ODU

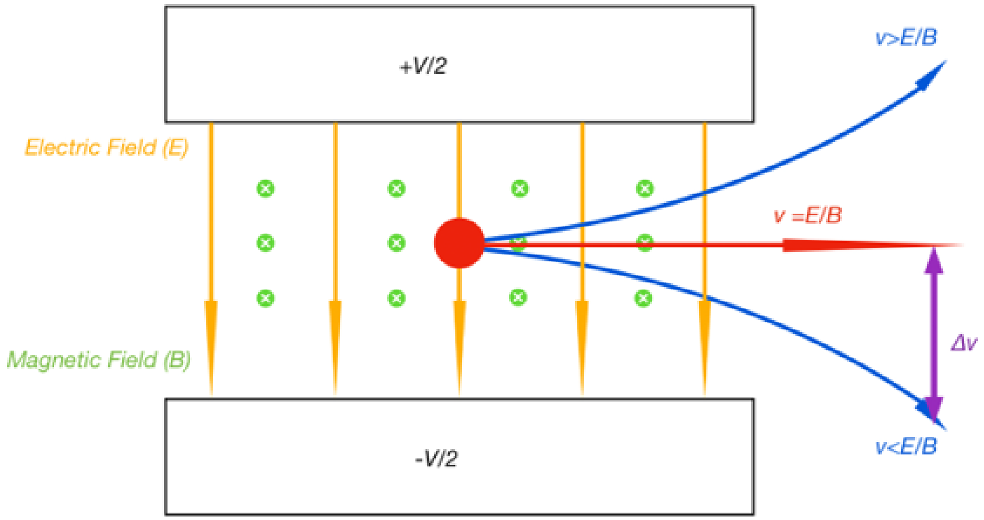
Department of Electrical & Computer Engineering

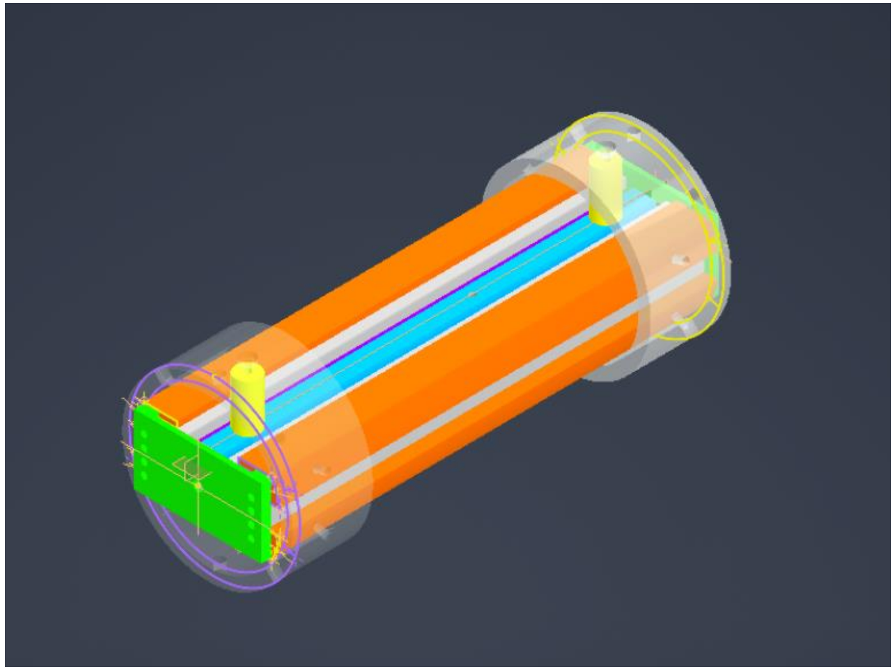
ECE 482 SENIOR DESIGN PROJECTS

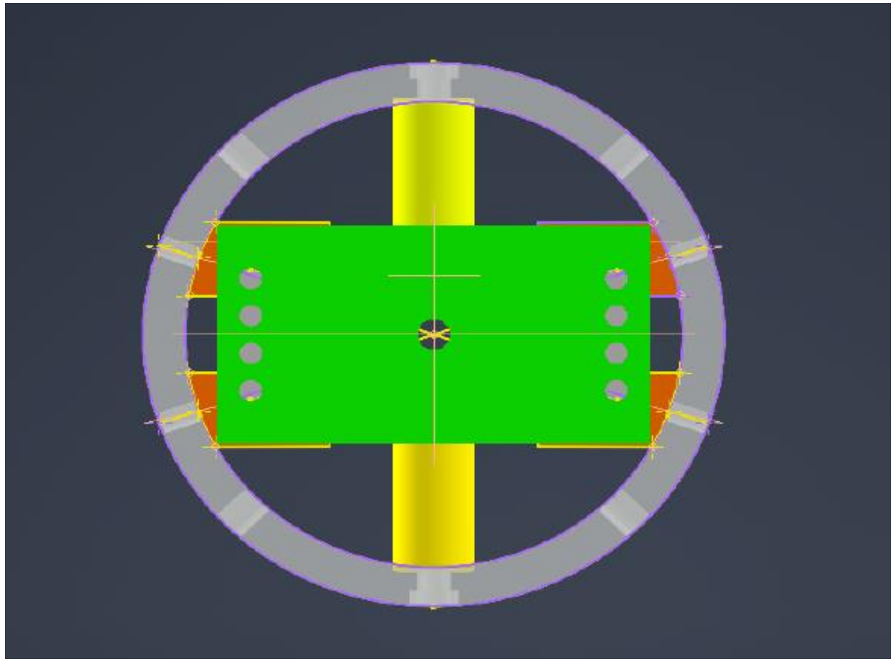
INNOVATING THE FUTURE IS WHAT WE DO

SPRING 2026

ODU
Department of Electrical &
Computer Engineering







ODU
Department of Electrical & Computer Engineering

Development of an Ion Velocity Selector for a Laser Ion Source

Funding Agency: National Science Foundation

Design, test and test a Wien filter for a laser ion source to select niobium ions with high precision.

Team Members : *Trey Warren, Riley Smith, TJ Allen*

Advisor : *Hani Elsayed-Ali*

Design Challenge

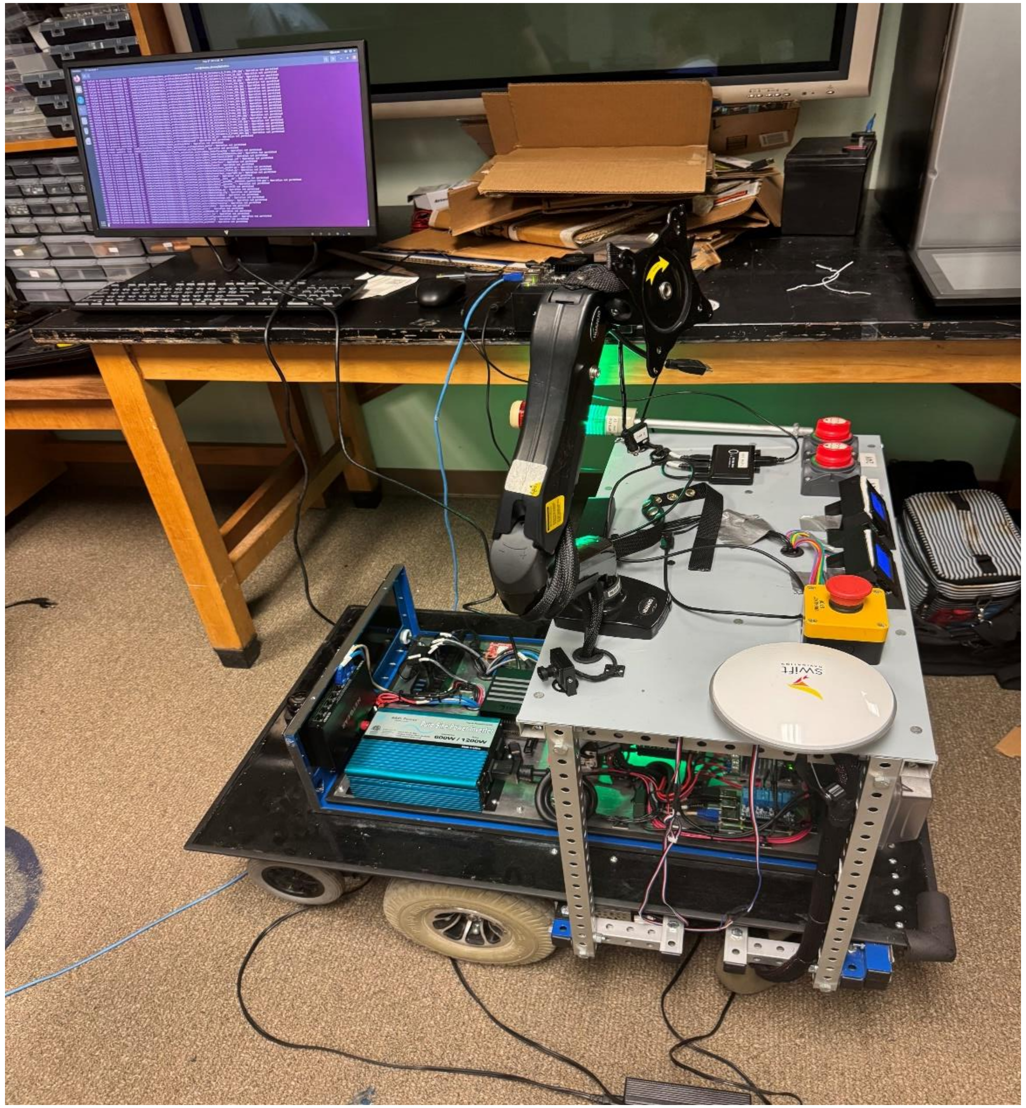
Design a working Wien filter that will fit into an ultrahigh vacuum 6-inch flange to be mounted on the laser ion source.

Design Goals

- Have an ion spread of $\Delta E/E < 10^2$
- Generate a 0.2-0.3T Magnetic field
- Maintain orthogonal E and B fields
- Fit into a 6-inch UHV flange

> **The whole universe is made up of the interplay of electric and magnetic forces.- Michael Faraday**

ODU
Department of Electrical & Computer Engineering



Autonomous Intelligence Ground Vehicle

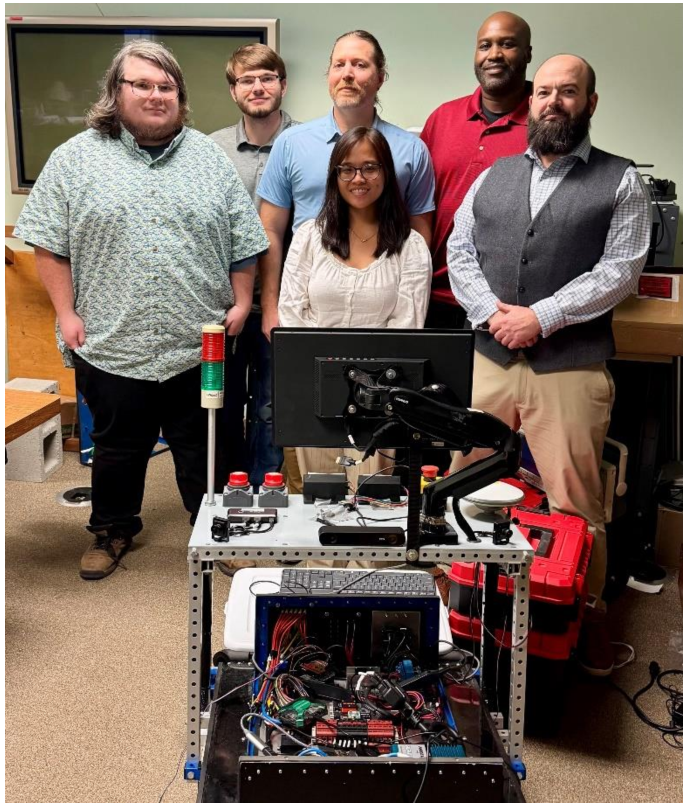
ODU
Department of Electrical & Computer Engineering

Funding Agency: Old Dominion University

Design and construct an autonomous vehicle that will qualify and compete in the 2026 IGVC competition.

