

Ryan Dreifuerst

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Education

North Carolina State University

Ph.D in Electrical Engineering

Advisor: Prof. Robert W. Heath Jr.

Raleigh, North Carolina

Jan. 2022 - Expected 2024

The University of Texas at Austin

M.S. in Electrical Engineering

Advisor: Prof. Robert W. Heath Jr.

Austin, Texas

Aug. 2019 - Jan. 2022

Technische Hochschule Lübeck

B.S. in Electrical and Communications Engineering

GPA: 4.0

Lübeck, Germany

Sept. 2017 - May 2019

Milwaukee School of Engineering

B.S. in Electrical Engineering

GPA: 4.0

Ranking: 1/647

Milwaukee, Wisconsin

Sept. 2015 - May 2019

Graduate Courses

Signal processing and machine learning for advanced MIMO systems, Space-time communication theory, Digital communications, Data mining, Statistical machine learning, Probability and stochastic processes, Statistical estimation theory, Autonomous robots, Convex optimization, Wireless communications

Academic Experience

Graduate Research Assistant

Supervisor - Prof. Robert W. Heath Jr.

Sponsor: Facebook

Jan. 2022 - May. 2022

o Wideband 5G SSB Beam Management

- Extended simulations to wideband OFDM settings with realistic 5G resource management
- Demonstrated wireless environment impact on 5G FR1 and FR2 codebook design
- Presented “Massive MIMO Codebook Design in Sub-6 GHz 5G NR” at IEEE VTC 2022

Graduate Research Assistant

Supervisor - Prof. Robert W. Heath Jr.

Sponsor: Facebook

Aug. 2021 - Jan. 2022

o ML-assisted SSB Codebook-Based Beam Management

- Developed a 5G initial access simulator for beam management

- Proposed a neural network for codebook learning using beamspace observations
- “Massive MIMO Codebook Design in Sub-6 GHz 5G NR” accepted at IEEE VTC 2022

Graduate Research Assistant

Supervisor - Prof. Robert W. Heath Jr.

Sponsor: Facebook
Jan. 2021 - May. 2021

○ **Universal Simulation Development Platform**

- Developed a unified platform for simulating wireless networks
- Integrated multiple tiers of statistical, ray-tracing, and geographic simulators
- “Load Balancing and Handover Optimization in Multi-band Networks using Deep Reinforcement learning” accepted at Globecom 2021.

Graduate Research Assistant

Supervisor - Prof. Robert W. Heath Jr.

Sponsor: Facebook
Aug. 2020 - Jan. 2021

○ **Frequency Synchronization in Low-Resolution Millimeter-wave**

- Proposed a deep learning feedback network for generating pilot sequences for CFO estimators
- Developed a jointly optimized neural network for one-bit CFO estimation in multi-tap channels
- Presented at Asilomar Conference on Signals, Systems, and Computers 2020
- “Optimizing Coverage and Capacity in Cellular Networks using Machine Learning” Accepted at ICASSP 2021

Graduate Research Assistant

Supervisor - Prof. Robert W. Heath Jr.

Sponsor: Samsung
Jan. 2020 - May 2020

○ **Low Resolution Sinusoid Detection and Frequency Estimation using Deep Learning**

- End-to-end detection and estimation of sinusoid frequencies from noisy, few-bit samples
- Jointly optimized spectral component detection and estimation
- Proposed hierarchical algorithm utilizing time-frequency representations

Graduate Research Assistant

Supervisor - Prof. Robert W. Heath Jr.

Sponsor: Samsung
Aug. 2019 - Jan. 2020

○ **Deep Learning-based Carrier Frequency Offset Estimation with One-Bit ADCs**

- Low resolution training strategy proposed for single sinusoid frequency estimation from one-bit quantized data
- Outperforms traditional signal processing techniques with fewer samples, lower signal to noise ratios, and faster execution time
- Presented at Signal Processing Advances for Wireless Communications Workshop 2020

Undergraduate Tutor

○ **Lead Tutor**

Aug. 2016 - May 2019

- Upper division tutor for courses in DSP, embedded systems, and wireless propagation
- Oversaw and mentored new electrical engineering tutors

Work Experience

AI Wireless Research Intern, Samsung Research America

Remote, Dallas

○ **Extreme MIMO Systems**

May. 2022 - Aug. 2022

- Designed a system-level simulator for extreme MIMO systems for efficient large scale simulation
- Evaluated multiple hardware configurations and precoding algorithms for 6G massive MIMO
- Researched the relationship between hybrid architectures, limited feedback, and performance for next generation mobile broadband networks

Modem Systems Intern, Qualcomm

Remote, Boulder

○ **Uplink Performance Analysis**

June. 2021 - Aug. 2021

- Characterized uplink control information and share channel performance in PUCCH and PUSCH
- Optimized control information performance through LLR rescaling and algorithmic debiasing
- Presented findings in two site-wide presentations to more than 60 stakeholders

Research Assistant, Facebook

Remote, Menlo Park

○ **Intelligent Radio Access Network Algorithms**

June. 2020 - Sept. 2020

- Developed mobile coverage map simulator for open source radio access networks using Quadriga
- Exponentially reduced simulation time for multi-sector networks
- Designed a neural network for predicting live network coverage from limited information

Digital Hardware Design Intern, Plexus Corp.

Neenah, Wisconsin

○ **MRI communication protocol**

July. 2018 - Sept. 2018

- Designed a communication protocol based on the first four layers of the OSI model
- Constructed data aggregation, packetization and serdes system in Verilog for 2 Gbps MRI data

Digital Hardware Design Intern, Plexus Corp.

