [C4] **A. Pradhan**, H. S. Dhillon, F. Tufvesson, and A. F. Molisch, "Stochastic geometry analysis of a new gscm with dual visibility regions," in *IEEE PIMRC*, 2023
- [C3] D.-R. Emenonye, **A. Pradhan**, H. S. Dhillon, and R. M. Buehrer, "OtfS enabled ris-aided localization: Fundamental limits and potential drawbacks," in *2023 IEEE/ION Position, Location and Navigation Symposium (PLANS)*. IEEE, 2023, pp. 344–353
- [C2] **A. Pradhan**, J. K. Devineni, H. S. Dhillon, and A. F. Molisch, "Intelligent surface optimization in terahertz under two manifestations of molecular re-radiation," in *Proc., IEEE GLOBECOM*, 2021
- [C1] **A. Pradhan**, S. Basu, S. Sarkar, S. Mitra, and S. D. Roy, "Implementation of relay hopper model for reliable communication of iot devices in lte environment through d2d link," in *Communication Systems & Networks (COMSNETS), 2018 10th International Conference on*. IEEE, 2018

GRADUATE COURSEWORK

Multi-channel communications, Stochastic signals and systems, Optimization theory, Advanced Digital communications, Large Array Analysis and Design, Machine learning in Communication, and Statistical inference.

SELECT GRADUATE COURSE PROJECTS

Application of Machine Learning to Communications

Fall 2019

- Applied deep-learning techniques to DoA estimation and compared its performance with CRLB and MUSIC algorithm.
- Designed a reinforcement learning algorithm for spectrum sharing between a primary user (PU) and secondary user (SU).
- Implemented the policy evaluation and policy improvement steps of the policy iteration for the spectrum sharing problem.

Multichannel Communications

Fall 2020

- Coded SU-MIMO receivers based on Pre-coding, Zero-Forcing (ZF), Successive Interference Cancellation (SIC) algorithms to compare performance of multiplexing schemes.
- Analyzed various antenna diversity techniques including maximum ratio combining (MRC), space-time block coding (STBC).
- Performed OFDM channel estimation using LS and MMSE approaches and implemented receiver algorithms including ZF, MMSE and SIC.
- Simulated an end-to-end frequency selective time varying OFDM channel with synchronization,

bit-loading and channel estimation.

Advanced Digital Communications

Spring 2020

- Approximated the distribution of received signal-to-noise ratio (SNR) for RIS-aided SISO communication distribution and validated with theory.
- Simulated end-to-end wireless image and audio transmission through a SISO channel utilizing steganography, JPEG2000 standards and Hamming encoding.

Optimization Techniques

Spring 2021

- Optimized an active RIS-aided SIMO system with interference through iteratively utilizing semidefinite relaxation (SDR) and MMSE in a block-coordinated descent (BCD) framework and compared it with passive RIS.

Cellular Communication Systems

Spring 2021

- Involved in the study of competing various solutions such as 5G and starlink.
- Wrote a technical survey on reconfigurable intelligent surfaces.

OTHER POSITIONS

Member of the Student Leadership Committee of Wireless@VT, ECE.

Graduate Teaching Assistant for Stochastics, signals and systems.

Reviewer of IEEE Transactions on Wireless Communications, Vehicular Technology Magazine, IEEE Transactions on Vehicular Technology, and IEEE Transactions on Green Communications and Networking.

SKILLS

- Algorithms: Transmitter/Receiver structures for MIMO and OFDM/Single Carrier Wireless systems; Convex Optimization; First-order Gradient Descent Methods, Back propagation and Artificial Neural Networks; Policy Iteration in Reinforcement learning.
- Programming Languages: MATLAB.
- Scripting Languages: L^AT_EX, MS Office.

REFERENCES

Available upon request.