Team Members : *Andre Hayes, Jerrick Bradley, Thomas Maddox, Norisa Avillanoza, Jeremy Perkins, Robert Romero*

Advisor: *Dr. Lee Belfore*



Design Challenge

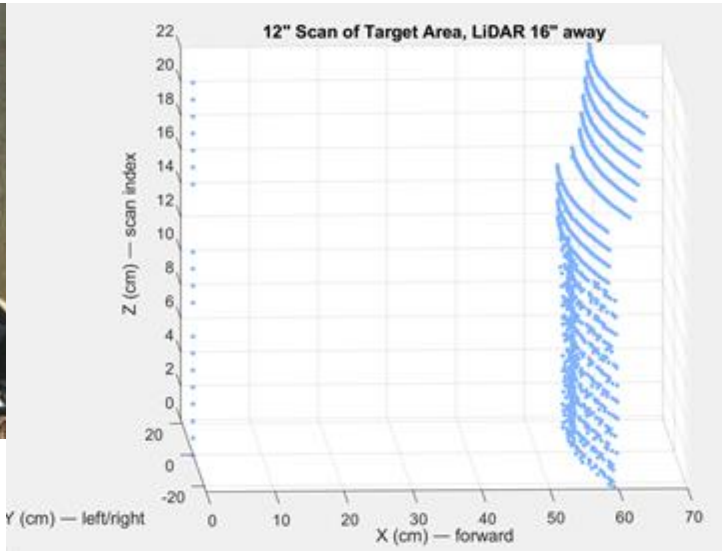
Enhance and adapt the current Little Blue vehicle model to meet the requirements for IGVC competition eligibility.

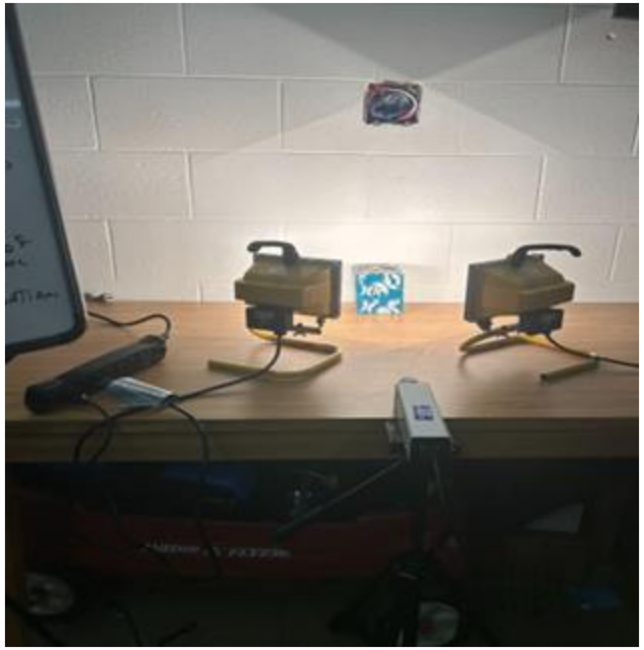
Design Goals

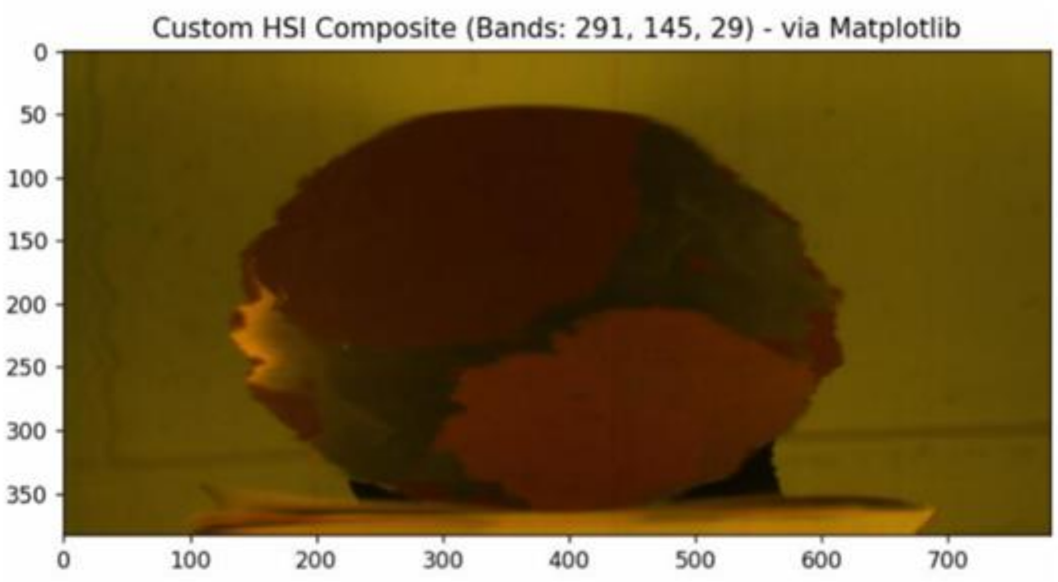
- *Eliminate Arduino brown-out to reduce any unstable operation.*
- *Enhance the camera system to deliver a high- resolution aerial viewpoint.*
- *Integrate an encoder for speed monitoring and control feedback.*
- *Deliver a vehicle that qualifies for IGVC competition.*

> ***The most effective way to begin is simply to take action.***

Department of Electrical & Computer Engineering





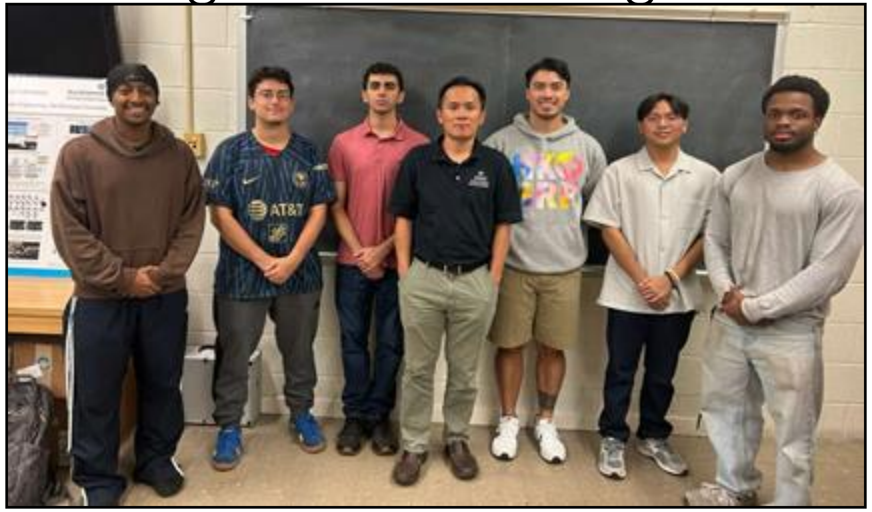


Department of Electrical & Computer Engineering

Autonomous Anomaly Detection Sensor (AADS) Prototype

Department of Defense

This project integrates LiDAR, Hyperspectral Imaging (HI), and RGB cameras to detect and classify corrosion in maritime tanks. LiDAR and 3D cameras create a digital twin for navigation and localization, while HI details surface conditions.



Team Members: Thomas Gaballa, Bradway Byrd, Patrick Nyanor, George Vassilakopoulos, Josh Gray, Nicholas Belber, Amanuel Yoseph

Advisor: Dr. Chung Hao Chen

Design Challenge

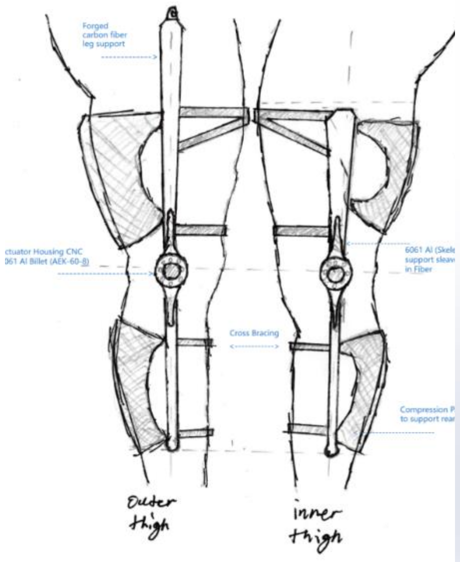
Develop an integrated sensing and analysis system that accurately detects, classifies, and monitors corrosion.

