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ECE 486 SENIOR DESIGN PROJECTS

INNOVATING THE FUTURE IS WHAT WE DO

FALL 2024

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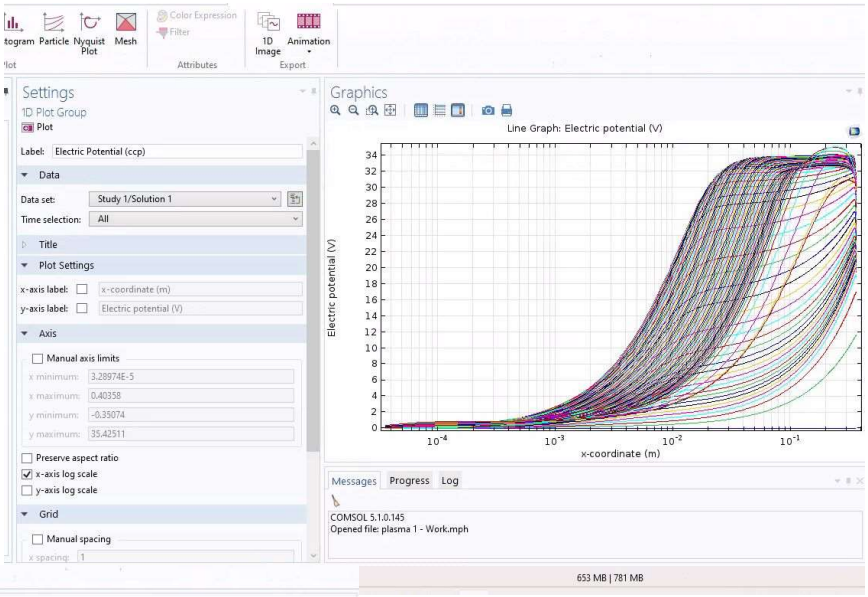

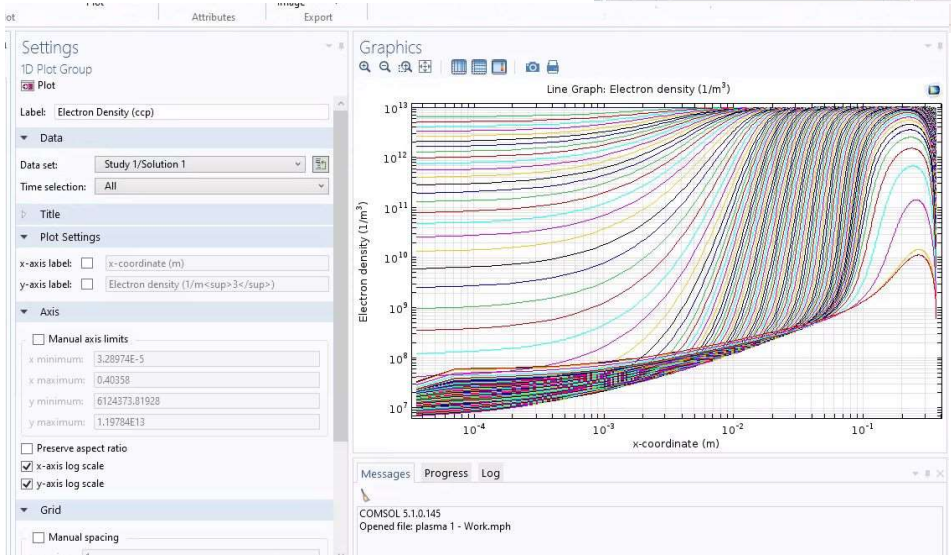

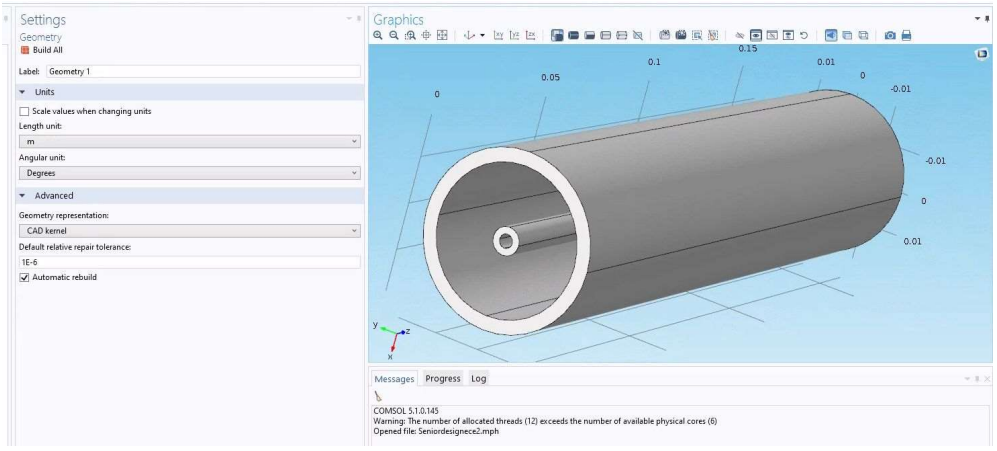

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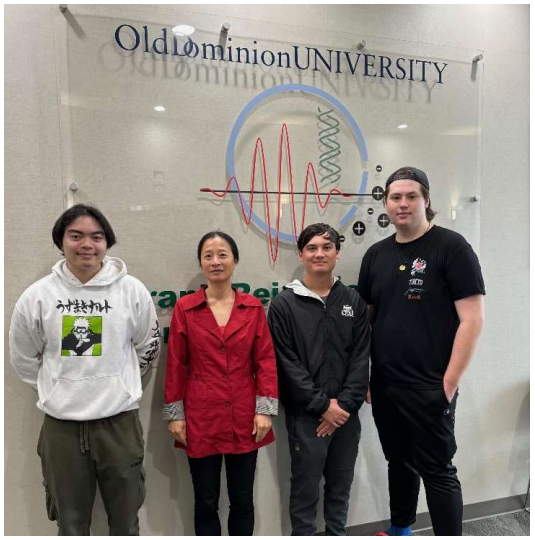
Modeling and Simulation of an Atmospheric Pressure Plasma Impinging on Water

Self-funded. Available for Academic Year

Explore underlying physicochemistry of an advanced technology for wastewater treatment. Utilizing sophisticated cad software: COMSOL Multiphysics to test and simulate possible designs. Also, learn to use Bolztig+ to solve Boltzmann equations to obtain properties of ionized gas.

Team Members *Mikel Douangdara (EE, CpE), Christian Miller (EE), Nicholas Koberstein (EE, CpE)*

Advisor: *Dr. Chunqi Jiang*



Design Challenge

Addressing resilience problem in the water of the Hampton Roads region.

Design Goals

- Build a model (2D symmetry or 3D)on COMSOL
- Learn to use Boltzig+ to solve Boltzmann equations
- Combine outputs of both software's to obtain final solution.

> **"Nothing cool was ever easy to make"**
> ***-Nicholas Koberstein***

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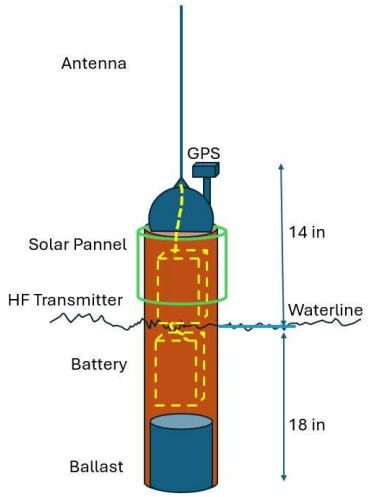
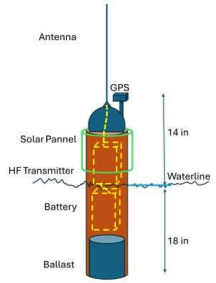
Real-Time High Frequency Propagation Observation System

Old Dominion High Frequency Propagation Buoy





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Real-Time High Frequency Propagation Observation System

*F*unding Agency: United States Navy

The purpose of this project is to develop a measurement device to observe the propagation of long-range radio signals

Team Members: *Mario Williams, Blake Brown, Terrance Wilson*

Advisors: *Dr. Dennis Watson & Dr. Linda Vahala*

Design Challenge

To create a water-borne beacon system capable of monitoring high-frequency long-range signals.

