UCONN | COLLEGE OF ENGINEERING

SENIOR DESIGN

Demonstration Day 2025

engineering.uconn.edu

Biomedical Engineering Senior Design Teams

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 01

Team

Daniel Lantigua Thuany
Marielle de Carvalho Lachos

Faculty Advisor(s)

Dr. Hugo Fernando Posada-Quintero

Sponsor

Dr. Posada-Quintero

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Posada Q Lab

Design of a Multimodal Belt for Pain Monitoring and Assessment

Description

The purpose of this project was to develop a wearable pain-monitoring system, composed of a belt and wrist component that integrates multimodal physiological sensors to assess pain in real time. The belt incorporates one electrocardiogram (ECG), two electromyograms (EMG), and two electrodermal activity (EDA) sensors into a compact, user-friendly device. Furthermore, the wrist component integrates an additional EDA sensor for more accurate data collection and validation purposes. Designed for continuous use, the belt prioritizes comfort, durability, and accurate data collection through a mobile device. The system employs advanced materials for flexibility, breathability, and moisture management while embedding robust circuits from the BITalino Revolution Plugged Kit and BITalino Mini shielded Kit for reliable signal processing for the belt and wrist component, respectively. This device targets individuals with irritable bowel syndrome (IBS), providing researchers and clinicians with real-time insights into physiological changes associated with pain episodes. The proposed belt offers a novel, wearable solution to pain monitoring, reducing reliance on self-reporting and improving patient outcomes.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 02

Team	Faculty Advisor(s)	Sponsor
Diego Melendez-Sanchez Prasanth Ganeshbabu Ahmet Seferge Eesham Bhattacharyya	Dr. Liisa Kuhn	University of Connecticut

Your Face in Ice Cream Sculpture

Description

This project develops a process for creating custom ice cream sculptures with detailed 3D facial features. 3D scanning technology captures facial details, which are processed in Autodesk Fusion 360 to generate G-code for a modified CNC machine that carves ultracold ice cream. Beyond food sculpting, this method has biomedical applications in bone graft fabrication and tissue engineering. Similar to ice cream, biomaterials like extracellular matrices (ECMs) and bone scaffolds require precise shaping under controlled temperatures and other variables, such as material composition, making this process relevant for custom implants and regenerative medicine.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 03

Team

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Abigail Powsner
Ashna Prakash
Alexa Torres

Faculty Advisor(s)

Fayekah Assanah

Sponsor

UConn Biomedical Engineering Department

A Laser-Based Testing Configuration for a Brain-Mimicking Hydrogel to Simulate Traumatic Brain Injury

Description

The purpose of this design project is to configure a laser testing chamber that will mimic traumatic brain injury (TBI) in vitro in a gelatin-alginate hydrogel model. The laser shock compression will serve as the force typically incurred during traumatic brain injury, whilst the hydrogel will model the brain's behavior following the impact. Upon fabricating the hydrogel, a holder must be devised to properly contain the component and enable laser beam entry to approximate the effects of the shock propagation. To measure the laser collision applied and its subsequent results, a metal foil must be placed between the hydrogel and laser on either side for suitable ablation to occur and generate a Photonic Doppler Velocimetry (PDV) signal. The resulting PDV data will provide the necessary parameters to establish our laser-hydrogel system for in vitro TBI modeling. Creating an alternative, more accessible method to simulate TBI will allow researchers to better understand the brain's response to such impairment.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 04

Team

Christopher Foyer

Afrida Hoque

Faculty Advisor(s)

Patrick Kumavor

Sponsor

Wendy Mosley RDMS and Lorlene Beck RDMS

Stay Warm Gel

Description

RESTRICTED

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 05

Team	Faculty Advisor(s)	Sponsor
Ifrat Nabo Viviana Cvecic Gisele Guerriero	Patrick Kumavor	NIUVT

Undergarment Apparel Fitted with UVB LED Strips to Supplement Body's Production of Vitamin D

Description

The submarine is both a physically and mentally demanding environment. For those submariners who are deployed for extended periods of time, this poses severe and adverse effects to their health and performance. Some of the challenges faced by them include a lack of natural sunlight which leads to a deficiency in vitamin D levels and in turn causes loss of bone density, fractures, and muscle weakness.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 06

Team

Peggy Minga

Yuexi Hao

Faculty Advisor(s)

