Ruth Gebremedhin

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Summary: Ph.D. student in ECE focusing on physics-based linear system models of wireless communication. Researching wave and diffusion propagation—electromagnetic, thermal, molecular—from an information theoretic perspective. Experienced in path-loss prediction, sharing spectra in FWA (sub-6, mmW), and Near Field & Wide Band beam-forming in sub-THz.

Education

New York University *Brooklyn, NY*

PH.D. ELECTRICAL ENGINEERING *Aug 2020 - May 2026*

- **Advisor: Prof. Thomas Marzetta, Tandon School of Engineering Fellowship**
  - Research Interests: Wave Propagation, Wireless Communication, Molecular Diffusion Communication, Channel Capacity.
  - Notable Coursework: Wireless Communications, Information Theory, Linear Systems for Wave Propagation, Detection and Estimation, Probability and Stochastic Processes, Partial Differential Equations, Optimization Methods, Digital Signal Processing, Digital Communications, Linear Algebra, Machine Learning, Deep learning.

New York University Abu Dhabi *Abu Dhabi, UAE*

B.S. ELECTRICAL ENGINEERING AND MINOR IN COMPUTER SCIENCE *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, LaTeX
Analytical	**Communication Theory** (channel model, RF propagation, PHY layer), **Information theory** (capacity, peak power constraint), **Linear Systems** (angular spectrum, impedance matrix), **Communication Technologies** (MIMO, OFDM, 5G NR, FWA, sharing spectra, sub 6, mmWave), **Signal Processing** (noise removal, equalization)

Work Experience

Qualcomm *Bridgewater, NJ*

RESEARCH INTERN *May 2025 - Aug 2025*

- **Incoming summer 2025 Research Intern with the Wireless Research and Development team**

Nokia Bell Labs *Murray Hill, NJ*

MATH AND ALGORITHMS INTERN *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 *Louisville, CO*

WIRELESS RF PROPAGATION INTERN *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*

- **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.
  - 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.
  - **Awarded Best Paper at GLOBECOM 2022.**
- **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.
- **Near Field Communication.** Supervisor: Prof. Thomas Marzetta
  - Examining spectral plane wave representation of the near field spherical wave.
  - Researching the role of evanescent waves in the near field of dense antenna arrays.
- **True Time Delay Beam-forming and Wide Band Nulls.** Supervisors: Prof. Thomas Marzetta and Prof. Danijela Cabric

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, 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. Iiyoshi, **R. Gebremedhin**, V. Gokhale, and M. Eid. "Plug-and-Play Haptic Interaction for Tactile Internet based on WebRTC." EAI INTETAIN 2020.

K. Iiyoshi*****, 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**).

Honors and Awards

2024	**Panelist:** Brooklyn 6G Summit, 6G Graduate Students 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

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

Academic Service

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