Design Goals

- Design an operational system
- Ensure the system is durable
- Ensure the system is sustainable
- Create an upgradeable system

> **Failure is often a better teacher than success. Embrace the failures, they're lessons to learn from!**

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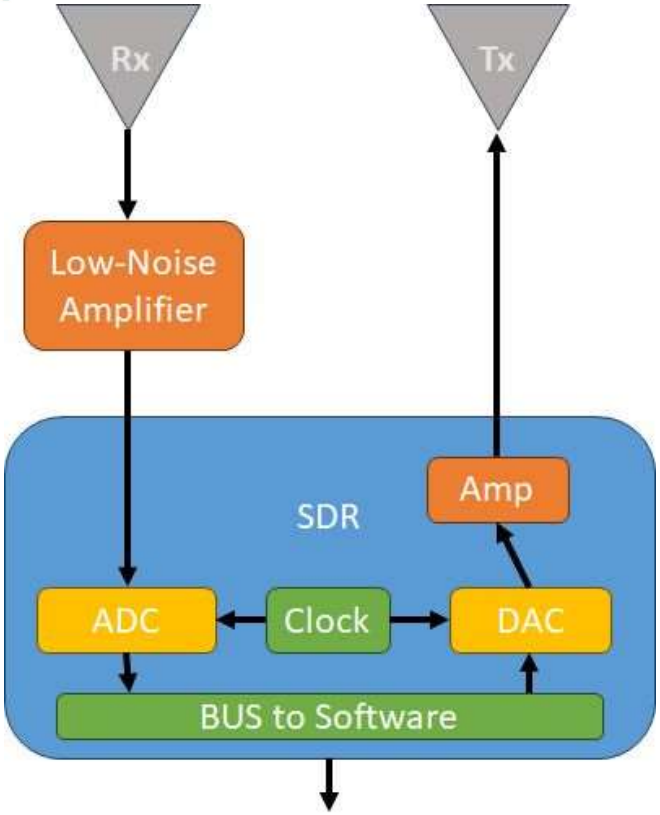

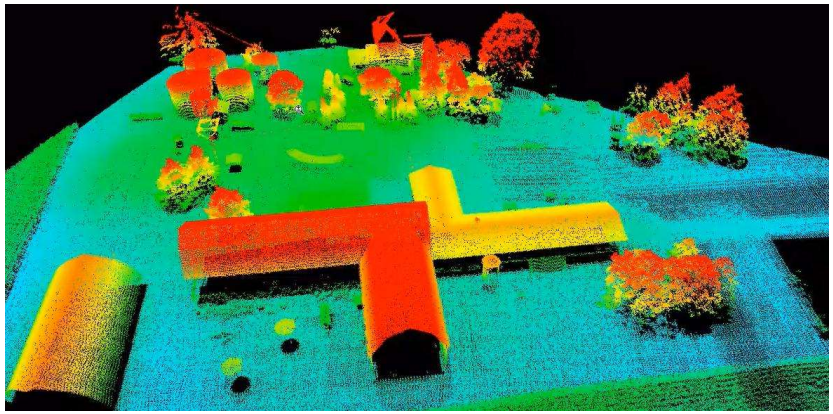

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Synthetic Aperture Radar using Software Defined Radios

*F*unding Agency: U.S. Army ASPIRE

Software-defined radios (SDRs) are key to modern communication systems, enabling low-cost, portable solutions by replacing hardware with software. This project applies SDRs in Synthetic Aperture Radar (SAR) systems, which collect data by transmitting and receiving electromagnetic signals to image targets and environments. The objective is to design a system that transmits RF signals, captures reflections, and synthesizes object images.

Team Members: *Myles Perry, Matthew Jackson, Tyler Hernandez*

Advisor: *Dr. Dimitrie Popescu*

Design Challenge

Conceptual Design of SAR with SDR

Design Goals

- Convert Coffee Cans to Antennae
- Program SDR with GNU Radio
- Object Identification

Knowledge is knowing is a tomato is a fruit. Wisdom is knowing not to put a tomato in a fruit salad. – Tyler Hernandez

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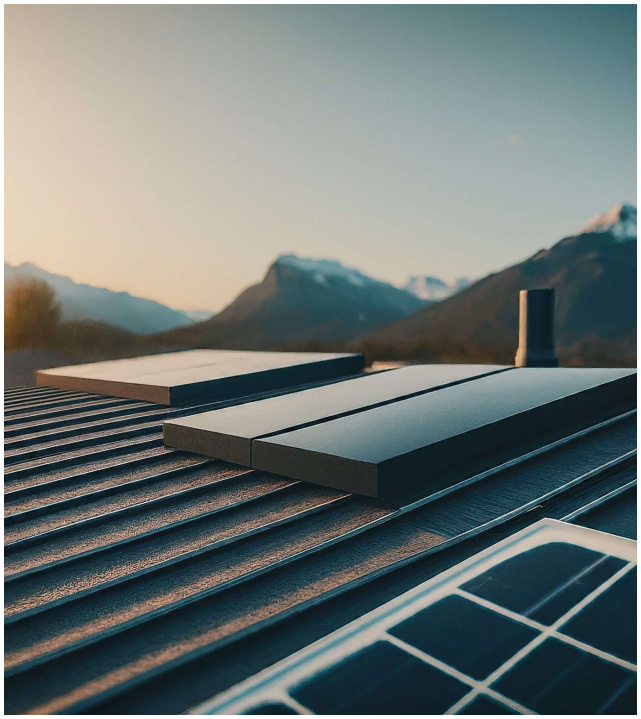
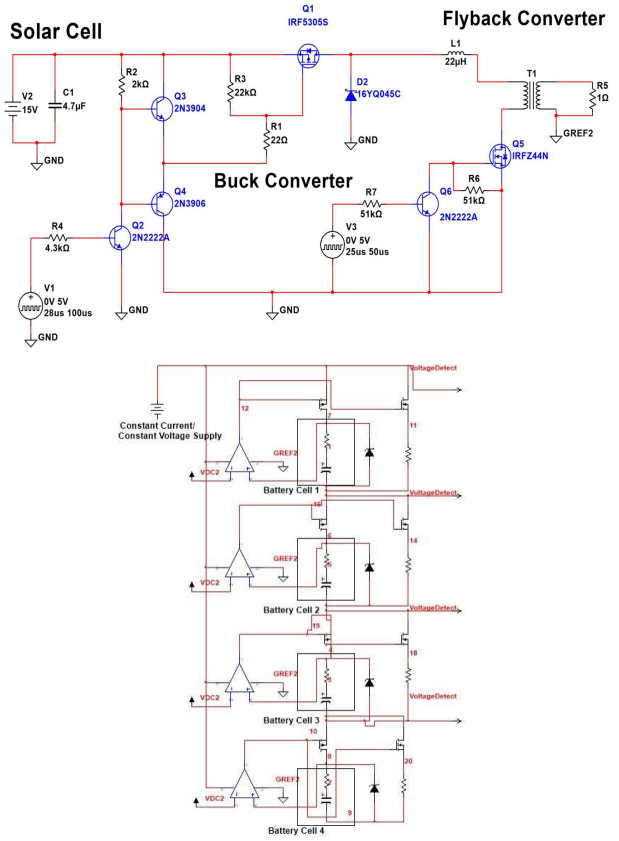


