Nitish Vikas **Deshpande**

4TH YEAR PHD STUDENT AND GRADUATE STUDENT RESEARCHER

UC San Diego · Electrical Engineering

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Education

University of California San Diego — *San Diego, CA, USA*

DOCTOR OF PHILOSOPHY (PH.D.), MAJOR IN ELECTRICAL ENGINEERING — *Jan 2024 - May 2026 (Expected)*

- Graduate student researcher with Prof. Robert W. Heath Jr.
- Transferred as Ph.D. student from NC State

North Carolina State University — *Raleigh, NC, USA*

DOCTOR OF PHILOSOPHY (PH.D.), MAJOR IN ELECTRICAL ENGINEERING — *August 2021 - Dec 2023*

- G.P.A **4.0/4.0**
- Graduate Research Assistant with Prof. Robert W. Heath Jr.
- Passed Qualifying exam in Oct 2023

Indian Institute of Technology, Kanpur — *Kanpur, India*

BACHELOR OF TECHNOLOGY, MAJOR IN ELECTRICAL ENGINEERING — *July 2017 - May 2021*

- C.G.P.A **9.4/10**
- Awarded Proficiency Prize for Best Project in Electrical Engineering

Graduate coursework

Signal Processing and Machine Learning for Advanced MIMO, RF Design for wireless, Electromagnetic fields, Advanced space-time communication, Analog circuits, Optimization and algorithms, Antennas and arrays, Advanced microwave design, LTE and 5G, Wireless communication lab with USRPs

Academic experience

Hybrid beamforming with parasitic reconfigurable antenna array — *UC San Diego, CA, USA*

SUPERVISOR-**PROF. ROBERT W. HEATH JR.**, SPONSOR-**NOKIA BELL LABS** — *Aug.2023-Present*

- Developing optimization methods for configuring parasitic antenna array using a multi-port circuit theory approach

Frequency-selective beamforming and beam training with dynamic metasurface antenna — *UC San Diego, CA, USA*

SUPERVISOR-**PROF. ROBERT W. HEATH JR.**, SPONSOR-**QUALCOMM** — *Aug.2023-Present*

- Developing optimization methods for configuring dynamic metasurface antennas for wideband communication
- The project won the "Qualcomm Innovation Fellowship" award for the academic year 2023-24

Achievable rate analysis with Bode-Fano wideband matching theory — *NC State, Raleigh, NC, USA*

SUPERVISOR-**PROF. ROBERT W. HEATH JR.**, SPONSOR-**NOKIA BELL LABS** — *Jan.2023-Present*

- Proposed a general bound on the MISO achievable rate over all linear and passive matching networks
- Developed a practical approach to approximate the achievable rate bound using ADS circuit design software
- Paper titled "Achievable rate of a SISO system under wideband matching network constraints," accepted at IEEE GLOBECOM 2023
- Paper titled "A generalization of the achievable rate of a MISO system using Bode-Fano wideband matching theory," published in IEEE TWC 2024

Wideband analysis of dense arrays — *NC State, Raleigh, NC, USA*

SUPERVISOR-**PROF. ROBERT W. HEATH JR.**, SPONSOR-**NOKIA BELL LABS** — *Aug.2022-Dec.2022*

- Analysis of array gain performance by modeling frequency-selectivity of circuit components like impedance matching networks
- Presented "Analysis of dense array massive MIMO with practical constraints," at WSA & SCC 2023 in Braunschweig, Germany

Analysis of near-field and wideband communication systems — *NC State, Raleigh, NC, USA*

SUPERVISOR-**PROF. ROBERT W. HEATH JR.**, SPONSOR-**NOKIA BELL LABS** — *Jan.2022-June.2022*

- Analyzed beamforming gain for a general **near-field** and **wideband** channel
- Proposed a frequency-selective distance metric to determine the far-field to near-field boundary for a wideband system
- Uncovered a fundamental tradeoff between the aperture and bandwidth
- "A wideband generalization of the near-field region for extremely large phased-arrays," published in IEEE WCL.