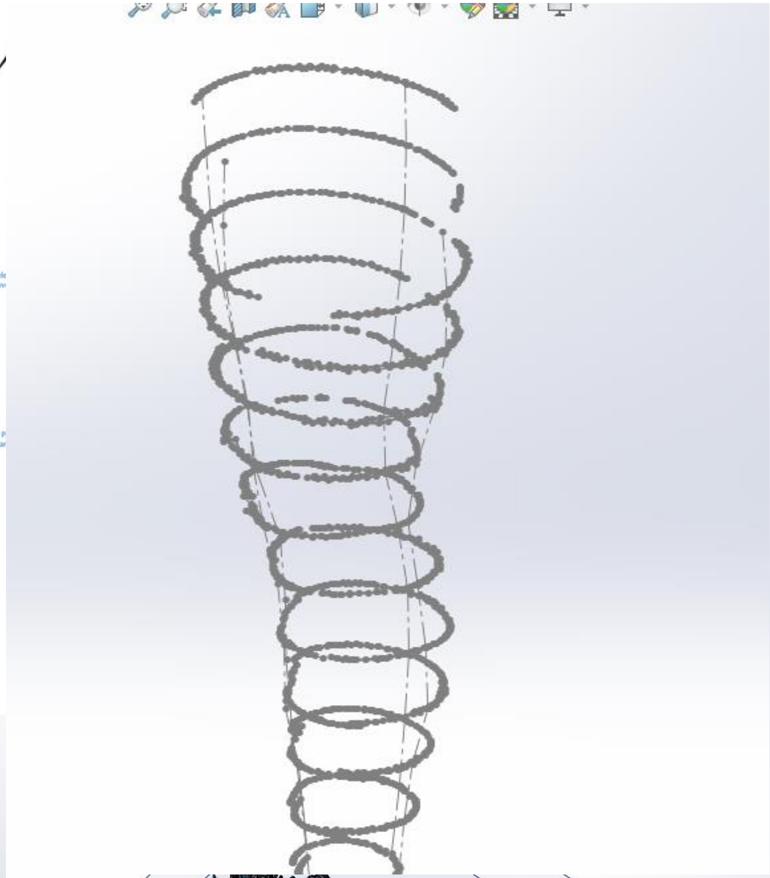
Design Goals

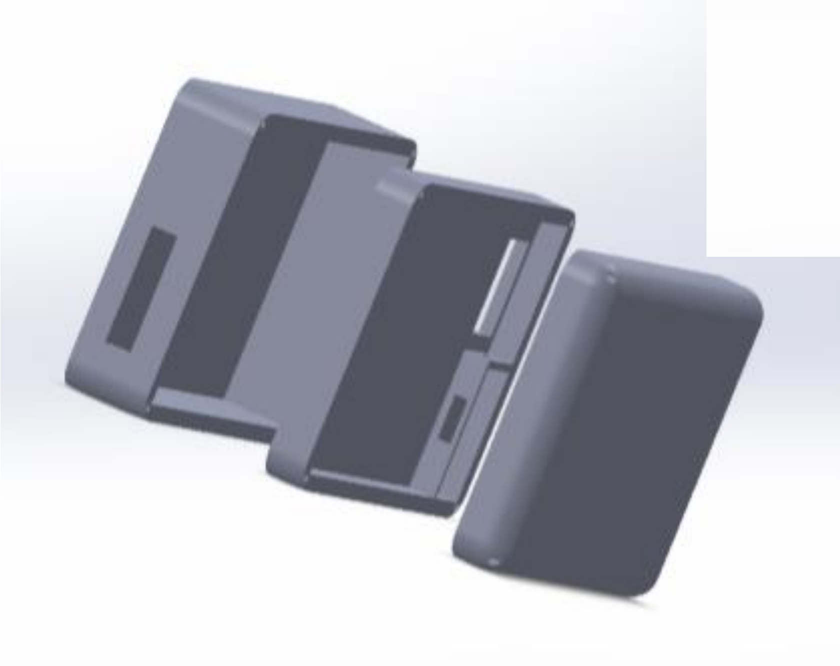
- Use a UAV with a 3D camera for RGB imaging
- Utilize LiDAR to reconstruct 3D mapping
- Develop HI sensing capabilities to differentiate corrosion levels

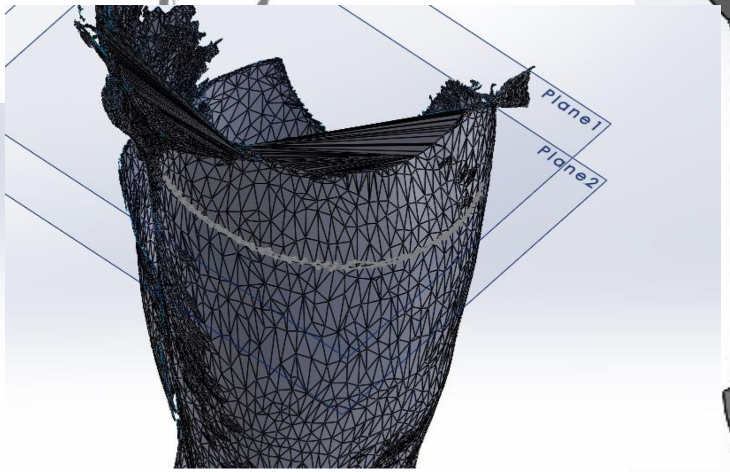
> **Corrosion never sleeps, but neither do we when it comes to protecting America's sailors.**

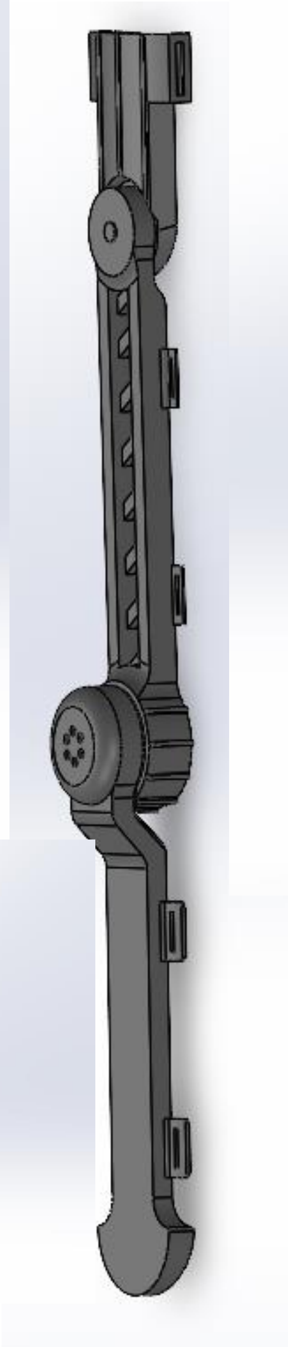
Department of Electrical & Computer Engineering

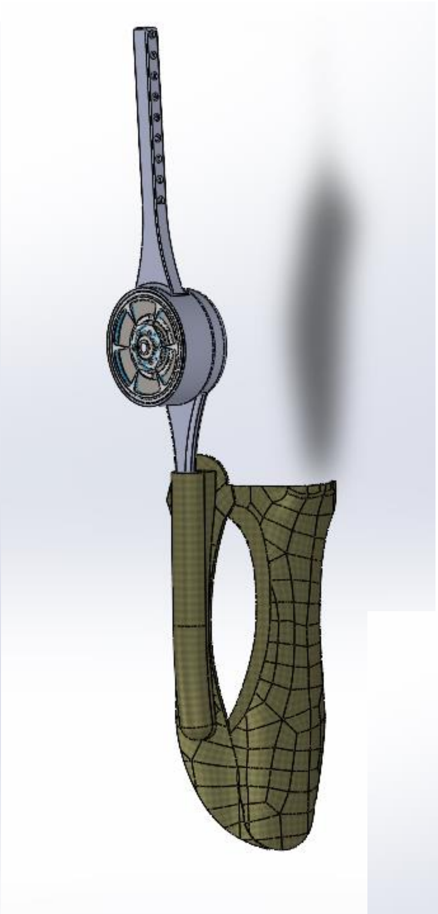


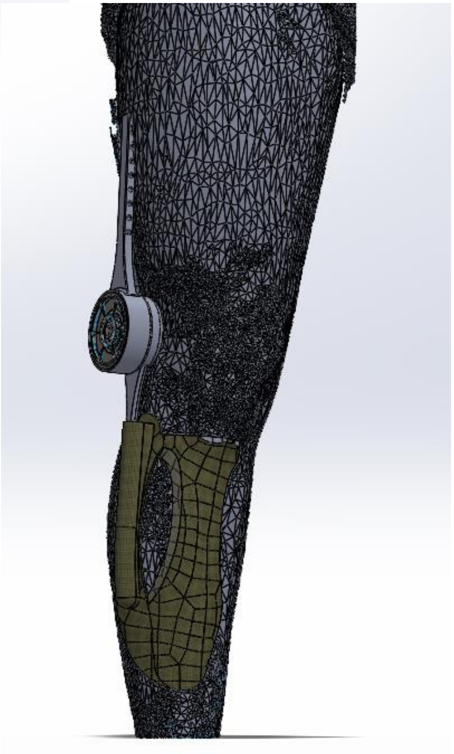












Lower-Limb Exoskeleton for Mobility
BCET and MAE Department

This lightweight lower-limb exoskeleton uses EMG and motion sensors to provide hip and knee assistance. Designed for safety and accessibility, it helps users with reduced mobility walk more naturally with less fatigue.

Team Members: *Roemell G., Qualei O., Lee S. Perrine V., Anthony H., Ethan S., Seth L., William C., Taniya R.*

Advisor: *Krisanand Kaipa*

Design Challenge

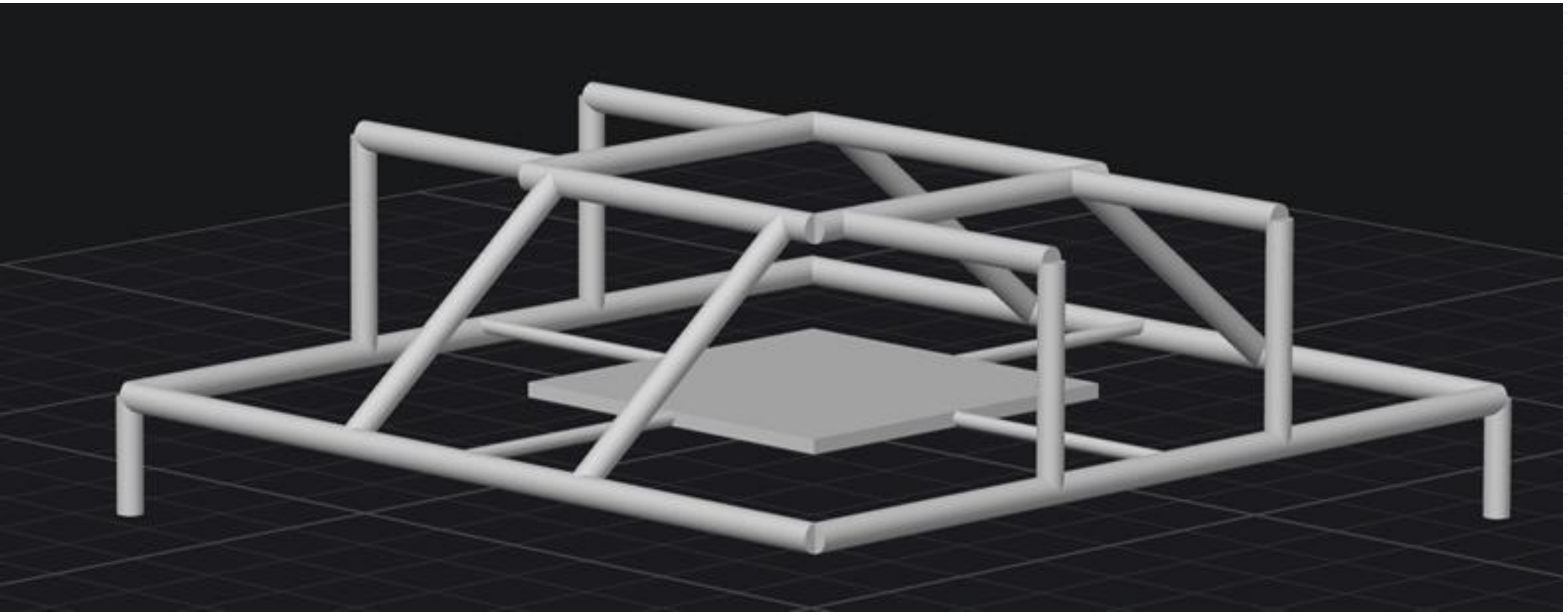
To develop a lightweight, affordable exoskeleton that safely delivers assistive knee torque while responding to real-time human movement intent.