AI-generated images by Google Gemini



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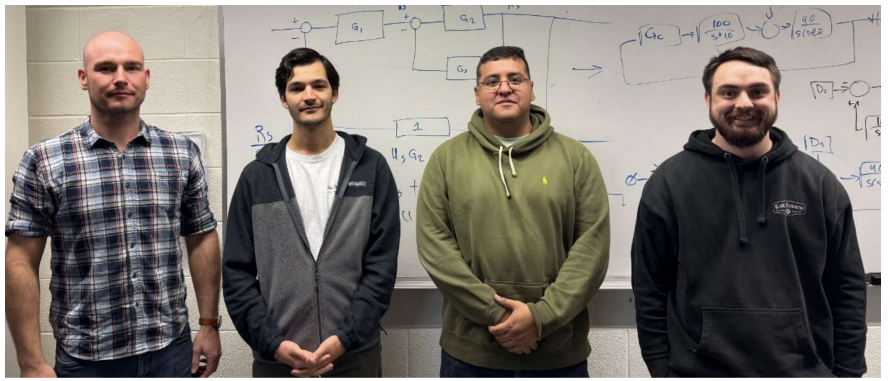
Enabling Battery Development with Artificial Intelligence

Funding Agency: ARMY ASPIRE Capstone Project

Build a LiFePO4 charging and discharging system using Arduino to harness solar energy. Integrate a program using Kalman filter and neural network machine learning to create an AI that can predict remaining useful lifetime (RUL). In particular, the AI's scope will focus on state of charge (SOC) detection.

Team Members: *Brandon Hedelund, Karl Hotys, Bryant Humud-Arboleda, Robbie Reinert*

Advisor: *Dr. Gon Namkoong*



Design Challenge

Create a charging system with an AI predicted lifetime feature.

Design Goals

- Create a battery bank
- Charge battery with solar energy
- Monitor and predict battery life with AI

> ***"Is AI taking over?"***
> ***-Brandon Hedelund***
> ***"If you build it, they will come."***
> ***- Bryant Humud-Arboleda***

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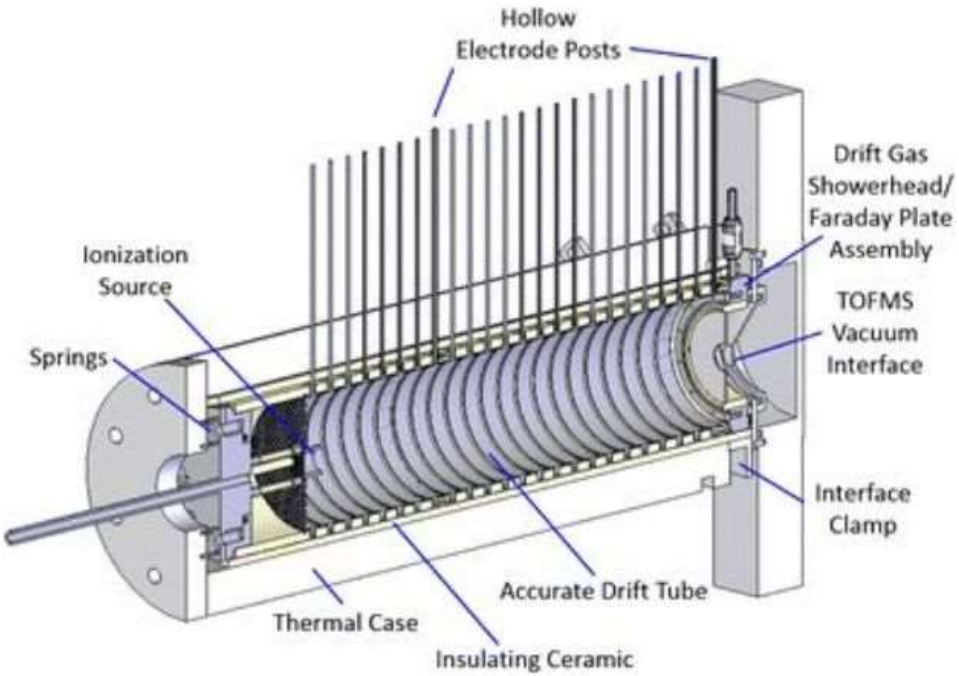

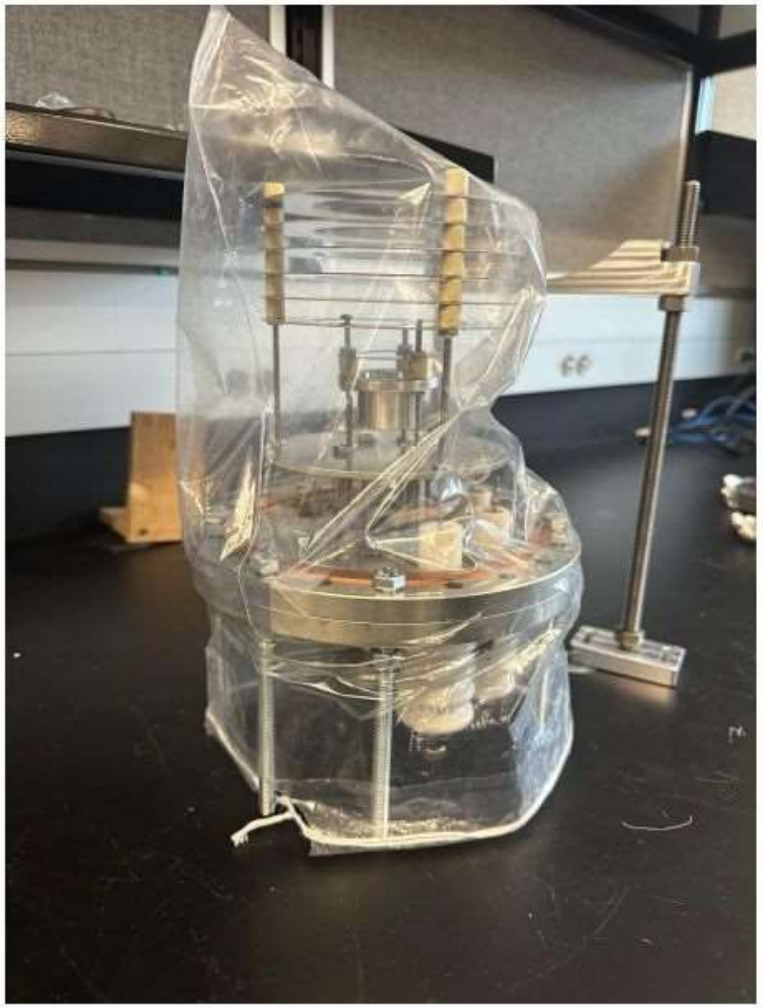

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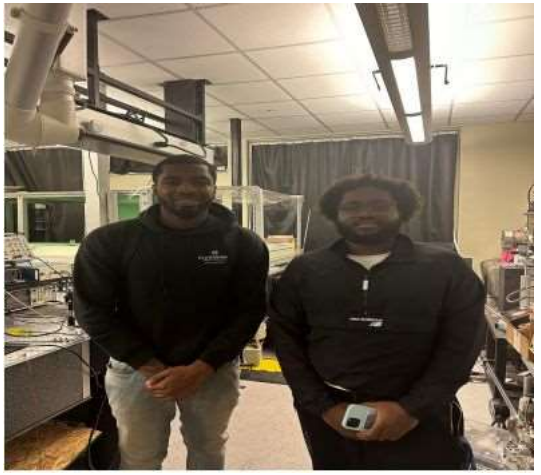
Design of an Ion Pulse Compressor for a Laser Mass Spectrometer

Funding Agency: National Science Foundation

The goal of this project is to develop an ion pulse compressor for a laser mass spectrometer. This is to improve the precision of the spectrometer by compressing ion pulses. We will be measuring the mass to charge ratio by using time of flight. We must then test and simulate the Reflectron and the electrodes.

