MARK H. GOLDWATER

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EDUCATION

Franklin W. Olin College of Engineering   *August 2017 – May 2021*
Candidate for a B.S. in Electrical and Computer Engineering
GPA: 3.98/4.00

Relevant coursework: Microcontrollers, Software Systems (C/operating systems), Controls,
Bayesian Inference and Reasoning, Partial Differential Equations, Introduction to Analog and Digital
Communications, Introduction to Microelectronic Circuits, Data Structures and Algorithms, Principles of
Engineering (electronics, software, and hardware integration projects), Quantitative Engineering Analysis I/II
(multivariable calculus, linear algebra, differential equations, signals and systems, and mechanics), Discrete
Mathematics, Computer Architecture, Software Design (introduction to programming and object oriented design
in Python), Modeling and Simulation of the Physical World (discrete system modeling in Python), Introduction
to Sensors, Instrumentation, and Measurement (analog circuitry for signal processing and measurement devices)

RESEARCH

Woods Hole Oceanographic Institution
Woods Hole, MA   *June 2020 – Present*
- Built a convolutional neural network (CNN) to detect spectrograms of multi-modal calls from Southern right whales in large audio data
- Achieved high accuracy and precision across multiple datasets of passive acoustic data

Franklin W. Olin College of Engineering
Needham, MA   *September 2019 – Present*
- Implemented an infrared communication link to transmit an acknowledgement of data receipt (ACK) on the uplink of a hybrid radio-frequency (RF) and visible-light communications (VLC) system
- Designed digital circuit logic to process the ACK
- Enabled the system to coexist on the same network with other 802.11-compatible devices that are sending data on the system's uplink over the saturated RF spectrum

MIT Lincoln Laboratory
Lexington, MA   *May 2019 – August 2019*
- Developed system to calibrate an infrared camera to serve as a highly accurate power meter in a laser communication terminal testbed
- Developed signal processing algorithm in MATLAB to detect non-functioning camera pixels and account for them in the power calculation

Franklin W. Olin College of Engineering
Needham, MA   *January 2019 – December 2019*
- Developed open source software to detect and catalog near-Earth asteroids using telescope images
- Implemented a preprocessing pipeline to account for thermal noise and varying pixel sensitivity in images

INDUSTRY EXPERIENCE

General Electric (GE) Healthcare – Senior Capstone Project in Engineering

Milwaukee, WI   *September 2020 – Present*

- Developing improved digital intercom for Computerized Tomography (CT) machines to facilitate better communication between the patient and operator
- Enabling technicians to interface less directly with patients through improved audio communication to reduce the likelihood of COVID-19 transmission

Track Information, Inc.

Boston, MA   *June 2018 – August 2018*

- Designed and prototyped RESTful API for a mobile app to track a user's health statistics using React Native in JavaScript as well as Ruby on Rails
- Engineered the app's backend data flow to easily interface with third-party APIs

PROJECTS

OceanSense – Ocean Measurement Platform   *October - December 2020*

- Designed a PCB using KiCad to monitor environmental conditions during ocean science experiments at the water's surface for up to seven days
- Device measured air temperature, surface humidity, and acceleration data
- Logged data to an onboard SD card for further processing

Image Inpainting   *May 2020*

- Implemented an inpainting algorithm in MATLAB based in partial differential equations that iteratively fills in missing sections of images
- Algorithm applied anisotropic diffusion in between inpainting iterations to ensure correct evolution of the field
- Created problem set and solution guide to teach image inpainting and its mathematical underpinnings to peers

Magnetic Levitation Control System   *May 2020*

- Developed a mathematical model and simulation to model the forces of a permanent magnet positioned under an electromagnet
- Implemented a PD feedback control loop to levitate the permanent magnet and tested it in a custom simulation
- Successfully implemented the control loop on a realistic computer model of the system (rather than a physical system due to COVID-19)

Schroeder Reverb in C   *March 2020*

- Implemented the Schroeder reverberation algorithm in C to add a reverb effect to music in a mono-channel 16-bit .wav file
- Built custom buffer data structures, a .wav file parser, and digital comb and all pass filters

American Sign Language/Spoken English Translation System *July 2019 – January 2020*
- Designed and presented system concept to take a user-oriented approach to the creation of an American Sign Language (ASL) language model to facilitate translation from ASL to English and vice versa
- Began initial data collection of ASL video data to train a machine learning model
- Spoke to local deaf and hard of hearing organizations to guide the design process

Digital Morse Code Decoder *December 2019*
- Designed and simulated a digital hardware system that takes Morse code input from a button and outputs the ASCII codes of inputted letters on LEDs
- Successfully programmed and tested the digital circuit on a Zybo Zynq-7000 FPGA SoC Trainer Board