Patrick Kumavor

Sponsor

NIUVT

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NATIONAL INSTITUTE FOR UNDERSEA VEHICLE TECHNOLOGY

Gait Monitoring Footwear Device for Submariners

Description

This project involves designing and prototyping a resistance pressure sensor insole with 16 sensors to measure and analyze foot pressure distribution and gait patterns in real time for submariners. The goal is to monitor and detect cognitive fatigue and sleep deprivation by identifying deviations in gait. The system uses a voltage divider circuit, an Arduino microcontroller, and Arduino IDE to collect, process, and visualize data. Future iterations aim to optimize the design by reducing size, improving wearability, incorporating wireless connectivity, and an algorithm on MATLAB to detect the deviations, ensuring the insole is comfortable, accurate, and efficient for real-world applications.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 07

Team

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Mark McWhirter

Faculty Advisor(s)

Patrick Kumavor

Sponsor

NIUVT

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NATIONAL INSTITUTE FOR UNDERSEA VEHICLE TECHNOLOGY

Wearable Physical Activity Monitor for Submariners

Description

This design project's purpose is to build a wearable physical monitor that measures and tracks the activity level of submariners. The design consists of several accelerometers being worn at locations across the submariner’s body including the arms, legs, and trunk. The accelerometers along with accompanying electronics and power supply are being placed in protective 3D printed housing. These devices are low-profile and unobtrusive, ensuring they do not interfere with the user’s daily activities, and lightweight, making them unnoticeable during movement. The accelerometers measure the magnitude of acceleration which is used to calculate the submariner’s activity level. This valuable information can be monitored by medical staff to ensure that submariners are maintaining their combat-ready fitness during long deployments in the confined spaces of a submarine.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 08

Team

Srushti Balagali

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Faculty Advisor(s)

Patrick Kumavor

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NATIONAL INSTITUTE FOR UNDERSEA VEHICLE TECHNOLOGY

Body Posture Monitor to Alleviate Musculoskeletal Injuries for Submariners

Description

The submarine is both a physically and mentally demanding environment as submariners are deployed for extended periods of time. This poses severe and adverse effects on their health and performance. One of the challenges they face is performing physical tasks like heavy lifting and repetitive motions in cramped spaces which can result in musculoskeletal injuries and back pains. The goal of this project is to design a wearable, ergonomic, and unobstructive device to collect data regarding the body posture of the user through accelerometers. The device tracks upper back movements in submariners by recording accelerations through sensors placed at specific vertebrae along the spine. The sensors are integrated into a comfortable vest worn over the submariner’s uniform. The device provides the angles at which the upper back tilts during daily activities that submariners perform.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 09

Team	Faculty Advisor(s)	Sponsor
Dennis Sarajlic Sibi Pandian	Patrick Kumavor	NIUVT

Quantification of Warfighter Performance in Real Time

Description

Developing objectives and metrics for determining a submariners war fighting performance using artificial intelligence tools.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 10

Team

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Uendi Carcani
Ayana Shrestha
Caroline Flanagan

Faculty Advisor(s)

Patrick Kumavor, Krystyna Gielo-Perczak

Non-UConn Advisor

Bhavin Dalal

Sponsor

UConn College of Engineering

Optimal Uterus Sealing Approach Using 3 Inflatable Balloons for Ablation System

Description

Endometrial ablation is commonly used to treat heavy menstrual bleeding in an outpatient setting without the need for general anesthesia. This device design is intended to accommodate a variety of uterine sizes using a uniform balloon configuration. This study aims to evaluate how the size, shape, and placement of the three inflatable balloons on the probe interact with anatomical variations among patients. The work includes an in-depth analysis of anatomical data and the statistical distribution of uterus and cervix dimensions within the population. A SolidWorks Flow Simulation was developed to model the uterus, cervix, and probe interaction, providing a robust tool to investigate how changes in balloon geometry affect mass flow rate. To complement the simulations, a physical testing model of the uterus was constructed, incorporating interchangeable cervical canal inserts. This model supports experimental evaluation of various probe designs across a spectrum of anatomical sizes. Final recommendations based on insights gained through statistical analysis, computational simulation, and experimental validation were provided to the sponsor of this project.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 11

Team

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Faculty Advisor(s)

Profs. Sina Shahbazmohamadi & Patrick Kumavor

Non-UConn Advisor

Dr. Shahram Amini

Sponsor

Pulse Technologies - Integer

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Hierarchical Laser Restructuring for Next Generation Neural Interfacing Electrodes

