

Ruth Gebremedhin

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Summary: Ph.D. candidate focusing on physics-based linear system models of communication. Researching wave, thermal, and diffusion propagation from an information theoretic perspective. Experienced in **beamforming algorithms, fixed wireless access in shared spectra (sub-6, mmWave), near field and wide band channel modeling, path loss estimation.**

Education

New York University

Ph.D. ELECTRICAL AND COMPUTER ENGINEERING

Brooklyn, NY

Aug 2020 - May 2026

- Advisor: Prof. Thomas Marzetta, Tandon School of Engineering Fellowship

- **Research Interests:** Wave Propagation, 5G and 6G Wireless Systems, Thermal Communication, Channel Capacity.
- **Notable Coursework:** Wireless Communications, Information Theory, Detection and Estimation, Probability and Stochastic Processes, Partial Differential Equations, Optimization Methods, Machine Learning, Deep learning.

New York University Abu Dhabi

B.S. ELECTRICAL ENGINEERING AND MINOR IN COMPUTER SCIENCE

Abu Dhabi, UAE

Aug 2016 - May 2020

- Awarded **Full Scholarship** with study away at NYU Tandon and NYU Buenos Aires.

Skills

Programming MATLAB, C++, Python, PyTorch, Scipy, Matlab 5G NR Toolbox, Matlab PDE Toolbox, MIMO simulation, L^AT_EX

Communication Technologies (MIMO, OFDM, 5G NR, JPTA, FWA, shared spectra, sub-6, mmWave), Signal

Analytical Processing (noise removal, equalization), Communication Theory (angular spectrum, impedance matrix, channel model, RF propagation, PHY layer), Information theory (capacity, peak power constraint)

Work Experience

Qualcomm

WIRELESS RESEARCH AND DEVELOPMENT INTERN

Bridgewater, NJ

May 2025 - Aug 2025

- Beamforming Techniques and Power Consumption. Supervisors: Wenjun Li, Navid Abedini, and Junyi Li

- Developed a beamforming technique in time-frequency-spatial domain which reduced delay overhead in beam sweeping.
- Analyzed the impact of the technique on overall power consumption by integrating the performance statistics with 3GPP defined power requirements.
- Filed 3 patents (Patent pending).

Nokia Bell Labs

MATH AND ALGORITHMS INTERN

Murray Hill, NJ

June 2024 - Aug 2024

- Near-Field Wide-band Channels: True-time-delay and Array Geometry. Supervisors: Alexei Ashikhmin and Hong Yang

- Implemented a near-field wide-band channel model to simulate the effect of beam squint on beam-forming gain and channel capacity in MISO systems.
- Designed a dense array geometry solution that lowers the number of True Time Delay elements while achieving near optimal beam-forming gain.
- Received the "Outstanding Innovation Award" in the intern competition.

CableLabs

WIRELESS RF PROPAGATION INTERN

Louisville, CO

May 2023 - Dec 2023

- Fixed Wireless Access in Shared Bands: sub-6 GHz vs mmWave. Supervisors: Ruoyu Sun and Dorin Viorel

- Analyzed the effectiveness of Fixed Wireless Access in 5G shared spectrum at Sub-6 and millimeter wave bands by examining channel variation over OFDM sub-carriers.
- Empirically studied the MIMO capacity gain factor across two frequency bands, considering various channel conditions such as LOS and NLOS, as well as different orientations of the customer premises equipment.
- Designed and implemented a noise removal algorithm to pre-process typical suburban channel sounding data, resulting in a statistical analysis of power delay profile and delay spread.

Nokia Bell Labs

Murray Hill, NJ

WIRELESS PROPAGATION MODELLING INTERN

June 2022 - Aug 2022

- **Macro-site Path Loss Prediction: Parabolic Approximation of Wave Equation.** Supervisors: Dmitry Chizhik and Jinfeng Du
 - Implemented a parabolic approximation to the wave equation to improve macro-site path loss prediction in over the top propagation scenarios.
 - Conducted a comparative study of the newly developed method with measured path loss data, demonstrating a low error rate compared to a slope-intercept fit.
 - Received the "Outstanding Innovation Award", ranking in the top 7% worldwide in the intern competition.

Research Experience

NYU Wireless

Brooklyn, NY

GRADUATE RESEARCH ASSISTANT

Aug 2020 - present

- **Near Field Communication: Dense Arrays and Meta-surfaces.** Supervisor: Prof. Thomas Marzetta
 - Examined the plane wave spectrum (also known as angular spectrum method) for exact representation of EM fields arbitrarily close to antenna arrays (**Asilomar 2025**).
 - Developed a novel FFT-based numerical algorithm that enables computationally efficient and physically accurate evaluation of the plane wave spectrum.
 - Showed that sub half-wavelength antenna spacing yields performance gains in end-fire by leveraging evanescent waves.
- **Communication via Thermal and Molecular Diffusion.** Supervisor: Prof. Thomas Marzetta
 - Studied the heat/diffusion equation from a linear system and information theoretic perspective to explore the potential of thermal and molecular diffusion for communication (**Awarded Best Paper at GLOBECOM 2022**).
 - Derived the frequency response of a diffusion propagation channel and studied its angular spectral representation.
 - Simulated the impulse and frequency response of the diffusive channel to numerically investigate the channel capacity.
 - Examined the parabolic characteristic curve of the heat equation and explored its impact on channel capacity.
- **AWGN Channel Input Constraints: Peak Power and Mean Absolute Deviation.** Supervisor: Prof. Thomas Marzetta
 - Studied the optimality of discrete channel inputs under peak power (amplitude) constraints.
 - Analyzing the similarities and distinctions between amplitude constraints and mean absolute deviation constraints in maximizing the mutual information of AWGN channels.