Team Members: *Jamari Roper and Enoch Ampong*

Advisor: *Dr. Hani E. Elasyed-Ali*



Design Challenge

To develop a Reflectron for a Laser Mass Spectrometer

Design Goals

- Create the Reflectron design using AutoCAD
- Test the Reflectron
- Test the ion trajectory using Simeon
- Simulate the reflectron electrodes

“Charge the present to electrify the future.” -Jamari Roper

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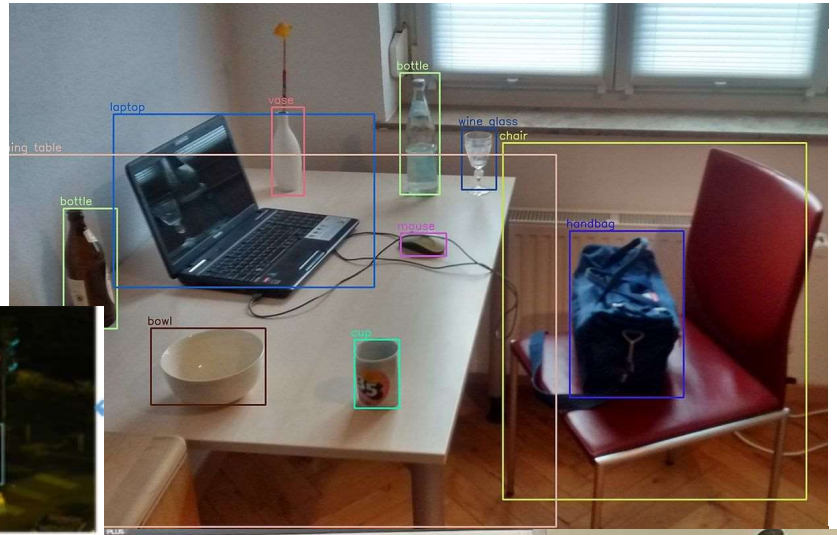
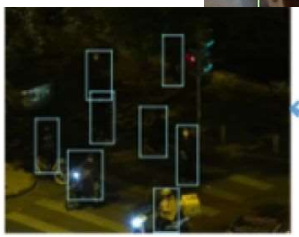
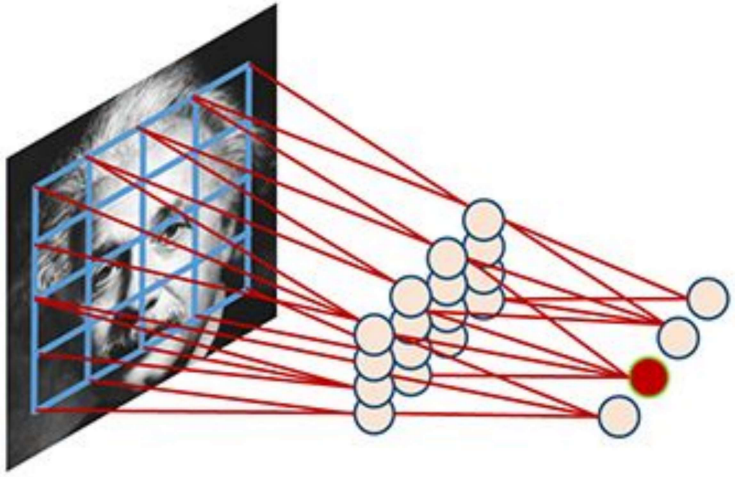




Labeled Visible Image

Labeled Infrared Image



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Exploring Visibility Metrics

Funding Agency: Army NVESD

Researching methods to gauge the probability of an object being detected in an image without having a detection scheme algorithm. Implement a visibility metric to analyze, determine characteristics, and detect the likelihood of an object.

Team Members: *Rich Case, Jacob Winebarger*

Advisor: *Dr. Khan Iftekharuddin*

Design Challenge

Detection of objects in low light conditions

Design Goals

- Accuracy(output a reliable probability)
- Robustness(Can perform in various environment conditions)
- *Efficiency(Able to analyze images quickly)*
- *Budget is 7k*

> ***The key to progress is to take the biggest goal and break it down into the smallest goal.***

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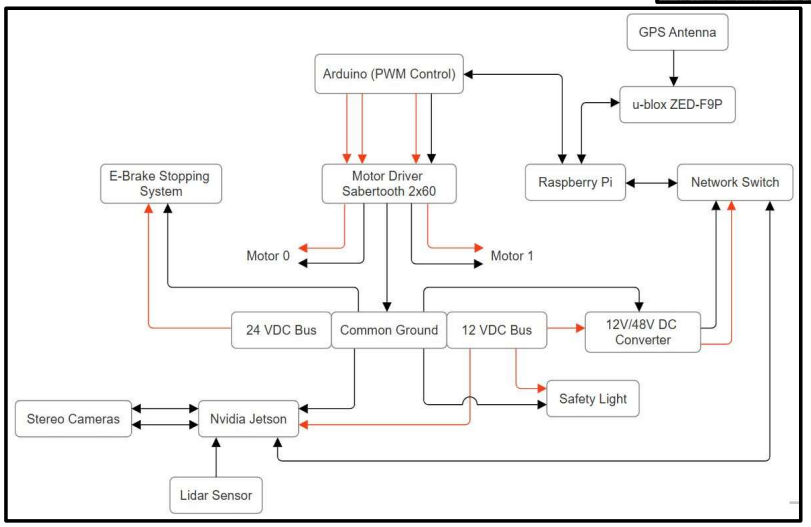

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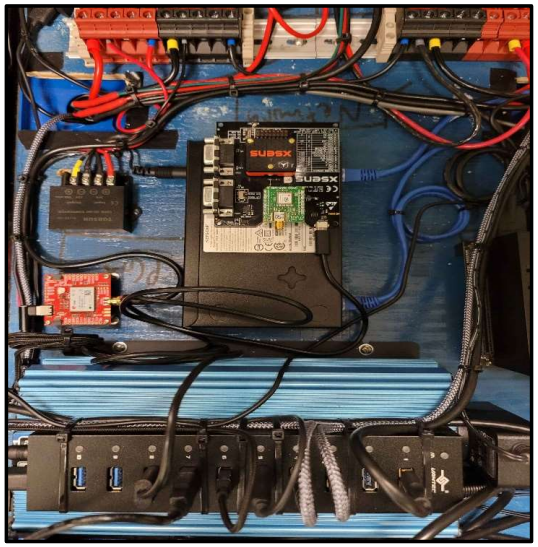
Intelligent Ground Vehicle

Funding Agency: ODU

The objective is to design an autonomous vehicle capable of sensing the environment and moving autonomously towards some prescribed goal while navigating a course that can include traffic controls and obstacles.



Team Members: *Julia Miller, Jared Cochran, Tyler Cason*
Advisor: *Dr. Lee Belfore*

Design Challenge

Extending an existing A.I navigation system by adding additional sensors like IMU, LIDAR, and camera data.