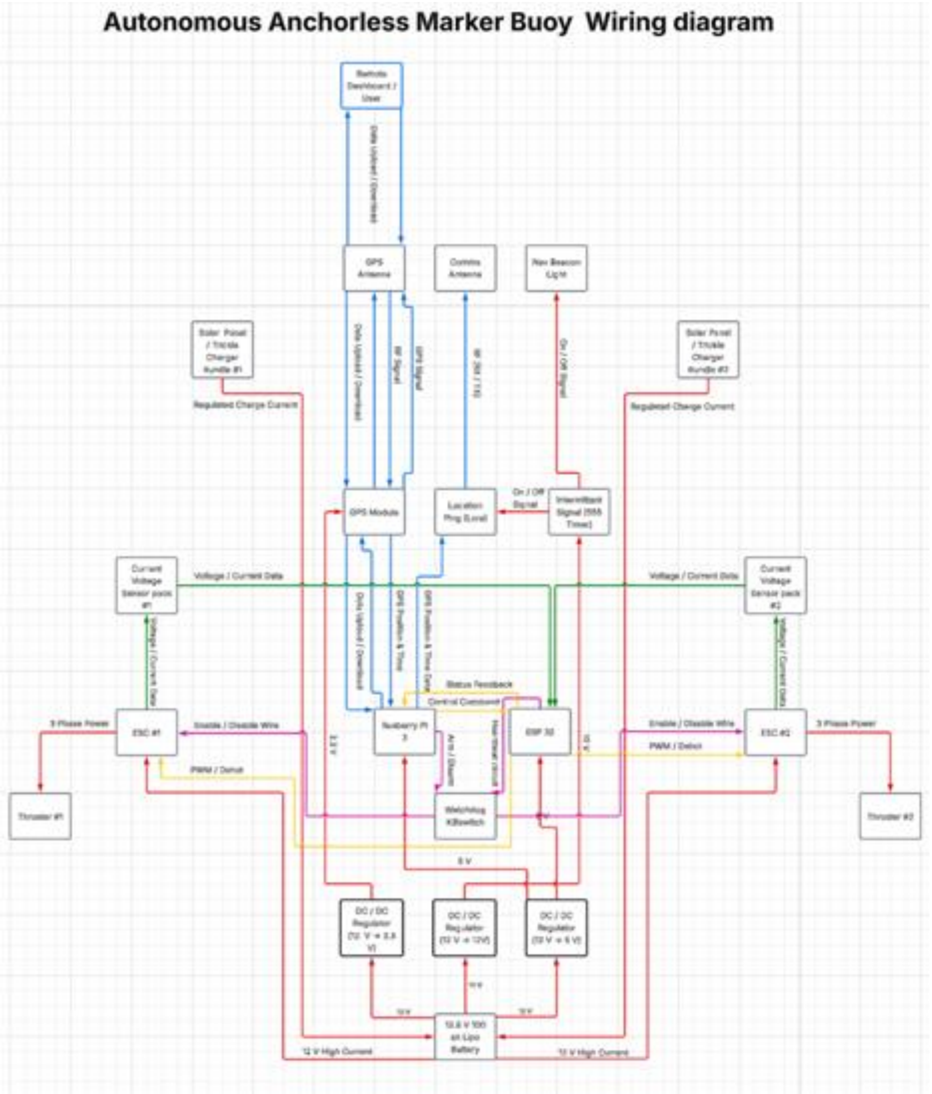
Design Goals

- Deliver controlled assistive torque up to 12.5 Nm using compact brushless actuators
- Integrate EMG and IMU sensors for real-time gait detection
- Ensure structural safety with FEA-validated components

"You have to be odd to be number one." - *Dr. Seuss*

ODU
Department of Electrical & Computer Engineering





ODU
Department of Electrical & Computer Engineering

Autonomous Anchorless Marker Buoy

Funding Agency: ODU ECE, ODURF, Dr. W. Steven Gray

This project's goal is to design, build, and test an anchorless smart marker buoy capable of holding its position autonomously. Using GPS guidance and thruster-based control, the buoy eliminates the need for traditional anchoring, increasing flexibility, scalability, and environmental safety in maritime applications.

Team Members: *RJ Bailey, Taha Bilal, James Ward, Brandon Stuck*

Advisor: *Dr. W. Steven Gray*

Design Challenge

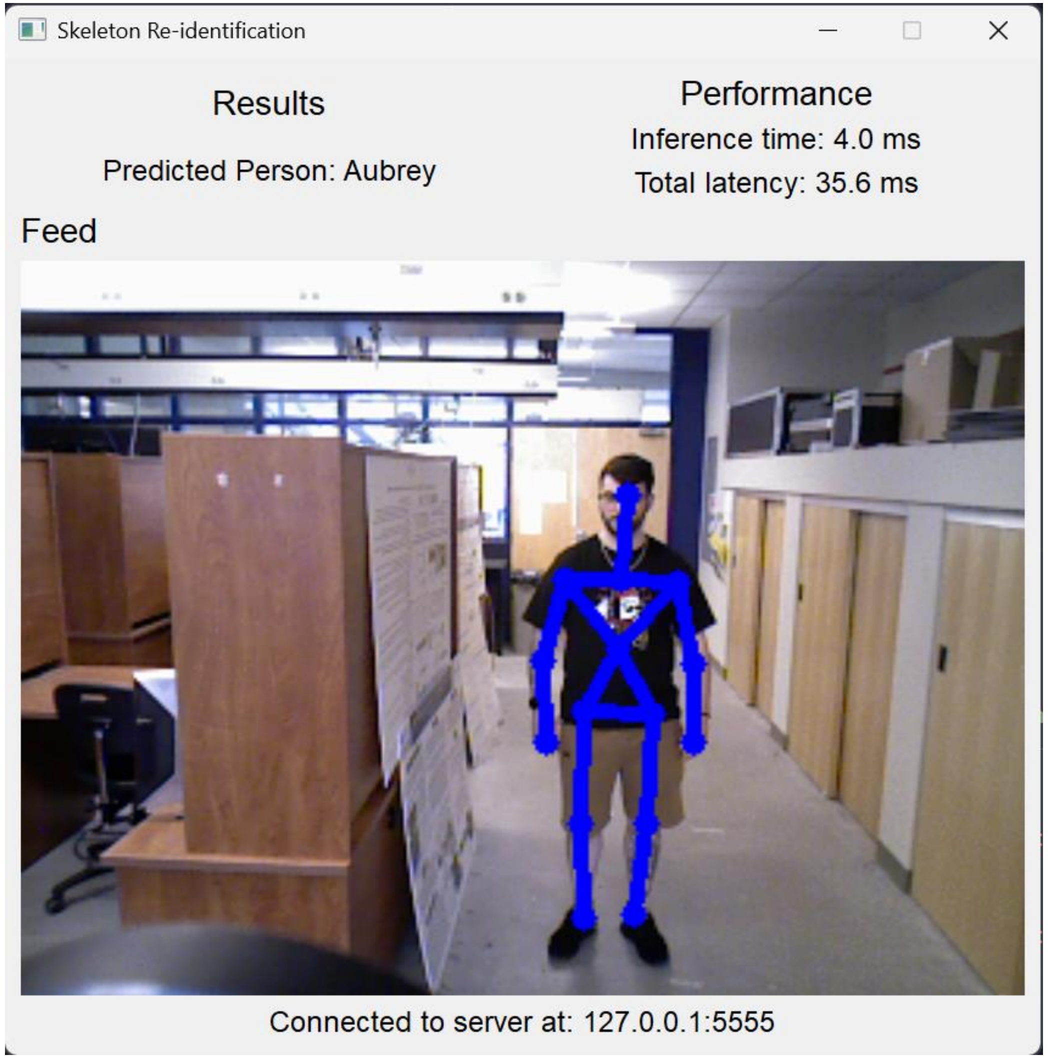
Design and build a functional and cost-effective anchorless smart marker buoy capable of autonomous positioning.

Design Goals

- Construct an operational prototype
- Achieve reliable autonomous positioning via GPS
- Adaptable under various maritime conditions
- Remotely-programmable using GUI

> ***A small buoy with a big mission.***
> ***-RJ Bailey***

Department of Electrical & Computer Engineering



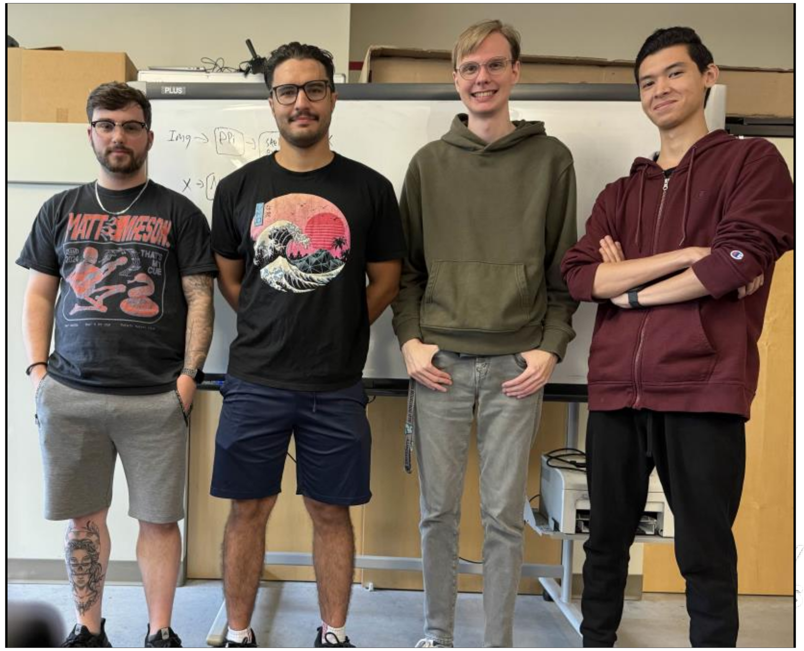
Skeleton-based Re-identification System

Funding Agency: *ODU ECE Department*

Development and Deployment of a Lightweight Skeleton-Based Person Re-Identification System for Real-Time Security Applications onto a Raspberry Pi Microcomputer.

Team Members: *Aubrey McKinney, Antonio Mendoza, Noor Humphreys, Seth Myers*

Advisor: *Dr. Khan Iftekharuddin*



Design Challenge

Run effective skeleton re-identification on a low-power microcomputer that is easily scalable and cost-effective.