NYU Abu Dhabi Applied Interactive Multimedia Lab

Abu Dhabi, UAE

RESEARCH INTERN

May 2018 - July 2020

- **Haptic Feedback for Tele-operation: Remote Actuation in Virtual Reality.** Supervisor: Prof. Mohamad Eid
 - Proposed and implemented a WebRTC based network handshake protocol that enables bidirectional haptic and audio-visual communication as part of the 1918.1.1 IEEE working group.
 - Developed and tested a Leader-Follower Tele-operation Codec to communicate haptic data between two devices and explored its application as part of the 5G Tactile Internet.
 - Designed a 3D VR environment using Unity to assess the impact of haptic feedback on cognition and emotion.

NYU Center for Cosmology and Particle Physics

Abu Dhabi, UAE

RESEARCH INTERN

May 2017 - July 2017

- **Radio Frequency Radiation from Star Formation.** Supervisor: Prof. Joseph Gelfand
 - Investigated the correlation between star formation and radio luminosity through statistical data analysis.
 - Conducted a comparison study of visual luminosity versus radio luminosity to identify star formation patterns.

Selected Projects

YIN Pitch Estimation for Music and Voice

- Real time implementation of YIN algorithm with piano display for output ([Repository](#))
- Course: Digital Signal Processing

Wordle DQN

- Deep reinforcement learning approach to the popular NYT game, Wordle
- Course: Deep Learning

Publications

- R. **Gebremedhin**, and T. Marzetta. "The Role of Evanescent Waves in Near Field MIMO: A Numerical Study." IEEE Asilomar 2025.
- R. **Gebremedhin**, W. Keusgen, D. Viorel and R. Sun. "MIMO Channel Capacity Measurements in an Outdoor-to-Indoor Environment at 6 and 37 GHz." IEEE VTC 2024.
- R. **Gebremedhin**, R. Sun, D. Viorel and W. Keusgen. "Frequency Domain Channel Characteristics in an Outdoor-To-Indoor Environment at 6 and 37 GHz." EuCAP 2024.
- R. Sun, D. Viorel, W. Keusgen and R. **Gebremedhin**. "Empirical Path Loss Model and Small-Scale Fading Statistics in an Indoor Office Environment in 6 and 37 GHz Shared Bands." EuCAP 2024.
- R. **Gebremedhin**, and T. Marzetta. "Thermal Conduction as a Wireless Communication Channel." IEEE GLOBECOM 2022.
- W. Park, M. Jamil, R. **Gebremedhin**, and M. Eid. "Effects of tactile textures on preference in visuo-tactile exploration." ACM TAP 2021.
- K. liyoshi, R. **Gebremedhin**, V. Gokhale, and M. Eid. "Plug-and-Play Haptic Interaction for Tactile Internet based on WebRTC." EAI INTETAIN 2020.
- K. liyoshi*, M. Tauseef*, R. **Gebremedhin***, V. Gokhale, and M. Eid. "Towards standardization of haptic handshake for tactile internet: a WebRTC-based implementation." IEEE HAVE 2019 (*Equal Contribution).

Awards and Honors

- 2025 **Paul Baran Young Scholar:** Marconi Society
- 2024 **Panelist:** Brooklyn 6G Summit Panel moderated by Peter Vetter
- 2024 **Outstanding Innovation Award:** Nokia Bell Labs Internship
- 2024 **Tandon ECE Student Travel Grant:** EuCAP 2024
- 2022 **Best Paper Award:** IEEE Global Communications (GLOBECOM) 2022 Conference
- 2022 **Outstanding Innovation Award:** Nokia Bell Labs Internship
- 2022 **Winner of Mozilla's Common Voice for Low-bandwidth Challenge:** Mozilla and NVIDIA
- 2020-2023 **School of Engineering (SoE) Fellowship:** NYU Tandon School of Engineering
- 2016-2020 **Full Scholarship:** New York University Abu Dhabi

Teaching

- 2023 **Signals and Systems**, Course Assistant
- 2021-2023 **Fundamentals of Communication Theory**, Course Assistant
- 2021-2022 **Digital Communications**, Course Assistant

Academic Service

- Session Chair **European Conference on Antennas and Propagation(EuCAP)**
- Reviewer **IEEE Journal on Selected Areas in Information Theory (JSAIT)**
- Reviewer **IEEE International Conference on Communications (ICC)**
- Reviewer **IEEE International Symposium on Information Theory (ISIT)**