Design Goals

- Sensor and platform integration
- Control system design for speed and steering
- Design/refinement of Robot Operating System

> **Sometimes the grass grows taller in the desert, but only when no one is looking – Julia M.**

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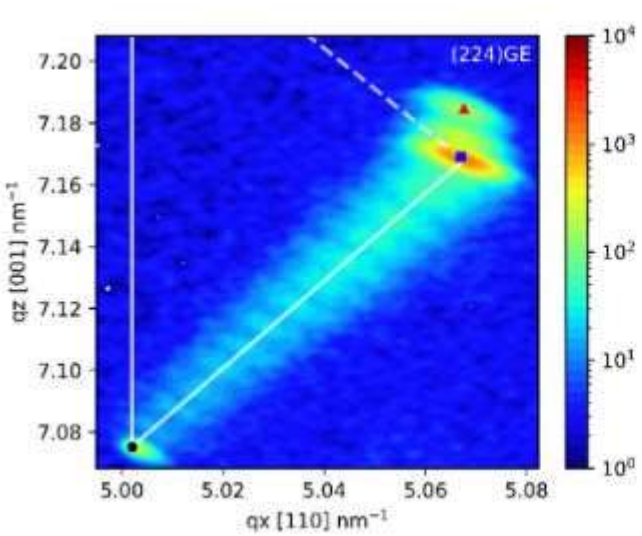

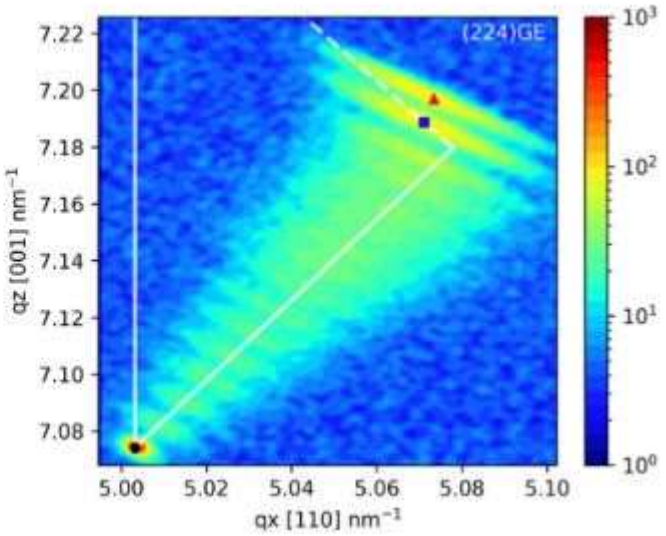

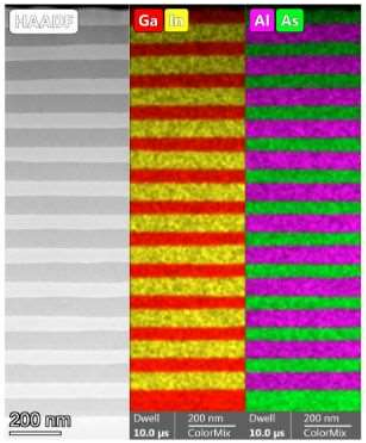

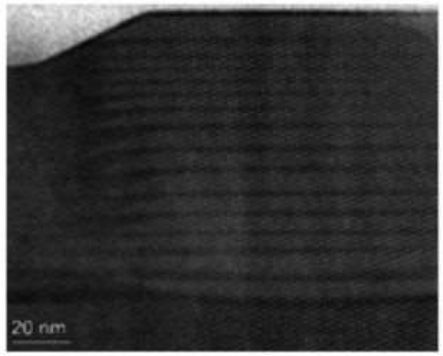

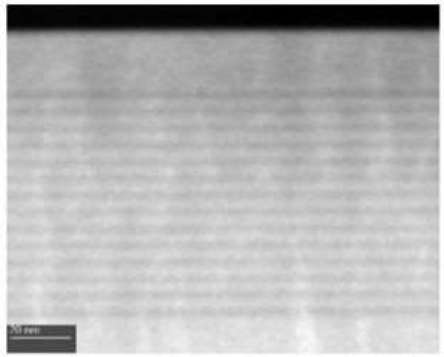

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Enhancing Spin Polarized Electron Sources

This project involves the designing of spin polarized electron sources which are used in nuclear energy experiments at the Thomas Jefferson Laboratory (JLab).

Team Members : *Marjorie Cenese, Arthur Hill, John Hill*

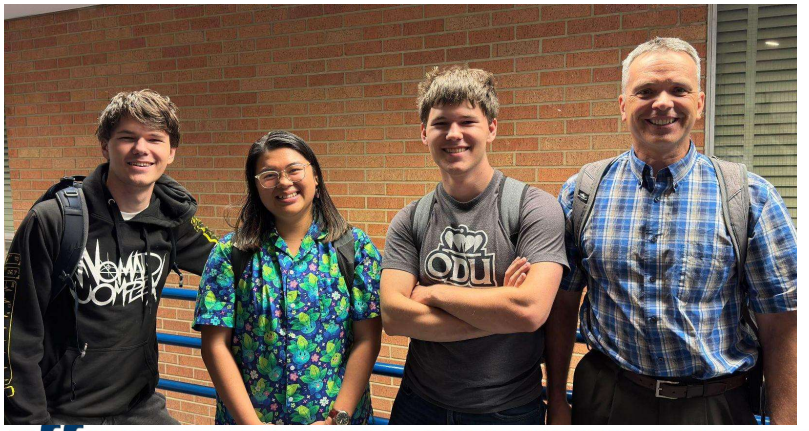
Advisor: *Dr. Sylvain Marsillac, Dr. Matt Grau*

Design Challenge

Design spin polarized electron sources

Design Goals

- Develop models of the devices using COMSOL Multiphysics
- Design the structure and materials for the devices
- Implement principles of photocathodes
- Apply design at JLab