Description

Long-term implantable neural interfacing devices are able to diagnose, monitor, and treat many cardiac, neurological, retinal and hearing disorders through nerve stimulation, as well as sensing and recording electrical signals to and from neural tissue. To improve specificity, functionality, and performance of these devices, the electrodes and microelectrode arrays—that are the basis of most emerging devices—must be further miniaturized and must possess exceptional electrochemical performance and charge exchange characteristics with neural tissue. Earlier work done has shown that the electrochemical performance of femtosecond-laser hierarchically-restructured electrodes can be tuned to yield unprecedented performance values that significantly exceed those reported in the literature, e.g. charge storage capacity and specific capacitance were shown to have improved by two orders of magnitude and over 700-fold, respectively, compared to un-restructured electrodes. However, laser systems must be designed and built to allow for implementation of such systems for various different geometries, electrodes sizes and thicknesses. This senior design project addresses this challenge by designing and building a laser system capable of doing the hierarchical laser restructuring.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 12

Team

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Marzuq Iqbal

Faculty Advisor(s)

Dr. Kazunori Hoshino

Sponsor

UConn School of Nursing

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UCONN
NURSING & ENGINEERING INNOVATION CENTER

Improving Pulse Oximetry Through Skin Spectrometry

Description

Conventional pulse oximeters are believed to measure oxygen concentrations accurately regardless of skin color. While companies who make these products claim they produce consistent results with all skin tones, recent studies have shown reduced accuracy in darker skinned patients during periods of hypoxemia. No commercial products have yet addressed this problem. The goal of this project is to create a more advanced pulse oximeter by integrating it with a spectrometer to address these inaccuracies. This will allow the device to obtain a quantitative value for the patient's skin tone in addition to a pulse oximeter reading. This device will be tested on adults to see how different skin tones absorb light. By understanding these variations, the hope is to make the device more accurate for everyone, regardless of skin tone. Ultimately, this project should improve pulse oximetry to provide more reliable and precise readings for people of all skin tones.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 13

Team

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Faculty Advisor(s)

Dr. Kazunori Hoshino

Sponsor

UConn College of Engineering

Culture, Imaging, and Characterization of Live 3D Tissues

Description

Culturing tumor cells in 3D culture and developing a way to image them constantly during proliferation. Characterizing the cells using high resolution 3D imaging methods.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 14

Team

Isabella Rojas
Evelyn Allen
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Sanaa' Peavy

Faculty Advisor(s)

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Sponsor

University of Connecticut

Advanced Ventriculoperitoneal shunt monitoring system for infection detection, cerebrospinal fluid analysis and pressure sensing

Description

Designing a smart ventriculoperitoneal shunt for the safe drainage of CSF fluid from the left ventricle of the brain in patients with hydrocephalus. This shunt will include sensors that relay information about fluid pressure, flow rate, and color wirelessly to an external device like a phone for safe and non-invasive monitoring of shunt status, in order to catch mechanical or biological malfunctions early before beginning to negatively affect the patient.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 15

Team

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Faculty Advisor(s)

Patrick Kumavor

Sponsor

DigiM Solutions

Empowering Drug Product Development Through Machine Learning Enabled Image Processing

Description

The primary goal of this project is to develop a non-invasive, machine learning-enabled software solution that can accurately detect and quantify both surface and internal features in pharmaceutical tablets using three-dimensional X-ray microscopy (XRM) imaging. By integrating 3D image processing techniques with artificial intelligence (AI), this project aims to enhance quality control processes in drug product manufacturing. While machine learning has already been applied in this field, existing methods typically analyze 3D images slice by slice, treating them as a stack of 2D images rather than as a single three-dimensional structure. The novelty of this project lies in the development of an approach that can analyze tablet microstructures in true three-dimensional space, simultaneously considering spatial relationships across all dimensions. There has been little to no research on machine learning models capable of performing 3D instance segmentation for pharmaceutical tablets in this manner. To achieve this, the project will focus on developing a machine learning-based 3D instance segmentation model to directly process volumetric XRM data. These models will be optimized for high accuracy and precision in detecting tablet features, enabling more comprehensive defect detection and material characterization. The developed AI models will then be integrated into DigiM's existing software, ensuring seamless adoption into current pharmaceutical workflows. The software package will be validated using tablets supplied by DigiM, with performance benchmarked against traditional methods. By capturing and analyzing pharmaceutical tablets in three dimensions, the project aims to provide insights into tablet microstructures, ultimately optimizing manufacturing processes.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 16