Neenah, Wisconsin

○ **Medical device schematic capture**

June 2017 - Sept. 2017

- Created ISO 13485 certified medical device schematic in Altium
- Led two customer schematic reviews and one internal review

Journal Papers

- **Ryan M. Dreifuerst**, Robert W. Heath Jr., “Massive MIMO Beam Management in Sub-6 GHz 5G NR”, *in preparation for submission to IEEE Trans. on Wirel. Commun.*, Feb. 2023.
- Victor Hugo Lopes, Cleverson Nahum, **Ryan M. Dreifuerst**, Aldebaro Klautau, Kleber V. Cardoso, Robert W. Heath Jr., “Deep Reinforcement Learning-Based Scheduling for Multiband Massive MIMO”, *accepted for publication in IEEE Open Access*, 2022.

- Cleverson Nahum, Victor Hugo Lopes, **Ryan M. Dreifuerst**, Pedro Batista, Ilan Correa, Kleber V. Cardoso, Aldebaro Klautau, and Robert W. Heath Jr., “Intent-based Radio Resource Scheduling in a RAN Slicing Scenario using Reinforcement Learning”, *submitted to IEEE Trans. on Wirel. Commun.*, Aug. 2022.
- **Ryan M. Dreifuerst**, Robert W. Heath Jr., “[SignalNet: A Low Resolution Network for Sinusoid Detection and Estimation](#)”, *in Proc. of IEEE Trans. on Signal Process.*, 2022.

Conference Papers

- **Ryan M. Dreifuerst**, R.W. Heath, “Characterizing CSI Type-II feedback performance for MU-MIMO in 5G FR1 and FR2”, *in preparation for submission to SPAWC 2023*.
- **Ryan M. Dreifuerst**, Robert W. Heath Jr., and Ali Yazdan, “[Massive MIMO Codebook Design in Sub-6 GHz 5G NR](#)”, *in Proc. of IEEE Vehicular Technology Conference*, Jan. 2022.
- Manan Gupta, **Ryan M. Dreifuerst**, Ali Yazdan, Po-Han Huang, Sanjay Kasturia, Jeffrey G. Andrews, “[Load Balancing and Handover Optimization in Multi-band Networks using Deep Reinforcement Learning](#)”, *in Proc. of IEEE Globecom 2021*.
- **Ryan M. Dreifuerst**, S. Daulton, Y. Qian, P. Varkey, M. Balandat, S. Kasturia, A. Tomar, A. Yazdan, V. Ponnampalam, R.W. Heath, “[Optimizing Coverage and Capacity in Cellular Networks using Machine Learning](#)”, *in Proc. of IEEE ICASSP 2021*.
- **Ryan M. Dreifuerst**, Robert W. Heath Jr., Mandar Kulkarni, and Jianzhong Charlie Zhang, “[Frequency Synchronization in Low-Resolution Millimeter-wave](#)”, *in Proc. of Asilomar Conference on Signals, Systems, and Computers*, Dec. 2020.
- **Ryan M. Dreifuerst**, A. Graff, C. Unger, Sidharth Kumar, and D. Bray, “[End-to-End Radio Fingerprinting with Neural Networks](#)”, *Preprint available*.
- **Ryan M. Dreifuerst**, Robert W. Heath Jr., Mandar Kulkarni, and Jianzhong Charlie Zhang, “[Deep Learning-based Carrier Frequency Offset Estimation with One-Bit ADCs](#)”, *in Proc. of IEEE SPAWC 2020*, Apr. 2020.

Magazine Papers

- **Ryan M. Dreifuerst**, R.W. Heath, “Massive MIMO in 5G: How Beamforming, Codebooks, and Feedback Enable Larger Arrays”, *submitted to IEEE Communications Magazine*, Jan. 2023.

Projects

- **Wrist Rescue** - wearable fall detection and assistance Aug. 2018 - May 2019
 - Led a team of four through the product development lifecycle
 - Implemented random forest algorithm on real-time 9 axis sensor data
 - Served as primary data scientist, system programmer, and PCB designer
- **One Shot Whale Fluke Classification** Nov. 2018 - Jan. 2019
 - Designed a neural network to classify over 5000 different whales by their tails (flukes)
 - Used image augmentation and Siamese networks to achieve over 70% accuracy
- **FPGA Climate Control System** Oct. 2016 - Jan. 2017
 - Controlled a fan, windows, and VGA output based on environment sensors and user input
 - Implemented on soft core FPGA combining C and VHDL software

Honors and Awards

- Three-year NSF grant investigation on heterogeneous device beam management Aug. 2022
- Second place Cypress Bluetooth Design Competition Jul. 2019
- First place Senior Design Competition Apr. 2019
- Theodore Batterman Foundation Scholar Oct. 2016-2019

Professional Activities

- Tau Beta Pi Honor Society
- IEEE Eta Kappa Nu Honor Society
- IEEE Communication Society
- IEEE Signal Processing Society
- HAM radio technician class (KD9IGM)
- UT SAVES Editor
- IEEE JSAC Reviewer
- IEEE Globecom Reviewer x2
- IEEE TWC Reviewer x2
- IEEE TV Reviewer x2
- IEEE TCOM Reviewer x2
- IEEE VTC Session Chair
- PHYCOM Reviewer

Technical Skills

- **Programming languages:** Python, Matlab, C++, VHDL, Verilog, TCL
- **Frameworks:** Tensorflow, Numpy, Sci-kit learn, PyTorch, Jax, Numba, Quadriga
- **Design tools:** Altium, Cadence, Simulink, Quartus, Pspice
- **Hardware Experience:** SDR, embedded linux devices, DSP, FPGA