“Quantum mechanics at 8:45a is hard.” - Dr. Marsillac

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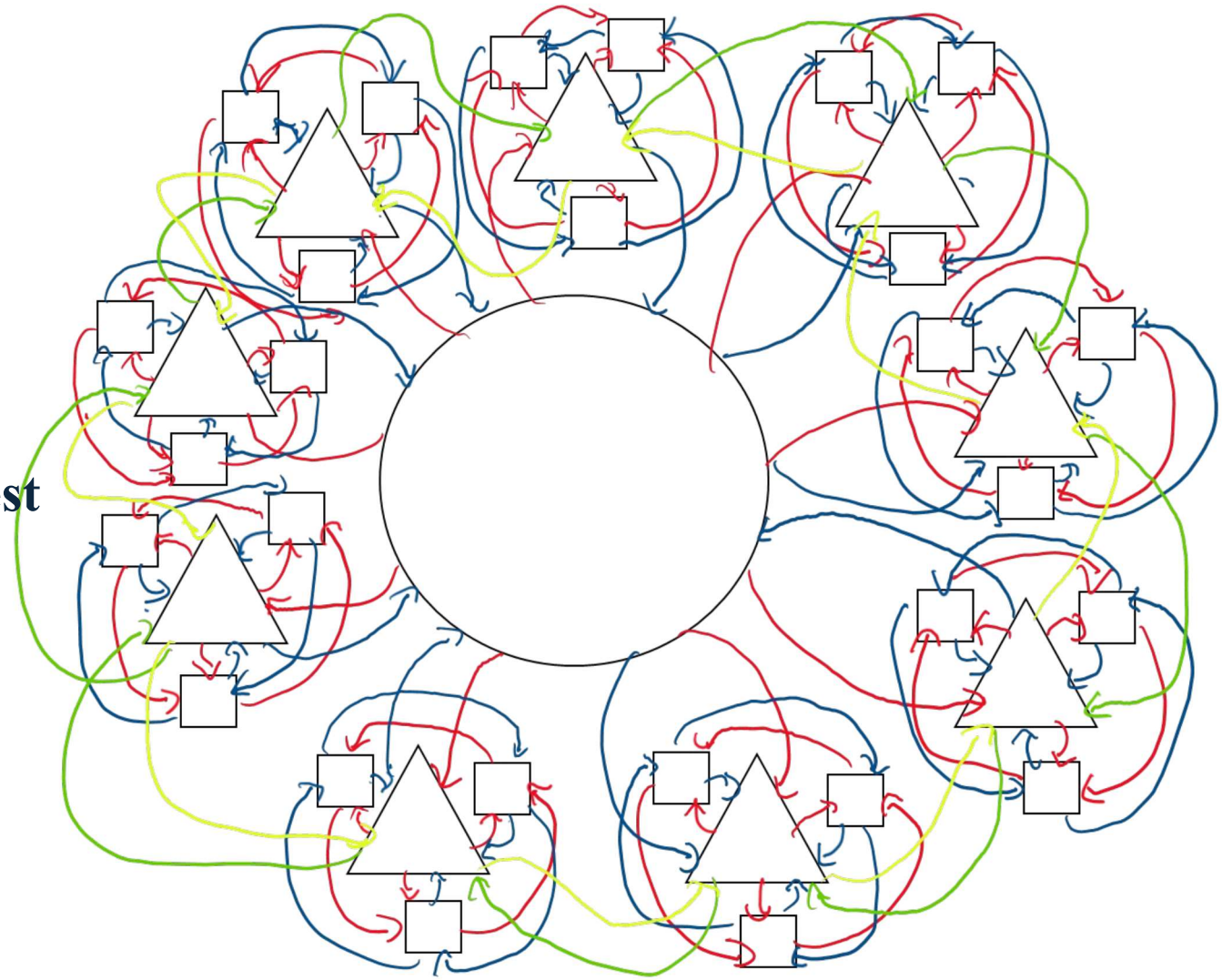
No matter how complex your request



AI will provide a tailored solution for it.

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Design AI for Technical Support
Funding Agency: HII-NNS.

This project will focus on an engineering design that will train an AI to provide technical support to an extent that seems impossible by humans.

Team Members : *George Bremansu, Michael Lael, Fabio J. Mairanafabianl*

Advisor: *Dr. Qianlong (Ronnie) Wang*

Design Challenge

Inclusive support without discrimination

Design Goals

- Build algorithm
- Design decision tree
- Test and retest results to fine-tune

> **"The future is shaped by those empowered to tackle today's challenges."**

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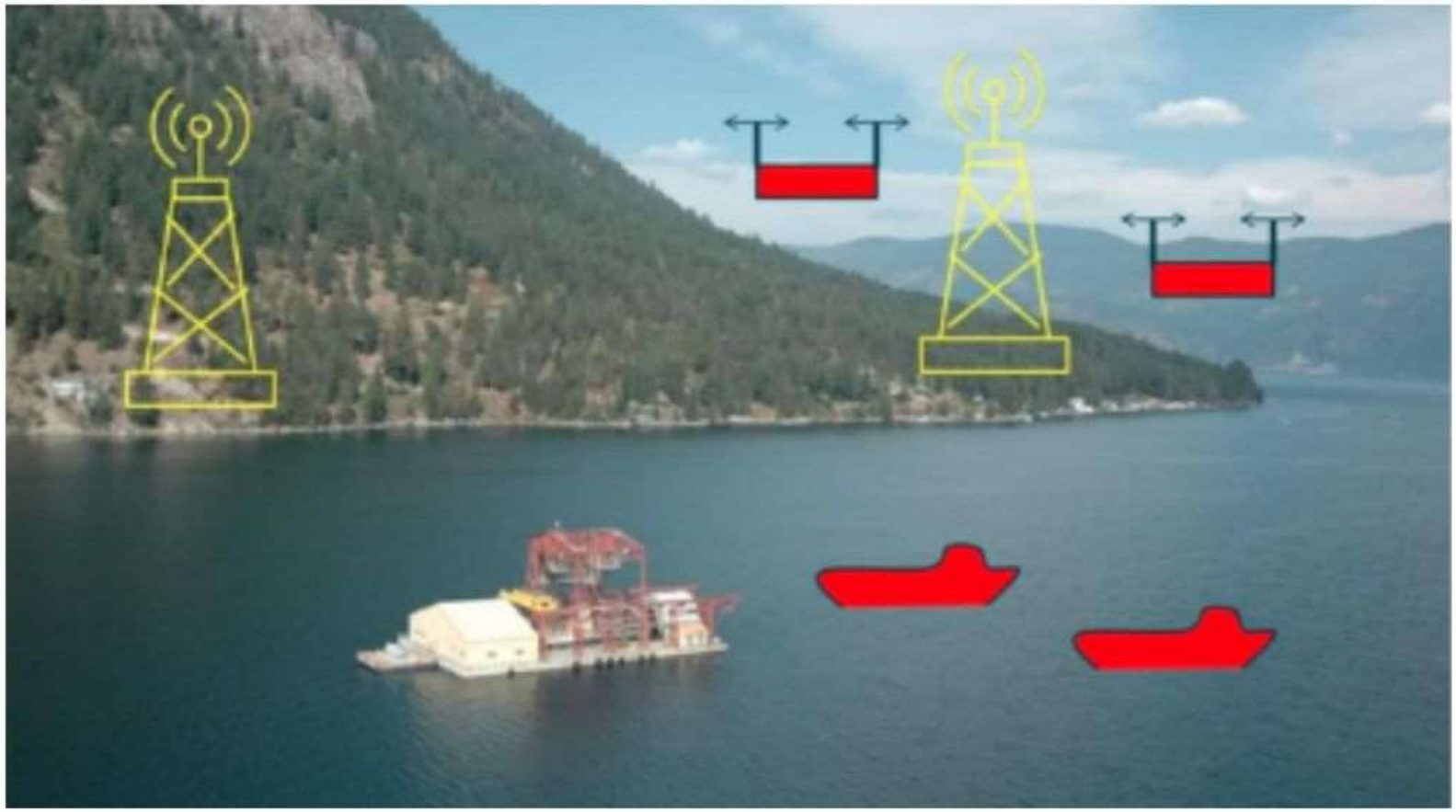

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Radio Frequency Emulated Training Environment

Funding Agency: NSWC Crane

The main objective of this project is to design an emulated Radio Frequency environment for testing and training purposes.

Team Members: *TaNiya Rolle, Josue Rodriguez, Anne Canlas*
Advisor: *Dr. Sachin Shetty*

Design Challenge

To emulate a civilian-level RF environment for military testing and training.