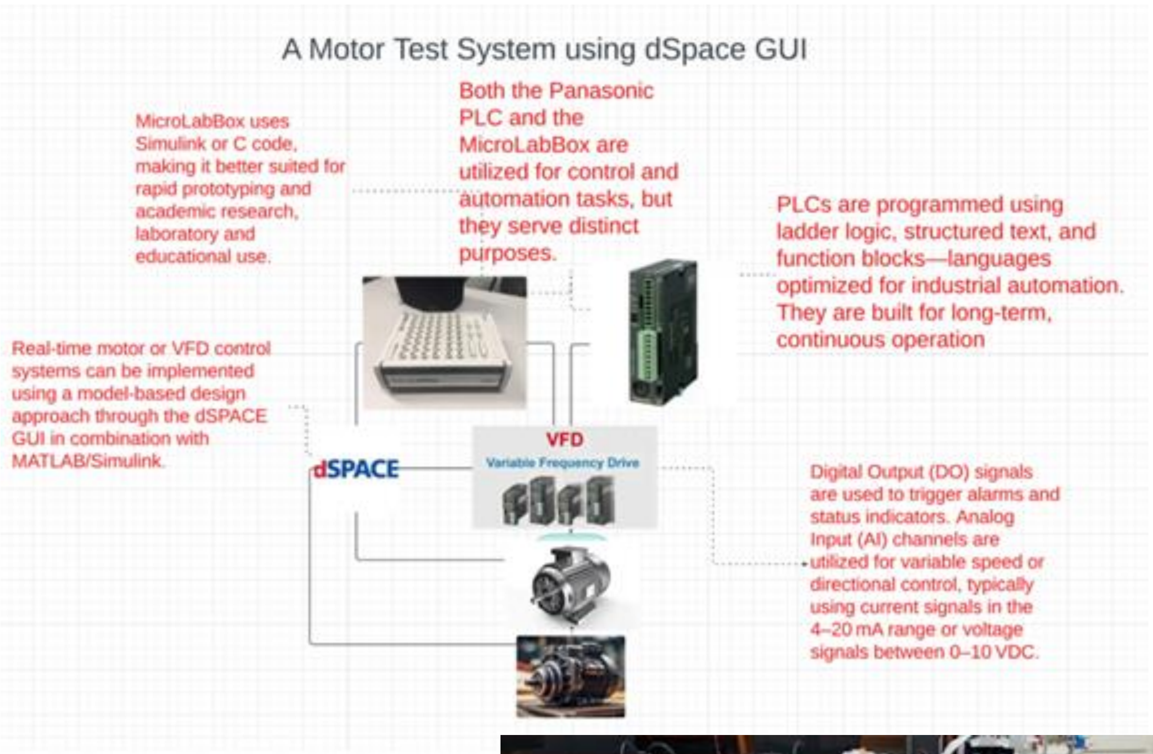
Design Goals

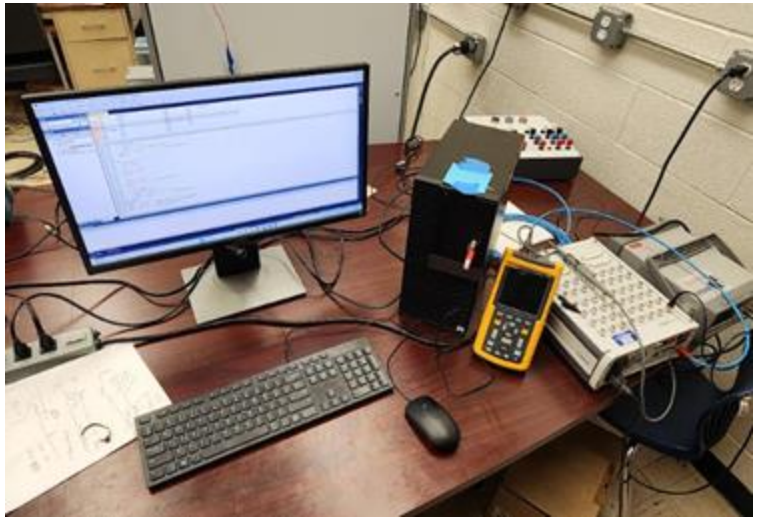
- Implement skeleton tracking with PrimeSense and FLIR thermal camera approaches
- Train a neural network to learn from data samples
- Create a user interface to display skeleton visualization and re-identification results

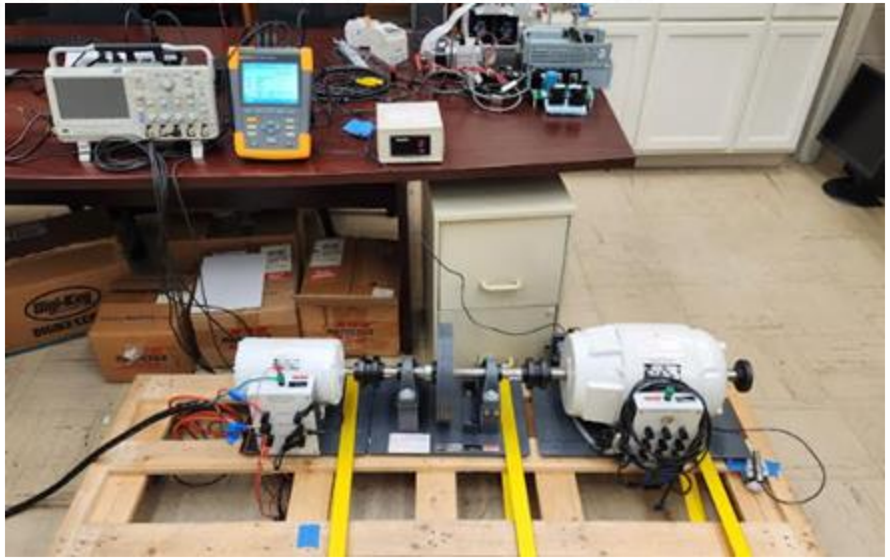
> **Parallel processing machine learning and human intelligence. -*Antonio Mendoza***

ODU

Department of Electrical & Computer Engineering







Motor Test System with dSPACE GUI

Funding: Self-Funded

ODU
Department of Electrical & Computer Engineering

A reusable dSPACE-based test bench that streamlines parameter identification, data capture, and visualization - turning classroom models into repeatable lab measurements for motors used in ODU courses and projects.

Team Members : *Alajuwan Mullins, Andrew Hobbs, Anthony Valenzuela, Daniel Noble, Joseph Jutton*

Advisor: *Dr. Shu Xiao*

Design Challenge

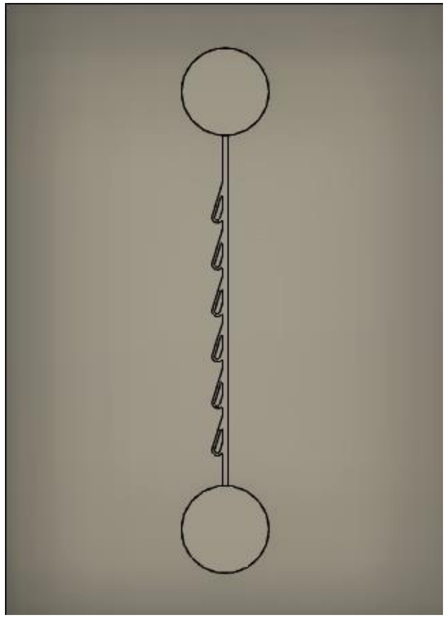
To develop a motor test system capable of determining a motor's intrinsic parameters

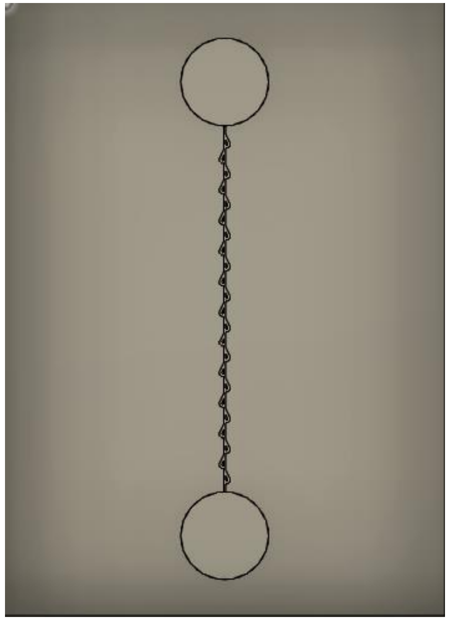
Design Goals

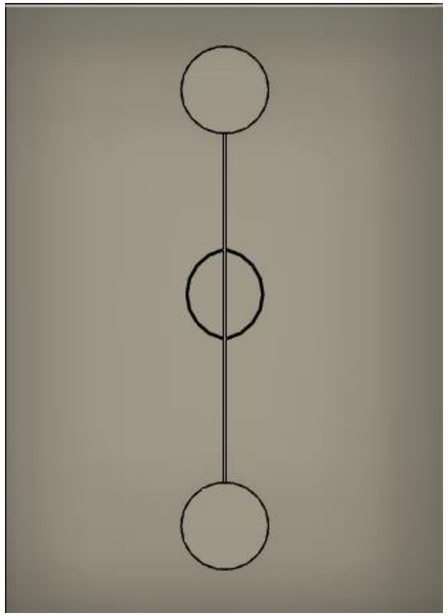
- Develop a reliable dSPACE-Simulink framework that integrates motor sensor inputs for a real-time parameter acquisition and monitoring
- Design and implement a user-friendly GUI that allows for streamlined data collection and visualization of motor behavior.
- Ensure accurate parameter measurement with minimal error while maintaining flexibility to adapt the test platform to different motor types and conditions.

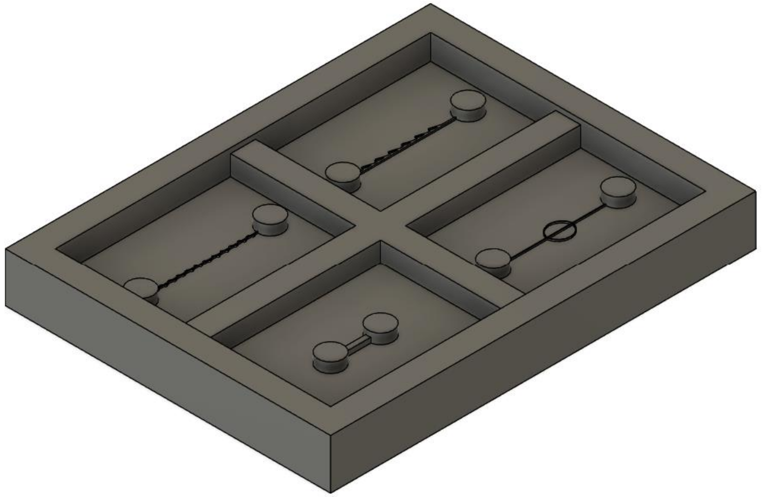
> **You can't improve what you don't measure. - Peter Drucker**

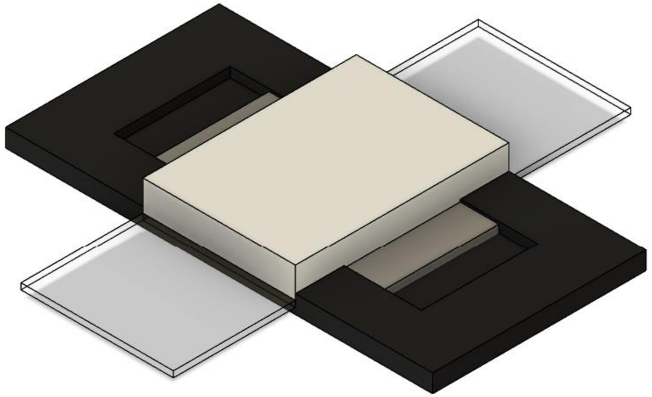
ODU
Department of Electrical & Computer Engineering











Magnetophoretic T-cell Isolation Device

National Science Foundation (NSF)

ODU
Department of Electrical & Computer Engineering

The goal of this project is to design, construct, and test a microfluidic channel that uses magnetic-activated cell-sorting (MACS) to isolate T-cells from a blood sample.

