

Jack Rademacher

jradema@mit.edu • 603-918-3110 • Cambridge, MA • jackrademacher.me

EDUCATION

Massachusetts Institute of Technology — Cambridge, MA

PhD. Electrical Engineering and Computer Science

September 2021 — Present

- **Research:** Underwater communication systems and hardware platforms for complex problems in oceanography, naval defense, aquaculture, and climate change monitoring
- **Coursework:** Computer Networks, Discrete-Time Signal Processing, CMOS Mixed-Signal Integrated Circuits, Machine Learning

University of Michigan — Ann Arbor, MI

B.S.E. Electrical Engineering, Summa Cum Laude

September 2017 — May 2021

- **Coursework:** Microwave Circuits, Digital Communication Systems, Analog Circuits, Digital Circuits, Antennas & Wireless Systems, Semiconductor Optoelectronics, Control Theory, Modern Physics

WORK EXPERIENCE

Analog Devices — Colorado Springs, CO

May 2021 — August 2021

Microwave Design Engineering Intern, Aerospace & Defense (ADEF) Business Unit

- Designed an integrated 6-14 GHz, 128 ps, 6 bit True-Time Delay unit for beamforming SoCs on a 45nm RF-SOI process
- Designed and simulated a time delay architecture not previously implemented by my team that improved layout area and time delay density by up to 45%
- Designed and simulated bypass networks for mimicking S_{21} of delay units and providing a flat differential time delay across 2ps, 4ps, 8ps, 16ps, 32ps, and 64ps units

Analog Devices — Colorado Springs, CO

May 2020 — August 2020

Microwave Product Engineering Intern, Aerospace & Defense (ADEF) Business Unit

- Created a test setup for characterizing IP₃ of beamforming ICs from 2-33GHz through PCBs or an RF probe
- Collected data on worst/average case input and output IP₃ to within ± 0.35 dBm of actual value across frequency & power to compare with designers' simulations
- Communicated and displayed summer work to upper level management, showing how my test bench is accurate, easy to use, and can be used over wide range of bandwidths, power levels, and device form factors

Apple — Sunnyvale, CA

Electrical Engineering Intern, Special Projects Group (SPG)

January 2019 — August 2019

- Designed the schematic and layout for a “wireless oscilloscope” PCB to measure and log voltage, current and temperature
- Wrote C to live-stream ADC samples to an SD card and wirelessly to a python application using the MQTT protocol
- Created a concurrent embedded application using FreeRTOS to manage ADC sampling, WIFI connectivity, wireless streaming & device control, SD card reading/writing, and RTC initialization using network time

RESEARCH EXPERIENCE

Signal Kinetics at the MIT Media Lab — Massachusetts Institute of Technology

Graduate Research Assistant, advised by Fadel Adib

- Designed, built, and tested a first-of-its-kind passive underwater retrodirective beamformer to provide orientation-agnostic backscatter
- Managed multiple undergraduate researchers to design and build a sub- μ W underwater backscatter temperature sensor
- Designed hardware platforms and signal processing algorithms for ultra low-power acoustic backscatter communication using piezoelectric devices
- Developed a hydrophone beamforming array and algorithm to estimate and invert the underwater channel and maximum-ratio-combine for improved SNR
- Designed a STM32L4 hardware platform for acoustic energy harvesting, low power imaging, and edge machine learning

Power Electronics and Energy Research Studios (PEERS) — University of Michigan

Undergraduate Research Assistant, advised by Al-Thaddeus Avestruz

September 2020 — July 2021

- Formulated major loss mechanisms in a current-mode class D (CMCD) converter for wireless power transfer
- Optimized the design of the CMCD converter for high power & efficiency by compromising C_{oss} and conduction losses, resulting in a design that exceeds the current state-of-the-art when examining power-efficiency-frequency product
- Designed a custom wireless power transfer 4-layer PCB coil in COMSOL to obtain the required inductance and coupling

PROJECT EXPERIENCE

University of Michigan Hyperloop — Ann Arbor, MI

Power sub-team lead

September 2018 — December 2019

- Managed a team of 8 members to design the electric vehicle systems for propelling a hyperloop pod to high speeds
- Collaborated with cross-functional teams to ensure reliable mechanical and electrical integration of wire harnesses, PCBs, power conversion units, battery compartments and battery management systems
- Designed a custom low voltage battery management system to monitor a 2S-8S high power battery pack
- Facilitated the design of a custom power conversion board with 3 independent buck, boost, and buck-boost blocks

“Light-Deck” RGB LED Audio Visualizer

Independent project — See website for more information

Summer 2020

- Designed and built a 297 WS2812 LED matrix—controlled from an STM32F4—to react to a 3.5mm audio input jack
- Developed a single custom PCB to integrate microcontroller, level shifters, power management, analog front-end, primary battery, and programming ports
- Wrote embedded C using DMA & CMSIS-DSP library to take 2048-sample FFT and display a real-time spectrum of audio signal across matrix

PUBLICATIONS

1. J. Rademacher, X. Zan and A. Avestruz, "High Power, High Efficiency Wireless Power Transfer at 27.12 MHz Using CMCD Converters," 2021 IEEE Energy Conversion Congress and Exposition (ECCE), 2021, pp. 5698-5703, doi: 10.1109/ECCE47101.2021.9594951.

SKILLS

Programming Languages: C/C++, Python, MATLAB, Java, HTML/CSS, JavaScript (React, ReactNative, NodeJS), Elm
Software Packages: Altium Designer, Cadence Allegro, Cadence Virtuoso, Keysight ADS, LTSpice, NI Labwindows/CVI, NI Max, Ansys HFSS, COMSOL E/M, Siemens NX, Linux, Git