True-time-delay beamforming optimization for wideband systems

NC State, Raleigh, NC, USA

Supervisor-**Prof. Robert W. Heath Jr.**, Sponsor-**Nokia Bell Labs** *Aug.2021-Dec.2021*

- Proposed delay design for true-time-delay beamforming architectures for a general channel with multi-path and near-field effects
- Presented a poster on "Nonuniform true time delay precoding in wideband MISO systems," in Asilomar conference on signals, systems, and computers in Pacific Grove, CA, in Nov 2022.

Intelligent Reflecting Surfaces (IRS) aided Wireless Communication

IIT Kanpur, India

Supervisor-**Prof. Rohit Budhiraja** *June.2020-June.2021*

- Analysed **Full Duplex Intelligent Reflecting Surface** aided wireless communication model with spatially correlated channels and imperfect channel state information
- Solved the energy efficiency and spectral efficiency optimization problems using algorithms like Lagrangian dual, Quadratic and Dinkelbach's transforms, and projected gradient ascent algorithm

Heterogeneous Cellular Networks using Poisson Cluster Process

IIT Kanpur, India

Supervisor-**Prof. Abhishek Gupta** *March.2020-Dec.2020*

- Derived exact expressions of **spectral efficiency** using Hamdi's Lemma approach for a typical user under a **K tier Heterogeneous Network** model using **Poisson Cluster Process** and **Poisson Point Process** under a max-power association scheme
- Analysed the effect of user-basestations correlation on the spectral efficiency for the typical user

Work Experience

Modem systems intern, Qualcomm

Supervisors- Jae Won Yoo, Manish Jain, Aishwarya Kasa, Abbas Termos *San Diego, CA, USA*

Enhanced channel estimation with Rx correlation using DMRS reference signal for 5G Modem *Jun. 2024 - Sept.2024*

- Proposed a low complexity algorithm leveraging Rx correlation to estimate the wireless channel
- Compared with optimal MMSE solution to show that the proposed algorithm achieves similar performance for low - moderate SNR
- Implemented the algorithm in Python in the end-to-end simulator and observed throughput gains for PDSCH
- Proposed and implemented two approaches to estimate Rx correlation using tracking reference signal

6G Radio systems research intern, Nokia Bell Labs

Supervisors- Saeed Khosravirad, Kumar Badheka, Jinfeng Du, Harish Viswanathan *Murray Hill, NJ, USA*

Parasitic Reconfigurable Antenna Array: A New Paradigm of Analog Beamforming *Jun. 2023 - Aug.2023*

- Proposed optimization methods for analog beamforming using parasitic reconfigurable antenna array
- Designed parasitic antenna in Feko software
- Received the "Outstanding student research award" for the intern project
- Submitted invention report titled "Methods and devices for analog beamforming using parasitic resonating elements."

Communication systems research intern, Nokia Bell Labs

Supervisors- Saeed Khosravirad, Jinfeng Du, Harish Viswanathan *Murray Hill, NJ, USA*

Hardware-aware analysis of dense array massive MIMO *Jun. 2022 - Aug.2022*

- Modeled wideband and dense array massive MIMO system using circuit theory
- Optimized array gain performance under several realistic hardware constraints
- Gained insights on the super-directivity phenomenon from a practical perspective

Publications

Journal Articles

[1] N. Deshpande, M. R. Castellanos, S. R. Khosravirad, J. Du, H. Viswanathan, and R. W. Heath, "Hybrid beamforming optimization for a MISO system with parasitic reconfigurable antennas," to be submitted to *IEEE Transactions on Wireless Communications*, 2024.

[2] N. Deshpande, J. Carlson, M. R. Castellanos, and R. W. Heath, "Frequency-selective beamforming and single-shot beam training with dynamic metasurface antennas," to be submitted to *IEEE Transactions on Wireless Communications*, 2024.

[3] J. Carlson, N. Deshpande, M. R. Castellanos, and R. W. Heath, "Wideband dynamic metasurface antenna performance with practical design impairments," to be submitted to *IEEE Transactions on Wireless Communications*, 2024.

[4] N. Deshpande, M. R. Castellanos, S. R. Khosravirad, J. Du, H. Viswanathan, and R. W. Heath, "A generalization of the achievable rate of a MISO system using Bode-Fano wideband matching theory," in *IEEE Transactions on Wireless Communications*, 2024.