Team	Faculty Advisor(s)	Sponsor
Akram Alhadainy	Dr. Bin Feng	UConn Biomedical Engineering Department

Next-Generation Neural Stimulators: In Silico Engineering for Customizable Dorsal Root Ganglia Modulation

Description

The project focuses on performing finite element analysis to model the temporal interfering (TI) electrical stimulation of the dorsal root ganglion to explore its potential to inhibit sensory neurons.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 17

Team

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Faculty Advisor(s)

Dr. Gielo-Perczak

Sponsor

UConn Biomedical Engineering Department

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Effectiveness of Connective Tissue Workouts

Description

The motive for this project is to propose a method of evaluation to assess the effectiveness of connective tissue workouts with the application of modern technological devices. This involves the investigation of various workout routines specifically designed to help people who lack the ability to produce a protein that helps give connective tissue its elasticity and strength. Two workouts will be done based on exercises by Miranda Esmonde-White, including “Rebalance Connective Tissue” and “Release and Build Fascia.” Each workout will be approximately 30 minutes in duration. The team aims to assess workout effectiveness through the measurement of muscle oxygenation using MOXY, muscle activity using EMG (Delsys Avanti), and heart pulse monitoring using ECG (Delsys Avanti). The expected outcome is to improve body balance. This will be tested by quiet standing, standing on one leg, standing in tandem, and standing from sitting. In addition, strength improvements will be measured by the grip strength test (Jamar). After the exploration of existing literature methodologies in connective tissue rehabilitation, the team will propose a refined evaluation method. The evaluation method will be validated through testing to ensure that the proposed solution effectively monitors connective tissue health. The ultimate goal is to use modern technological devices to create an evaluation method to assess connective tissue workouts. This evaluation would allow elderly individuals and those with connective tissue disorders to have a complete understanding of the effectiveness of connective tissue workouts.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 18

Team

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Yashvi Gupta
Rachel Turanchik

Faculty Advisor(s)

Dr. Krystyna Gielo-Perczak

Sponsor

Dr. Krystyna Gielo-Perczak

Evaluation of Shoulder Rehabilitation with application of Delsys Trigno Galileo sensor and NeuroMap software

Description

The motive for this project is to propose a novel method of rehabilitation with application of Delsys Trigno Galileo sensor. The Galileo is first-ever scientific instrument to measure neural firings and muscle activation for an integrated approach to human movement. The sensor can assist in range of motion exercises in order to increase the strength and mobility of the mending shoulder in rotator cuff patients. Shoulder rehabilitation method with application of newest Galileo sensor should be adjustable to fit any body type and should be accessed from a seated or standing position in order to meet the comfort of the patient.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 19

Team

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Grace Bonacci

Faculty Advisor(s)

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Sponsor

Medtronic

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Medtronic

Personalized Breast Self-Exam Virtual Reality Training Simulator

Description

The objective of this Project is to explore technology solutions and develop a prototype for at least one (1) key building block of a personalized virtual reality simulator to train women how to do a breast self exam including haptic simulation of pathologies. The full simulator is envisioned to demystify and remove embarrassment around breast self exams. It will be accessible to women in an office or mobile mammography unit environment to “play to learn” how to do a breast self exam and what they should be feeling for.

BIOMEDICAL ENGINEERING

Senior Design 2025 : Biomedical Engineering Team 20

Team

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Sarah Luning
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Faculty Advisor(s)

Patrick Kumavor and Sina Shahbazmohamadi

Non-UConn Advisor

Dr. Zehui Xia

Sponsor

National Aeronautics and Space Administration (NASA)