Multi-Cycle CPU *November 2019*
- Designed, implemented, and simulated a multi-cycle CPU, using the MIPS architecture, in Verilog
- Wrote custom assembly programs to solve the Tower of Hanoi problem, the Spinout puzzle recurrence relation, and others to test the architecture

Computer Vision Assisted Origami *May 2018*
- Created software that used an overhead camera and a homography transform to project origami instructions onto a piece of square paper
- Used Python and OpenCV to calculate and display the projections on an assistive screen

Active Noise Cancellation *December 2018*
- Implemented Least Mean Squares (LMS) adaptive filtering in MATLAB to cancel background noise in a speech recording
- Implemented an ideal Wiener filter to characterize and cancel the noise as a benchmark

Inverted Pendulum Control System *November 2018*
- Implemented a PI control loop using Arduino C to enable an inverted pendulum robot to balance upright
- Modified the feedback loop to direct the robot to translate forward much like a segway

Braille Sheet Music Printer *October - December 2018*
- Designed and built a device that can convert digitized music into braille sheet music and print it
- Implemented the electrical system and guided integration of the software, hardware, and electrical subsystems

3D Infrared Scanner *September 2018*
- Designed and 3D-printed hardware for a two-servo tilt/pan scanning mechanism
- Wrote software using Arduino C to take distance measurements and create a 2D projection of the scanned item by converting from spherical to cartesian coordinates

Autonomous Robot Obstacle Course Navigation *May 2018*
- Implemented the RANSAC algorithm that used LiDAR data to map an obstacle course which consisted of boxes and fences to block the robot
- Imposed a vector potential field on the model of the course and used gradient descent to navigate to desired coordinates while avoiding obstacles

Facial Recognition Software *March 2018*
- Implemented the Eigenfaces facial recognition algorithm which achieved 95% accuracy on a dataset of 50 individuals with a 1.09 second runtime
- Also implemented the Fisherfaces facial recognition algorithm to better account for intraclass variance

Boat Hull Stability Simulation *February 2018*
- Implemented a 3D boat simulation in MATLAB to simulate the angle of vanishing stability (AVS) for various hull designs to predict at which tilting angle the boat would capsize
- Constructed final boat hull which met the design goals of having an AVS between 120 and 140 degrees and floating flat

PUBLICATIONS AND PRESENTATIONS

1. **M. Goldwater**, P. Dhulipalla, M. Kang, T. Kim, N. Tan, S. Govindasamy, M.B. Rahaim, "An 802.11 Compatible Asymmetric Hybrid Visible-Light and Radio-Frequency Communications System," *2020 IEEE 31st Annual International Symposium on Personal, Indoor and Mobile Radio Communications*, London, United Kingdom, 2020, pp. 1-7.

2. **M. Goldwater**, J. Bonnel, D.P. Zitterbart, (2020, December), "Classification of dispersive calls using a convolutional neural network", Presentation at the Acoustical Society of America's Acoustics Virtually Everywhere meeting.

AWARDS, SCHOLARSHIPS, AND FELLOWSHIPS

1. Woods Hole Oceanographic Institution's Summer Student Fellowship, $6,500 (June 2020 – August 2020)

2. First Place Overall in MIT Lincoln Laboratory's Intern Innovative Idea Challenge and funding to continue work during the fall 2019 academic semester (July 2019)

3. Best Poster in MIT Lincoln Laboratory's Intern Innovative Idea Challenge (July 2019)

4. Franklin W. Olin College of Engineering's four-year half-tuition merit scholarship, $100,800 (August 2017 – Present)

TEACHING AND MENTORING EXPERIENCE

Franklin W. Olin College of Engineering Needham, MA

MTH2110: Discrete Math	September 2020 – December 2020
Mathematics Tutor	January 2020 – April 2020
ENGR3420: Introduction to Analog and Digital Communication	August 2019 – December 2019
CIE2018A: Quantitative Engineering Analysis I	January 2019 – May 2019
Academic Resource Co-Designer	August 2018 – Present
OIE1000: Olin First Year Introduction	August 2018 – December 2018
ENGR1125: Introduction to Sensors, Instrumentation and Measurement	August 2018 – December 2018

EXTRACURRICULARS AND COMMUNITY ENGAGEMENT

"Frankly Speaking" Student Newspaper – Editor	August 2020 – Present
STEM K-12 Outreach Activity Design and Research	January 2020 – Present
Habitat for Humanity Volunteer	March 2018
Student Government – Representative for Campus Services	January 2018 – December 2018

Campus-wide silent auction organizer   November 2017
International Aerial Robotics Competition Team   September 2017 – February 2019
Engineering Discovery (K-12 STEM outreach)   September 2017 – January 2018

TECHNICAL SKILLS

Languages	C++, C, Python, MATLAB, Java, Verilog
Tools and Libraries	Tensorflow, Git, KiCad, OpenCV, 3D Printer