Team Members: *Megan Hayes, Cierra Sparrow, Randall Daigle*

Advisor: *Dr. Dharmakeerthi Nawarathna*

Design Challenge

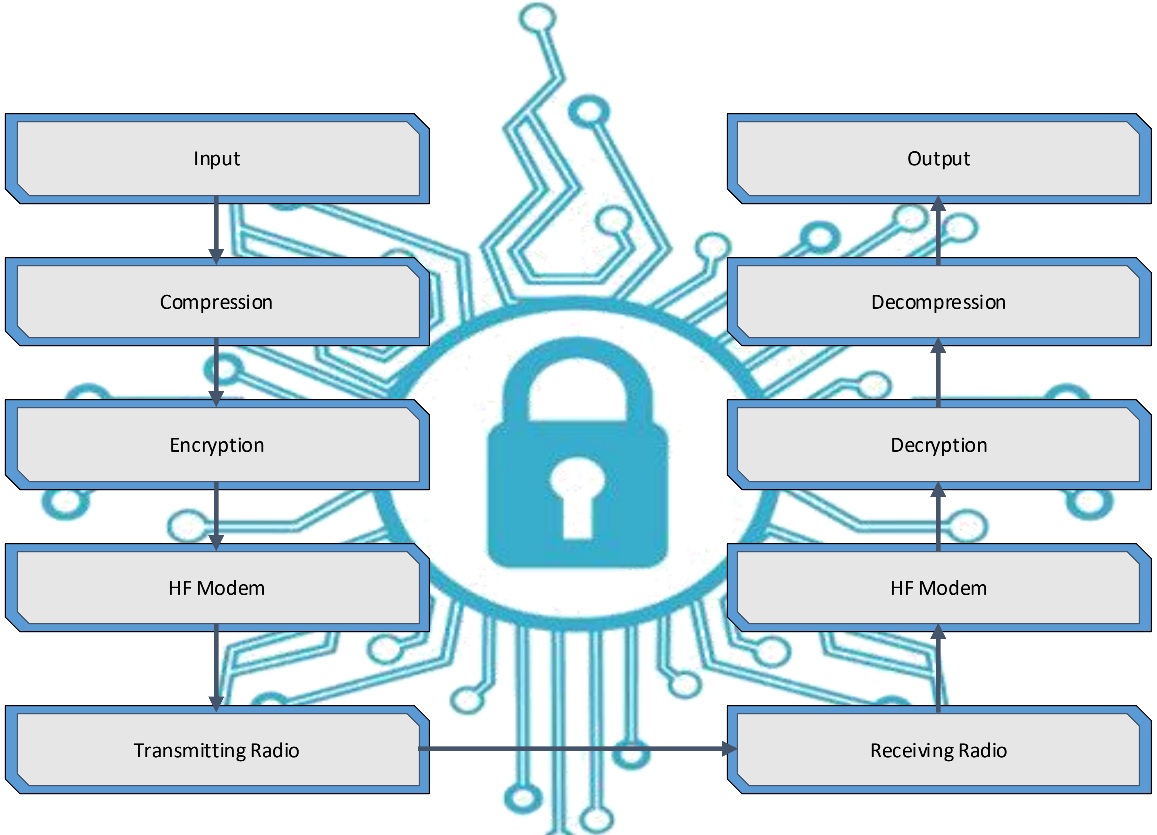
Design, construct, and test a low-cost magnetophoretic T-cell isolation device.

Design Goals

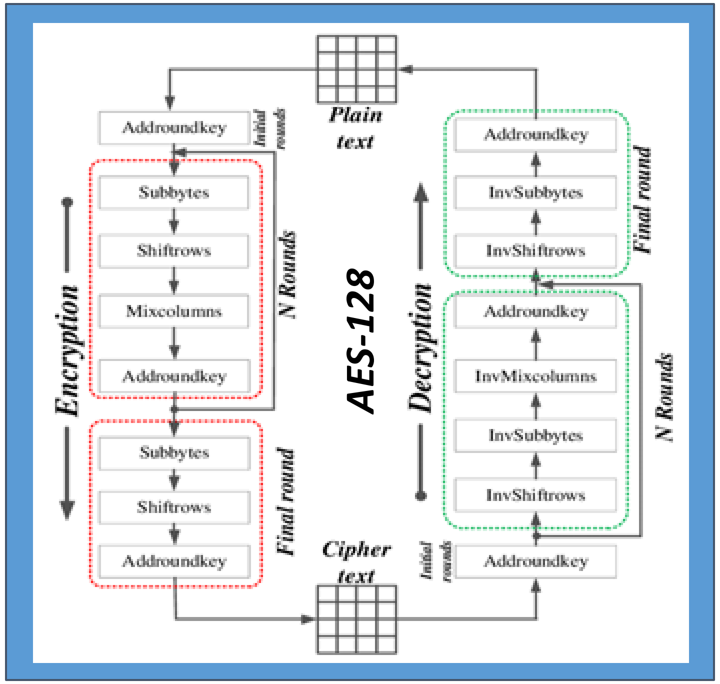
- Achieve high purity and enrichment of target cells from a mixed sample
- Use low-cost and easily attainable materials for commercialization
- Create a design that can be easily operated by medical staff

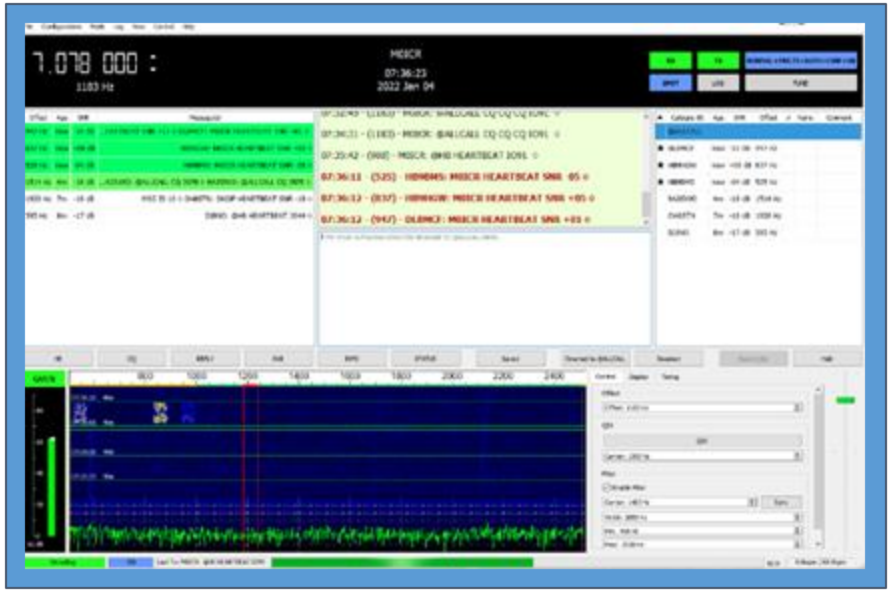
> **Low-cost lab equipment can lead to more affordable health care.**
> **- *Megan Hayes***

Department of Electrical & Computer Engineering



Communication Workflow





ODU
Department of Electrical & Computer Engineering

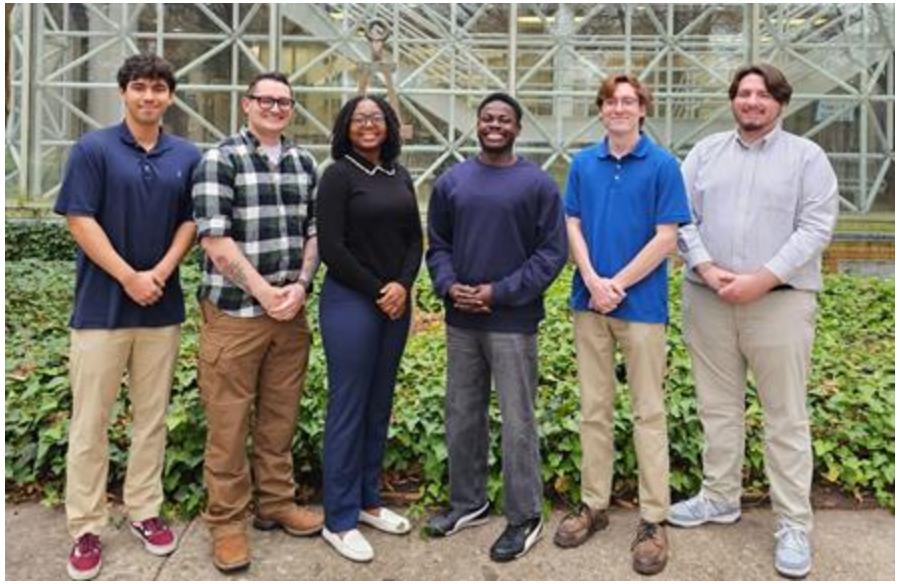
Encrypting HF Radio Communications

Funding: ONR & ECE Department

Apply accredited encryption standards to an open-source High-Frequency communications protocol for military communications.

Team Members: Ruth Akpalu, Darren Brewer, Johnathan Miller, Ryan VanGuilder, Ethan Spruill, Raphael Afrim

Advisor: Dr. Linda Vahala, Dr. Dennis Watson



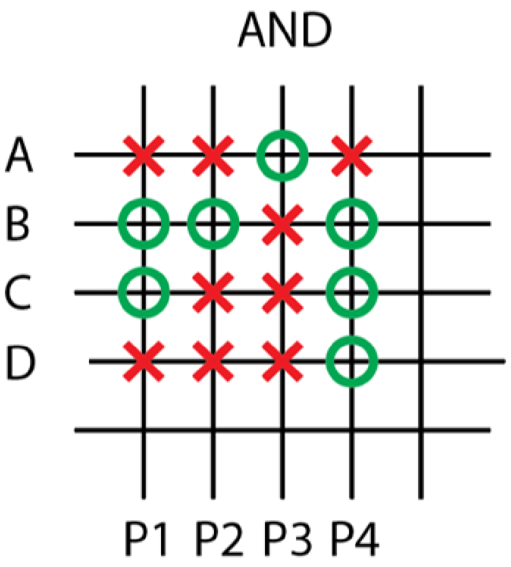
Design Challenge

Applying NSA approved encryption in a limited bandwidth system while maintaining minimal overhead.

Design Goals

- Locate optimal location for encryption protocol
- Maintain ease of use for user
- Limit added processing time for encryption/decryption

> **Communication should be reliable, simple, and protected.**
> **- Darren Brewer**

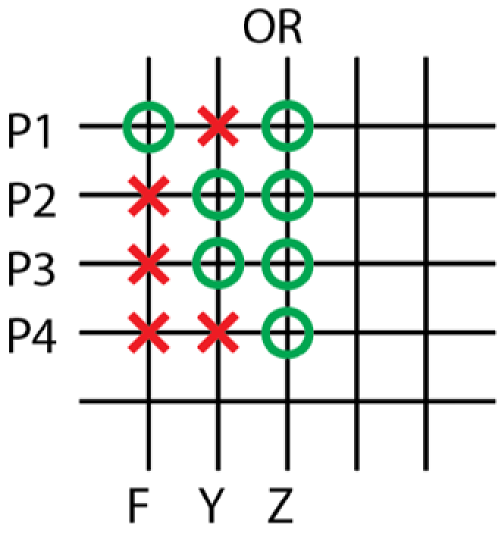


P1 = BC

P2 = B

P3 = A

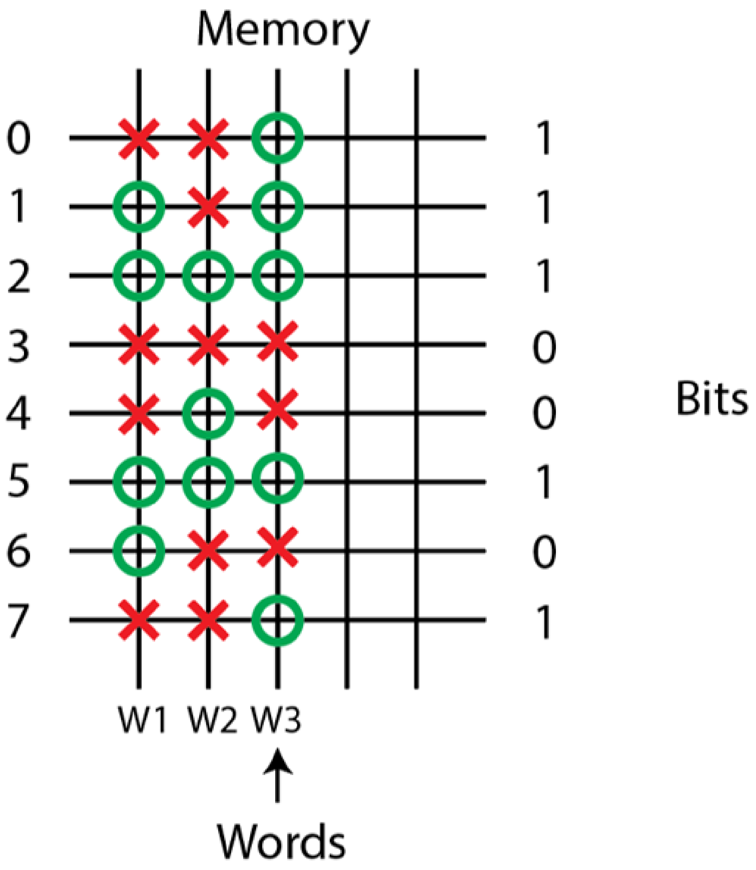
P4 = BCD



F = P1

Y = P1 + P2

Z = P1 + P2 + P3 + P4



ODU
Department of Electrical & Computer Engineering

Redundancy of 2D Arrays

This project introduces an Adaptive Variable Redundancy (AVR) scheme for programmable logic arrays (PLAs) at the smallest scale. AVR allocates redundant nanowires to inputs based on usage frequency and ON-output probability. The algorithm determines the optimal number of redundant wires needed to maximize yield using defect density, binomial probability, and a defined threshold. This ensures reliability by increasing redundancy only until defect probability reaches an acceptable low by the modern standard, while minimizing resource overhead.