Design Goals

- Developing protocol-compliant signal sets
- Surveying radio frequency environments
- Designing machine learning algorithms
- Conducting water-based testing experiments

> **Emulating the unseen, we ignite the spark of innovation and open the door to boundless possibilities.**

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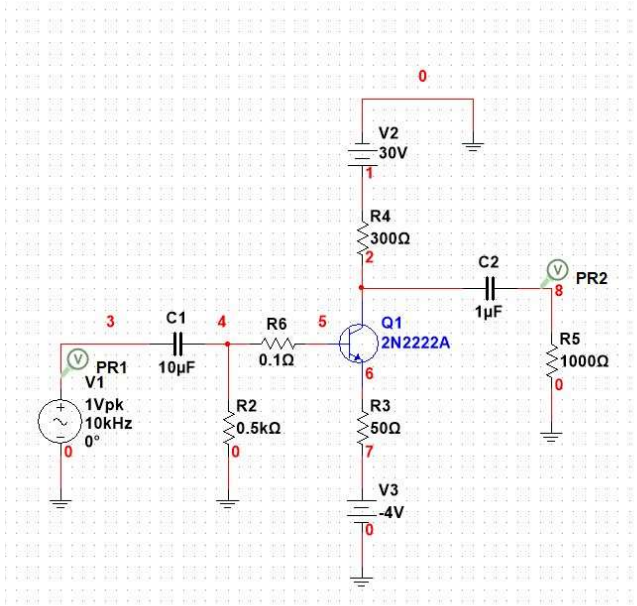

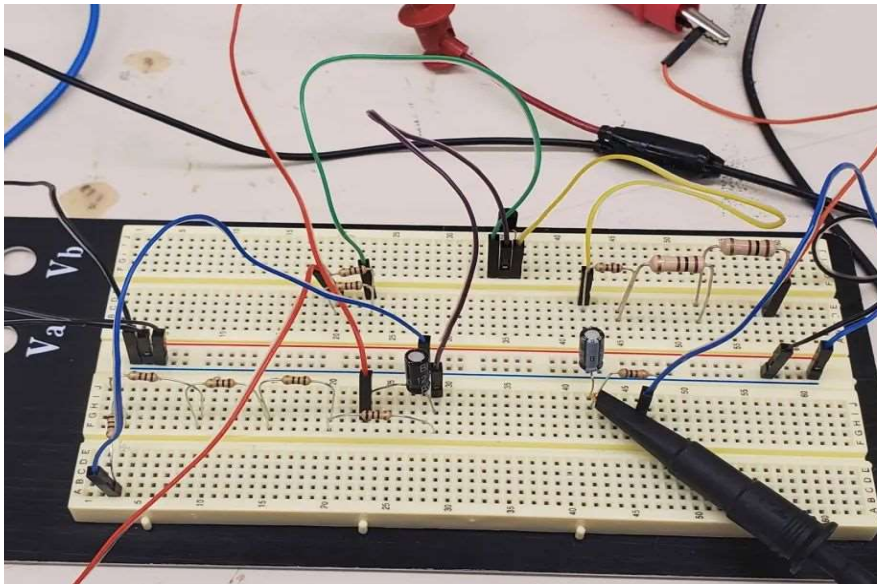

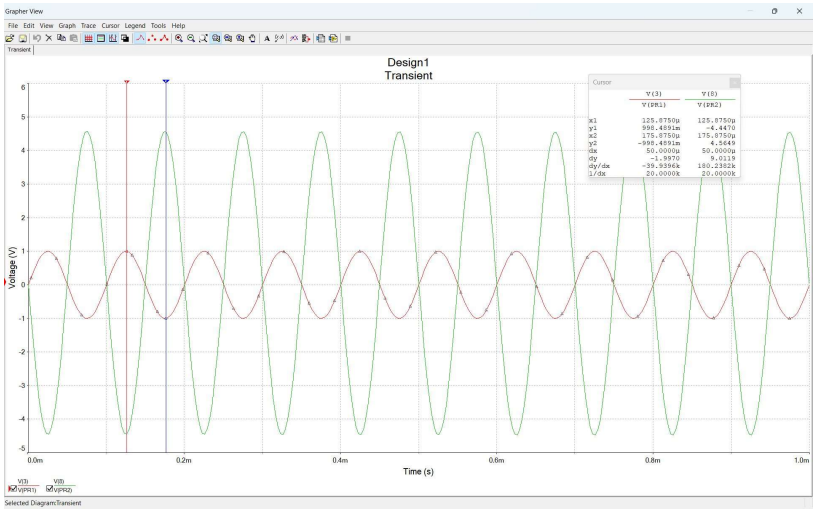

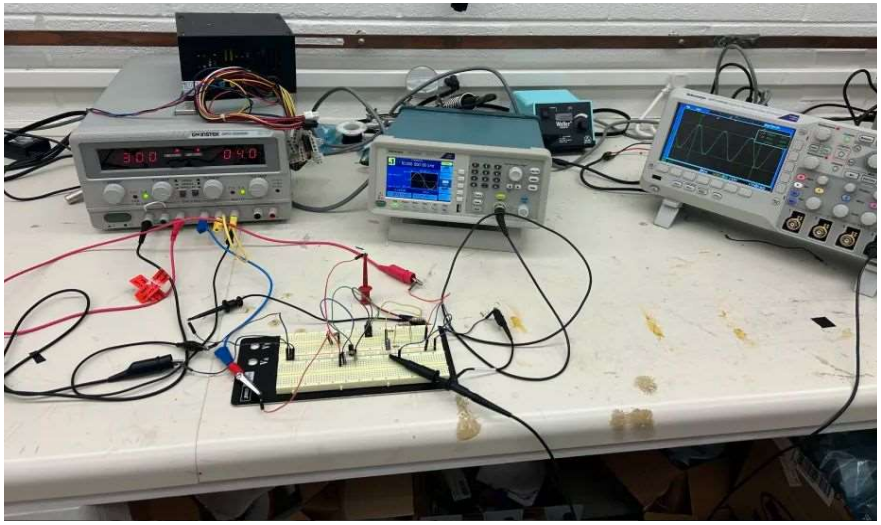

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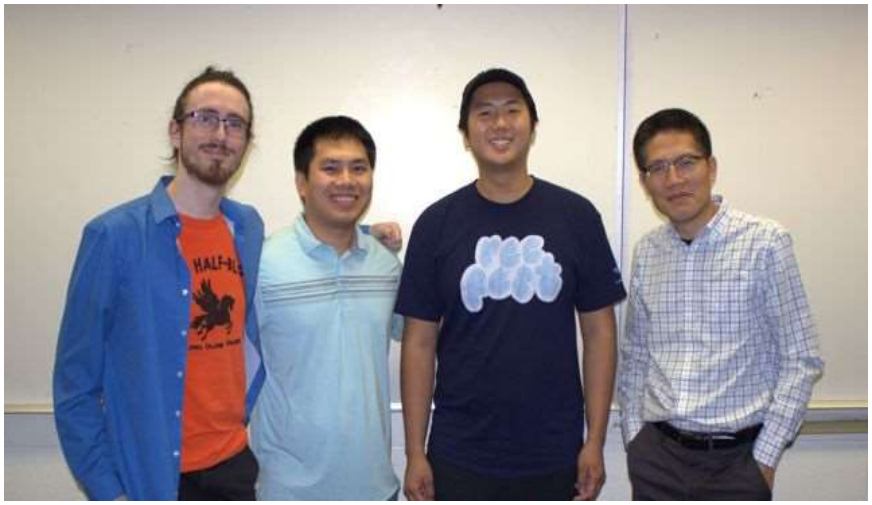
High-Power HEMT RF Amplifier Driver

To design a high-power HEMT RF amplifier driver optimized through simulations and testing for gain, efficiency, and signal performance.

Team Members: *Nicholas Hetrick, Phat Phuong, Tim Chen*

Advisor: *Dr. Shu Xiao*



Design Challenge

Design a high-power RF Amplifier.