Sponsor Logo

Nano/Micro Pore Fabrication for Biomedical Device Applications

Description

Our group is collaborating with Geoppert Labs and NASA to enhance the fabrication of nanopore meshes for resistive pulse sensing, a crucial technique for biomolecule analysis. The primary objective is to develop improved methods for creating precise and reliable pores, ensuring optimal sensitivity and stability in sensing applications. To achieve this, we are exploring and implementing advanced pore fabrication techniques. One key approach involves Focused Ion Beam (FIB) patterning, which enables high-resolution nanopore structuring with exceptional control over size and shape. Our team developed a new drilling pattern that could produce pores substantially smaller than the ION beam's spotsize. Additionally, we are leveraging laser direct writing to create nanopore structures with a high degree of precision and scalability. By using a femtosecond laser, we can ablate material with minimal thermal effects, producing clean, high-aspect-ratio pores. This method offers rapid prototyping capabilities and the flexibility to pattern complex geometries on various substrates. Furthermore, we are developing masking strategies using the Focused Ion Beam to create a mask with pores smaller than the spot size of the femtosecond laser. This technique will be used in conjunction with a sacrificial masking process. By depositing and selectively removing sacrificial layers, we can fine-tune pore dimensions and optimize the fabrication process for enhanced performance. Through these combined efforts, we aim to advance nanopore technology, enabling more effective biomolecule detection while improving the reproducibility and scalability of fabrication techniques.

Senior Design 2025 : Biomedical Engineering Team 21

Team

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Meryl Curtin
Jaden Little

Faculty Advisor(s)

Dr. Krystyna Gielo-Perczak

Sponsor

NIUVT

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Biomechanical Assessment of Submariners after Rowing Machine Exercises

Description

This project aims to address the limitations of fitness methods for submariners. Currently, there are no efficient exercise methods available due to the confined environment, resulting in poor physical condition and overall well-being. For submariners, most screening tests are only limited to physiological and psychological assessments. The project's main goal is to significantly improve the cognitive and physical well-being of submariners through the design of effective physical activity tailored to their unique environment. The project aims to develop a fitness method that increases endurance and strength while lowering the risk of injury and improving the submariners' mental health. The fitness method developed will be designed to be used in a compact space while also providing comfortability for the user. The goal is to also provide efficient feedback to the users in a way that is simple to understand and easy to track the submariners’ health and physical progress. Lastly, we hope that this project can promote further research on the problem, and lead to new findings of effective physical activity for submariners.

Civil Engineering Senior Design Teams

Senior Design 2025 : Civil Engineering Team 01

Team

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Angel Baba-Rivera
Katherine Gonzalez
Aly Frechette

Faculty Advisor(s)

Dr. Lownes

Non-UConn Advisor

Jesse Garuti

Sponsor

Manafort Brothers

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UConn Southwest Campus Infrastructure Upgrades

Description

The purpose of this project is to perform quantity takeoffs for the utility work associated with the UConn Southwest Campus Infrastructure Upgrades, in order to develop the lowest competitive bid that could secure the project award for our senior design team. The scope includes replacing existing utilities in the areas of Alumni Drive, Jim Calhoun Way, Husky Circle Lot, and Nathan Hale Hall. This project also encompasses the UConn Stadia development, which involves replacing the current athletic facilities with new stadiums for baseball, soccer, and softball. The utility work includes sanitary sewers, storm drainage, domestic water lines, and fire protection piping. Additional site improvements consist of new lighting, sidewalks, and paving. Once the bid is completed, it will be used to generate a resource-loaded project schedule and a work plan outlining how the project will be executed. Another key component of the project involves developing a submittal log and preparing all required submittals for Manafort Brothers Incorporated. These initial submittals include the resource-loaded schedule, material submittals, the project work plan, a water main flushing and disinfection plan, and documentation of key personnel.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 02

Team

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Ethan Peck
Kristin Daddi
Austin St. Cyr

Faculty Advisor(s)

Nicolas Lownes

Non-UConn Advisor

Malissa Carvalho

Sponsor

Connecticut Department of Transportation (CTDOT)

Intersection Improvements at Route 6 and Route 61

Description

In recent years the intersection of Route 6 and Route 61 in Woodbury, CT has become a dangerous intersection. This is part due to poor sight distances that prevent safe turning maneuvers, a higher speed limit causing vehicles to speed and the intersection being on the bend of a curve have caused numerous side angle crashes in the intersection in its current configuration. For the redesign of this intersection, our sponsor the Connecticut Department of Transportation tasked our group with coming up with one main solution as well as an alternative solution for this. The preliminary design is a single lane roundabout to significantly reduce the number of angled crashes and splitter islands with calming effects to slow the already speeding vehicles. Our alternative design is a signalized intersection to provide safe turning movements for vehicles turning onto the high speed road.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 03

Team

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Faculty Advisor(s)

Nicholas Lownes

Non-UConn Advisor

Andrew Esposito

Sponsor

Connecticut Department of Transportation (CTDOT)