[5] N. Deshpande, M. R. Castellanos, S. R. Khosravirad, J. Du, H. Viswanathan, and R. W. Heath, "A wideband generalization of the near-field region for extremely large phased-arrays," in *IEEE Wireless Commun. Lett*, 2022.

[6] N. Deshpande, S. Dey, D. Amudala, and R. Budhiraja, "Spatially-Correlated IRS-Aided Multi-User FD mMIMO Systems: Analysis And Optimization," in *IEEE Transactions on Communications*, vol. 70, no. 6, pp. 3879-3896, June 2022.

Conference Proceedings

[1] N. V. Deshpande, M. R. Castellanos, S. R. Khosravirad, J. Du, H. Viswanathan, and R. W. Heath, "Achievable rate of a SISO system under wideband matching network constraints," in *GLOBECOM 2023 - 2023 IEEE Global Communications Conference*, Kuala Lumpur, Malaysia, 2023, pp. 7514-7519.

[2] N. V. Deshpande, S. R. Khosravirad, J. Du, H. Viswanathan, M. R. Castellanos, R. W. Heath, "Analysis of dense array massive MIMO with practical constraints," in 26th Workshop Smart Antennas, Feb. 2023.

[3] N. Deshpande, M. R. Castellanos, R. W. Heath, "Nonuniform true time delay precoding in wideband MISO systems," in Proc. Asilomar Conf. Signals, Syst., Comput., Nov. 2022.
Conference presentation available here.

[4] N. Deshpande, S. Dey, D. Amudala, E. Sharma and R. Budhiraja, "Analysis of Statistical CSI-based Optimized Phase-Shift IRS-aided FD mMIMO System," in *2021 IEEE Global Communications Conference*, Dec 2021.
Conference presentation available here.

[5] N. Deshpande, Sandeep K Routray and A.K. Gupta, "Spectral Efficiency in Poisson Cluster Based HetNets with Users-Basestations Correlation," in *Proc. IEEE ANTS*, Delhi, India, Dec. 2020.
Conference presentation available here.

Patents

[1] N. Deshpande, D. Badheka, S. R. Khosravirad "Methods and devices for analog beamforming using parasitic resonating elements," submitted to *Finland, National Patent, Application number: 20246078*

Honors & Awards

2024	**Panelist in 6G Graduate students panel at Brooklyn 6G Summit**, Invitation as a panelist for 6G academic research moderated by Peter Vetter and Thierry Klein on Oct 25	*Nokia Bell Labs/ NYU*
2023-24	**Qualcomm Innvovation Fellowship**, Awarded for project proposal on "Dynamic metasurface antennas for wideband," in collaboration with Joseph Carlson	*Qualcomm/ UC San Diego*
2023	**Outstanding student research award**, Summer intern project on "Parasitic reconfigurable antenna array," received best intern project award in radio systems research at Nokia Bell Labs	*Nokia Bell Labs, Murray Hill, NJ*
2023	**GSA Travel grant**, Awarded for travel to WSA&SCC 2023 conference in Braunschweig, Germany	*NC State*
2022	**College of Engineering Travel grant** , Awarded for Asilomar conference travel to Pacific Grove, CA	*NC State*
2021	**Graduate Merit Award**, Awarded for the academic year 2021-22	*NC State*
2021	**Proficiency Prize**, Project on intelligent reflecting surface received best undergraduate project in Electrical Engineering	*IIT Kanpur*

Skills

Languages	Python, MATLAB, C/C++, Verilog, VHDL
Software	AWR, Feko, HFSS, ADS, Cadence, Xilinx ISE, Arduino IDE, LabView, Proteus, LaTeX
Hardware	FPGA, USRP, micro-controllers boards like arduino/NodeMCU, Single Board Computers like Rpi, IOT boards like ESP

Professional activities

Student member of IEEE COMSOC, IEEE APS, IEEE MTTS, reviewer for IEEE Communication Letters, IEEE JSAC, IEEE TWC, IEEE TCOM, IEEE WCL, IEEE TVT, IEEE ICC, PHYCOM