Design Goals

- Create a driver to interface with a HEMT
- Operate from DC to 1GHz AC
- Produce average power of 50W

> **Step up to transform problems into solutions as failure is always an option.**

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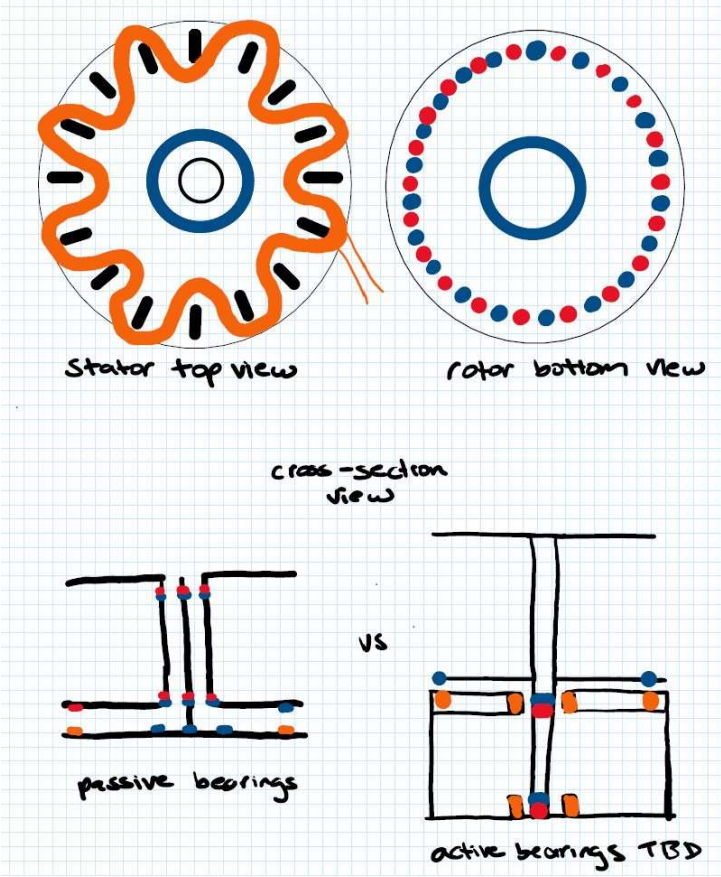

CAD mockup of wind turbine

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MAGLEV Wind Turbine Generator

This project's goal is to design, build, and test a residential wind turbine generator that uses magnetic levitation to provide friction-free rotor support. This will increase efficiency and performance of the generator.

Team Members: *Matt Jehle, Emma Kravets, Nehemias Wilkinson*

Advisor: *Dr. W. Steven Gray*

Design Challenge

Design and build a working and affordable magnetic levitation wind turbine generator.

Design Goals

- Optimize efficiency of the turbine
- Generate enough power to run a lightbulb
- Create a design that minimizes moving parts

> **Creating small scale, high efficiency wind turbines could help boost green energy production. -*Matt Jehle***

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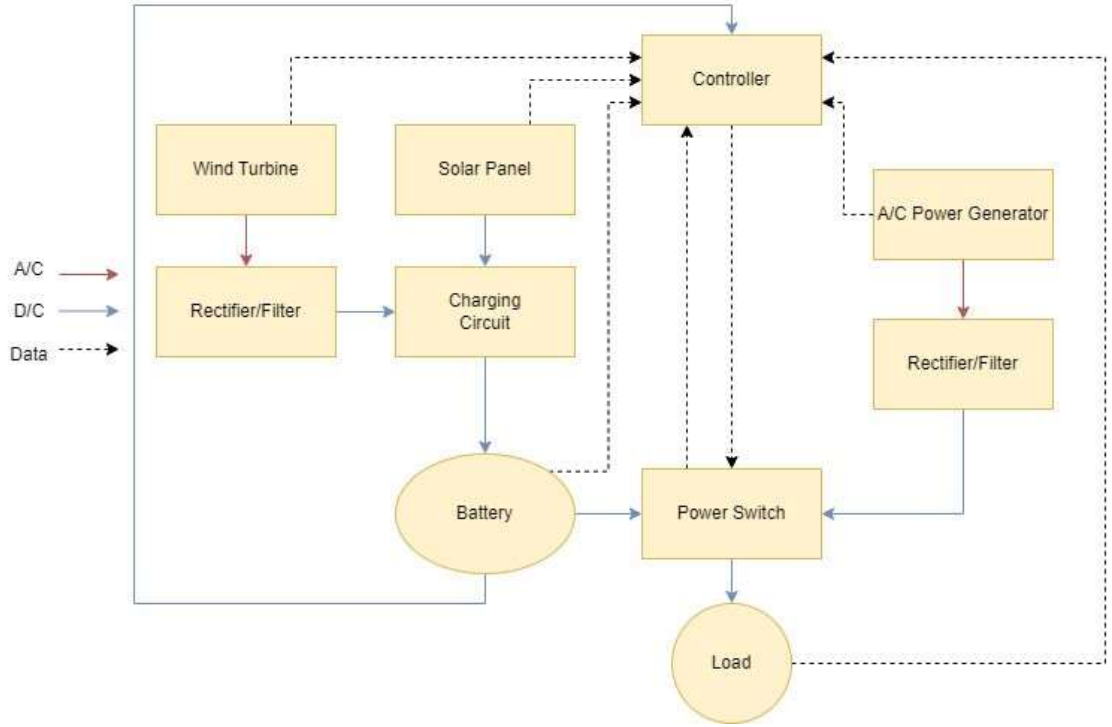
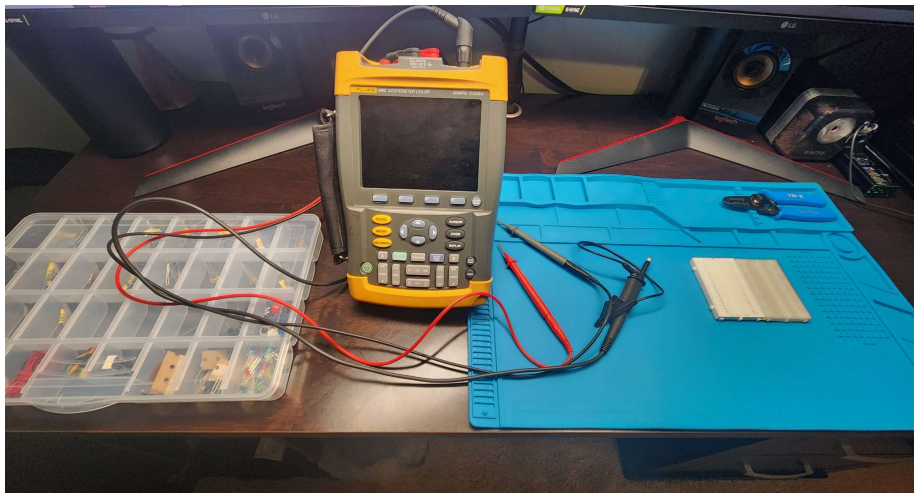




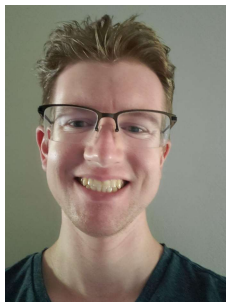
Smart Power Management System

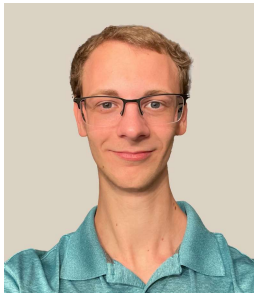
Funding Agency: ODU Dept. of Electrical and Computer Engineering

This project aims to reduce reliance on the aging power grid and move energy production to local renewable energy sources by utilizing a smart switching system.

Team Members: Christopher Marozick, Alex Ryan, Bryan Jones

Advisor: Dr. Waleed Al-Assadi





Design Challenge

Create a power management system to efficiently utilize renewable energy and backup grid power

Design Goals

- Design a power-sensing system to determine source viability
- Automatically, seamlessly switch sources in the event of a power failure
- Respond to fluctuations in power demand

"Knowledge is power. Power is control. We control power with our knowledge."
- Chris Marozick