Team Members: Christopher Rodriguez, Michael Niedzialek, Melanie Soble, Kathleen Lillie
Advisor: *Dr. Waleed Al-Assadi*

Design Challenge

Using silicon nanowire technology, design a methodology to improve reliability, configurability, and fault-tolerance of 2D crossbar arrays at the smallest scale.

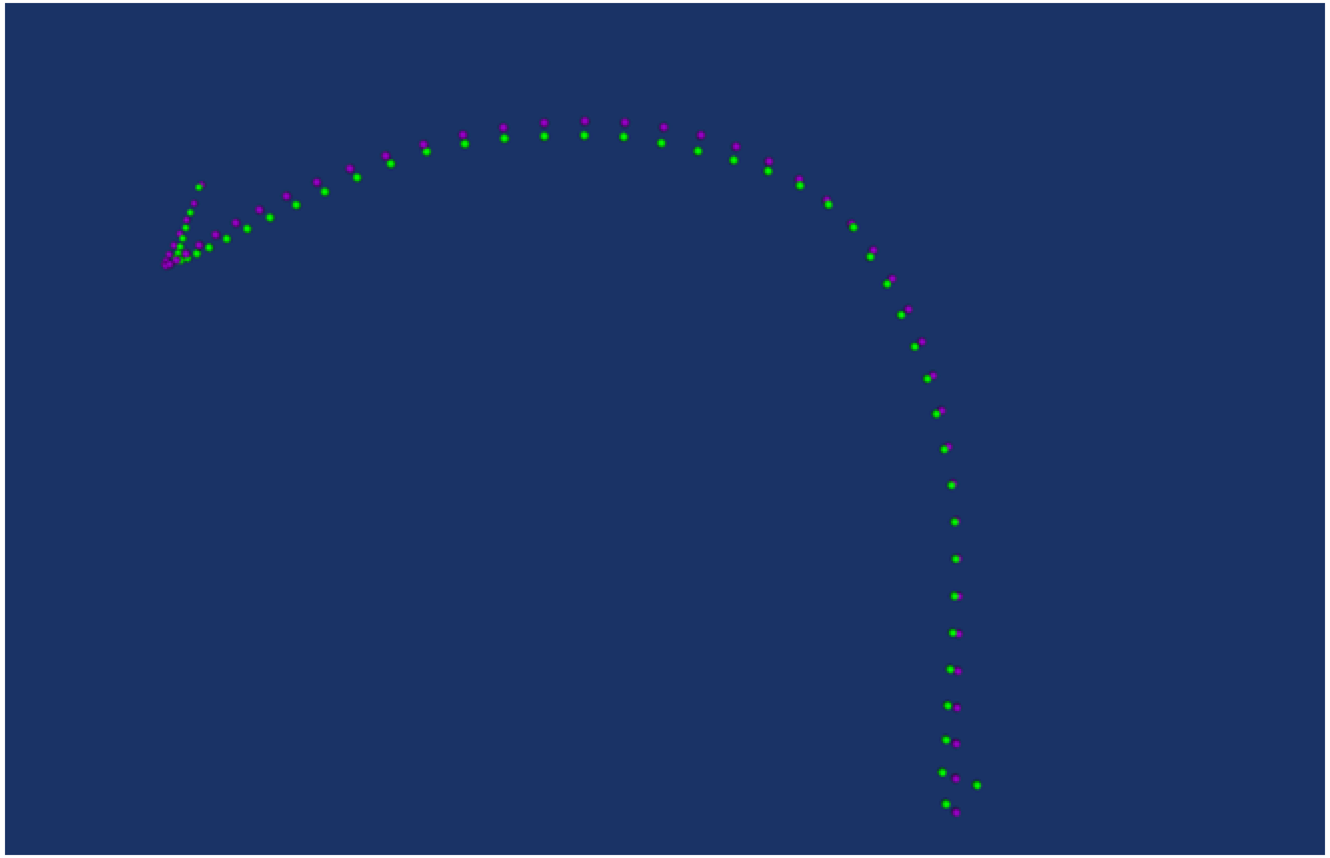
Design Goals

- Achieve +99% yield in 3x3 and larger arrays.
- Overhead constraints: 20% area, 15% power.
- Configuration process approaching real time speed.

> **We are pushing past the size constraints of modern computing**
> **- Christopher Rodriguez**

Department of Electrical & Computer Engineering

Branching Visualizer



1 Simplex Curve

ODU
Department of Electrical & Computer Engineering

Tracking Cranial Nerves in DTI for Neurosurgery

(no funding needed)

We will be working to develop software to help surgeons identify and map cranial nerves. This will help reduce the number of cranial injuries caused by surgeries.

Team Members: Jack Dibari, Cole Edwards, Madison Haynes, Kory Hartline

Advisor: *Dr. Michel Audette*

Design Challenge

To further develop the software to work with DTI and accommodate branching nerves

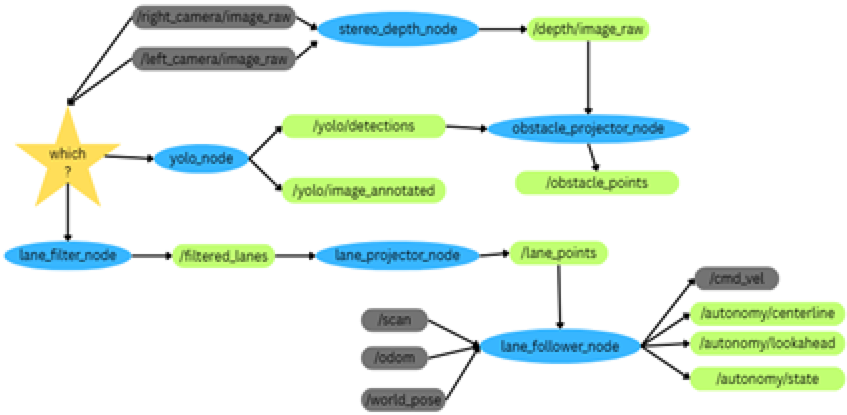
Design Goals

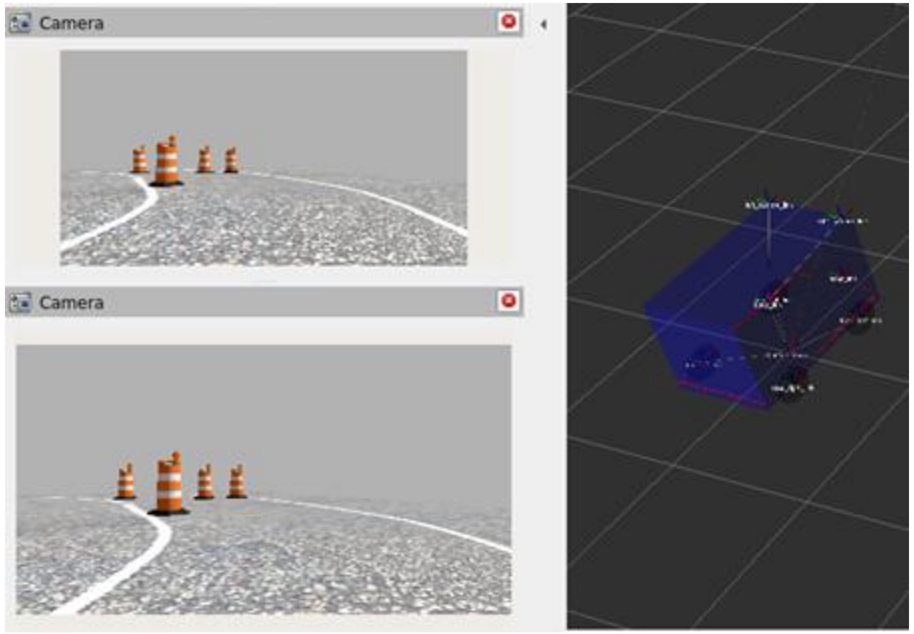
- *Modifying contour model to work with DTI imaging*
- *Develop software to create synthetic DTI images*
- *Adjusting 3D contour model to accommodate nerve branch points*
- *Develop an interface as a means of training graph neural networks*

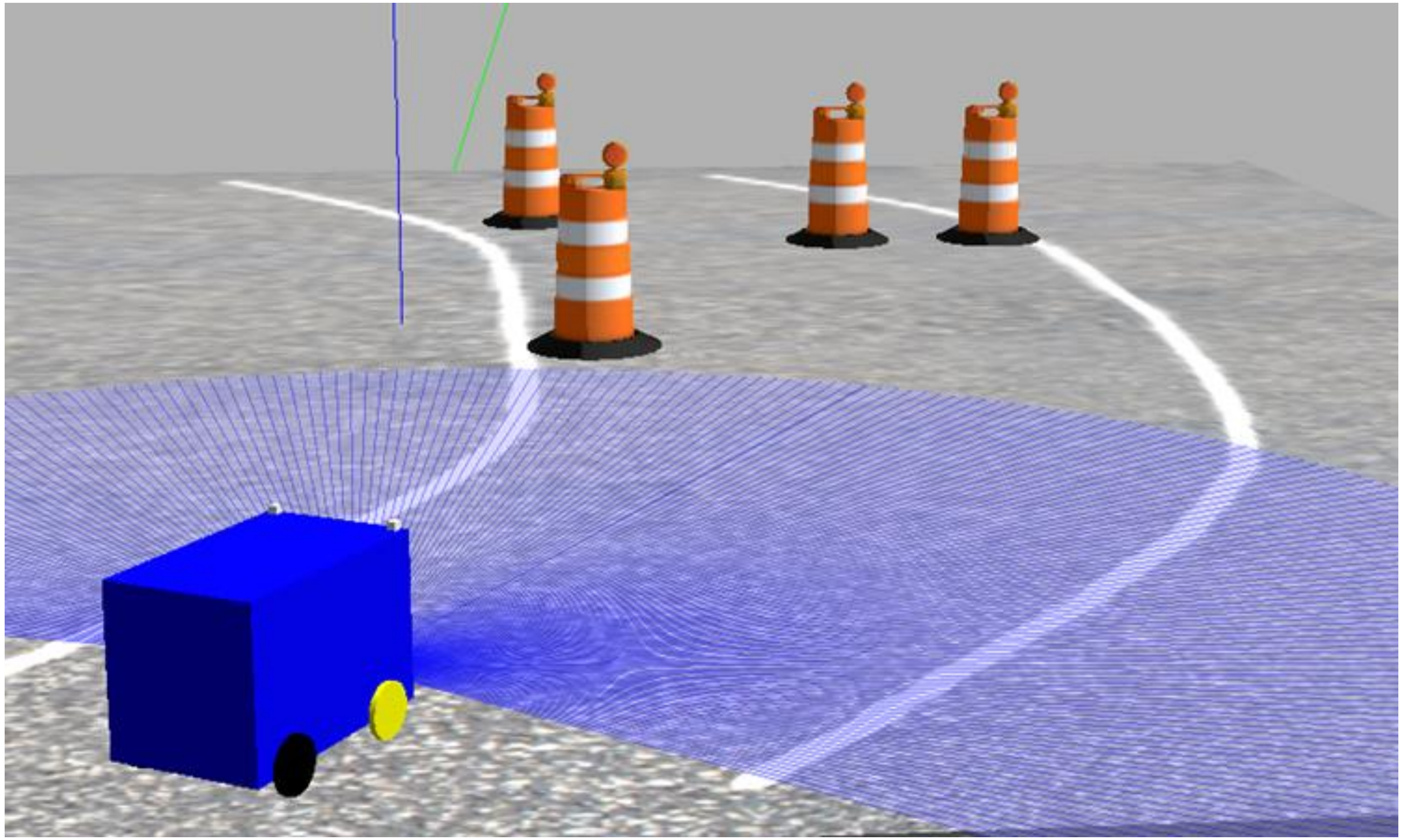
"Engineering precision today for safer surgeries tomorrow."
-Kory Hartline

ODU

Department of Electrical & Computer Engineering







ODU
Department of Electrical & Computer Engineering

INTELLIGENT GROUND VEHICLE
Funding Agencies: ODU

Designing a self-driving, autonomous vehicle to compete in the Intelligent Ground Vehicle Competition.

Team Members: *Andrew Duguay(CE), Mohamed Barakat(CE), Mark Johnston(CE)*

Advisor: *Dr. Lee Belfore*

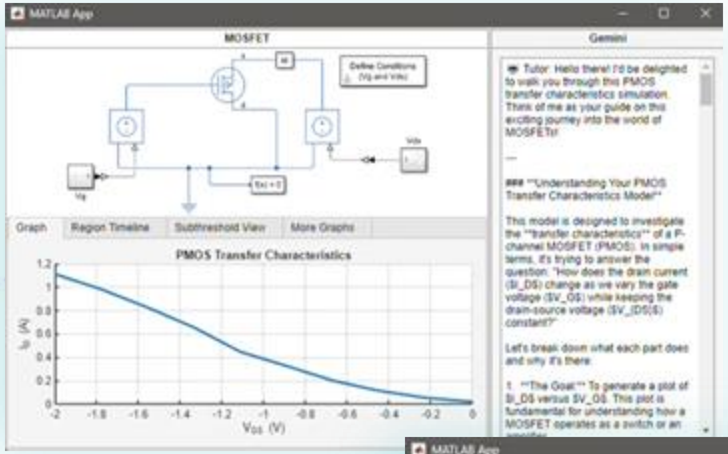
Design Challenge
Develop a vehicle controller for an autonomous vehicle that reliably avoids obstacles and follows lane-lines. Developing a robust simulation and testing system is essential for development.

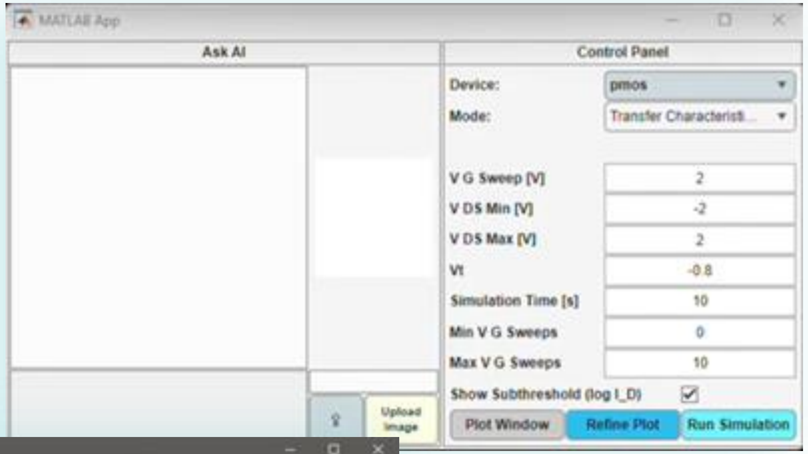
Design Goals
- *Develop a "headless" simulation framework.*
- *Improve on control unit's decision making.*
- *Establish simulation protocol to decouple simulation from architecture being tested.*

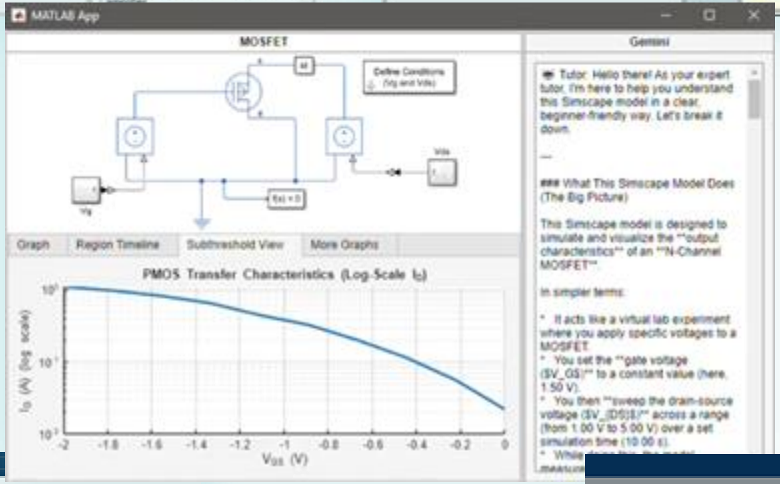
**"Teamwork, It's a must.
Without teamwork, It's a bust.
The team's work needs trust."
-Andrew D.**

Department of Electrical & Computer Engineering

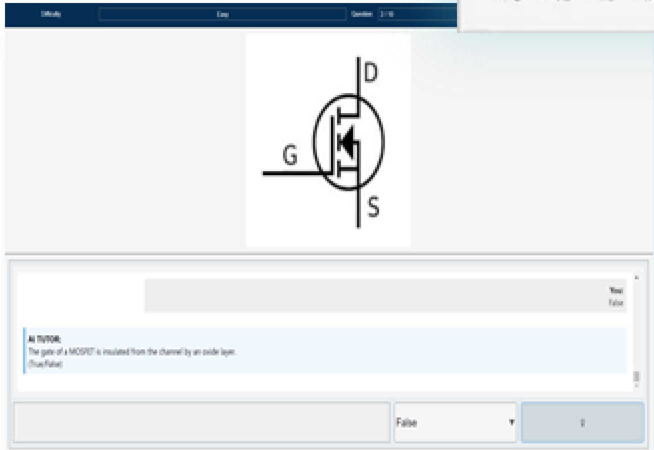
```
% Set up request options
options = weboptions( ...
    'RequestMethod','post', ...
    'MediaType','application/json', ...
    'Timeout',160);

% Send request to Gemini
response = webwrite(app.API_URL, requestBody, options);

% Extract and display response
if isfield(response, 'candidates') && ~isempty(response.candidates)
    generatedText = response.candidates(1).content.parts.text;

    % Replace only the last "AI: Thinking..." line
    currentText = app.AiResponse.Value;
    lastIndex = find(contains(currentText, "AI: Thinking..."), 1,
    if ~isempty(lastIndex)
        currentText{lastIndex} = char("AI: " + generatedText);
    else
        currentText{end+1} = char("AI: " + generatedText);
    end

    % Update chat window
    app.AiResponse.Value = reshape(currentText, [], 1);

    % Save to conversation history
    app.ConversationHistory{end+1} = "User: " + UserInput;
    app.ConversationHistory{end+1} = "AI: " + generatedText;
end

% Clear image preview and path after sending
app.UploadedImagePath = "";
app.ImagePathTextArea.Value = {'Gemini has analyzed the image and values.'};

catch ME
    % Replace last "Thinking..." with error message
    currentText = app.AiResponse.Value;
    lastIndex = find(contains(currentText, "AI: Thinking..."), 1, 'last');
    if ~isempty(lastIndex)
        currentText{lastIndex} = char("AI: Error: " + ME.message);
    else
        currentText{end+1} = char("AI: Error: " + ME.message);
    end
```

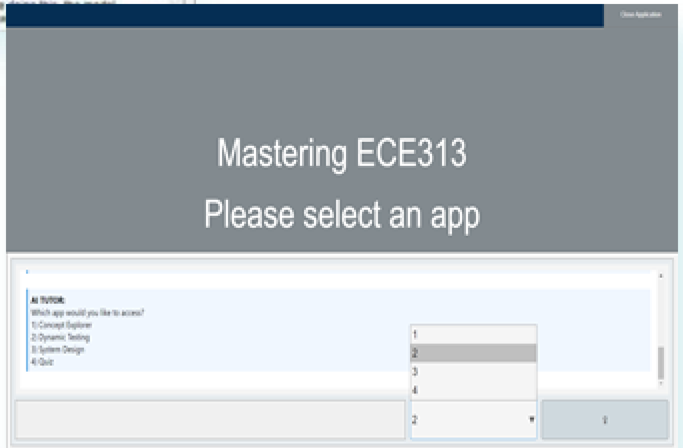







```
function advanceOrFinish(app)
    totalQ = min(app.numQuestions, numel(app.questions));
    if app.currentQuestionIndex < totalQ
        app.currentQuestionIndex = app.currentQuestionIndex + 1;
        app.displayCurrentQuestion(app.questions(app.currentQuestionIndex));
    else
        finalScore = sum(app.results(1:totalQ));
        finalMsg = sprintf("Quiz complete! Final Score: %d / %d", finalScore, totalQ);
        app.MainAppHandle.sendAIMessage(finalMsg);
        app.MainAppHandle.ToolbarAppHandle.stopQuizTimer();
        app.currentStep = "finished";
    end
end

function handleMultipleChoice(app, q, userInput)
    if userInput == "", app.showMCQ(q); return; end
    idx = str2double(userInput);

    if ~isnan(idx) && idx >= 1 && idx <= numel(q.shuffledChoices)
        studentAns = q.shuffledChoices(idx);
    else

        return;

    end
    if strcmp(studentAns, q.answer), app.results(app.currentQuestionIndex) = 1;
```





ODU
Department of Electrical & Computer Engineering

Intelligent Tutoring System for ECE Students

Electrical and Computer Engineering

This project is an interactive educational tool designed to help users explore core concepts in Electrical and Computer Engineering. Its platform design is to support intuitive learning, visual engagement, and user-driven exploration.

Team Members : Ayaka Marquez Adriano, Austin Broome

Advisor: Namkoong Gon

Design Challenge

The core design challenge is integrating interactive visualization, AI-generated explanation, and user-driven simulation into a unified educational tool that remains intuitive, responsive, and expandable.

Design Goals

- Integrate AI driven interaction, simulation, explanations and feedback
- Design an adaptable system for users
- Improve users conceptual understanding

> **Understanding begins not when you're told, but when you're shown how to explore it yourself.**