Intersection Improvements at Route 190 and Route 83

Description

The purpose of this project is to improve safety, traffic operations, and allow large vehicles to better navigate the intersection of Route 190 (Main Street) at Route 83 (Springfield Road/South Road). Historically, the offset nature of this intersection led to a high rate of crashes. This was rectified in 2019 when the Department of Transportation installed a new traffic control signal which split the north and south movements into separate phases. This solution, however, has led to significant increases in delay and queues during peak hours. The proposed solution should reduce the present congestion without sacrificing safety at the intersection.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 04

Team

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Davis Cota
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Tyler Curtiss
Ethan Crumrine

Faculty Advisor(s)

Nicholas Lownes

Sponsor

WSP

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Glastonbury Roundabout and Culvert Design

Description

This project involves replacing a signalized intersection with a roundabout at the intersection of the CT Route 17 on and off ramps and New London Turnpike in the town of Glastonbury, CT. Additionally, there is an unnamed water course passing through an existing 42" culvert on the project site, and this culvert will be replaced. After researching applicable design standards and guidance, a Preliminary (30%) plan set has been prepared.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 05

Team

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Jiahe Zou
Ricardo Guadalupe

Faculty Advisor(s)

Manish Roy

Non-UConn Advisor

Jess Brown

Sponsor

Denison Society

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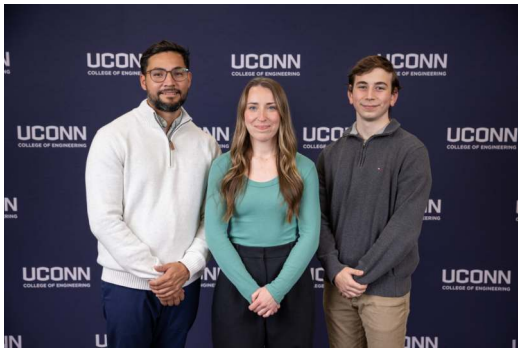
Powerline Hike/Bike Trail Design

Description

The Denison Homestead Hike/Bike Trail Project, undertaken by Senior Design Team CE 05 at the University of Connecticut, aims to design an environmentally sustainable recreational trail in Mystic, CT. The trail will run along the eastern portion of the Eversource distribution powerline, continuing from the previously planned section west of Pequotsepos Road. The project addresses the rising demand for safe biking and hiking trails while ensuring minimal environmental impact and compliance with local regulations. Key components include site assessment, trail alignment, traffic signage, and sustainability considerations. Challenges include limited space for parking while meeting zoning regulations, maintaining long-term trail durability, and integrating traffic calming measures to improve safety at the Pequotsepos Road crossing. The project also includes a detailed construction schedule and cost estimate. CAD drawings will present the final design and three alternative layouts, with a focus on balancing accessibility, functionality, and environmental preservation.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 06



Team

Mauricio Duarte
Payton Turnquist
Manaaf Shreiteh
John Cook (not pictured)

Faculty Advisor(s)

Manish Roy

Non-UConn Advisor

Nick Keenan

Sponsor

Kleinfelder

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Public Sewer Extension for Holmes Road

Description

The project at hand entailed the design of a sewer extension to accommodate the expansion of the Herman Melville Museum in Pittsfield, MA. As a part of this expansion, the museum abandoned their current onsite sewage disposal system as its capacity was not large enough for the expansion. Therefore, a sewer extension was needed to tie into the public sewer system on Holmes Road. However, a conflict with the proposed sewer extension arose as there was a drainage culvert that must be crossed. Therefore, a carefully planned solution was proposed to determine the best way to extend the sewer with relocating the drainage culvert.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 07

Team

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John Santangelo

Charlie DePinho

Owen Yeung

Ben Flower

Faculty Advisor(s)

Manish Roy

Non-UConn Advisor

Megan Massa

Sponsor

Town of Tolland, CT

Route 195 Tolland Sidewalk Project

Description

The Town of Tolland has improved pedestrian safety and connectivity by constructing a new sidewalk along Route 195. This project has established a continuous pathway from the town hall (located at 21 Tolland Green) southward to the I-84 ramps. Multiple goals were achieved as well: Elderly Housing Access: The sidewalk connects housing near the Town hall and the Town Green to essential services such as retail shops and restaurants located near I-84. Development Access: The sidewalk provides an access point for a new 240-unit housing development that is under construction just beyond I-84, linking it with schools, municipal buildings, and the Town Green.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 08

Team

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Faculty Advisor(s)

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Non-UConn Advisor

Erika Lindeberg

Sponsor

Jacobs

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Jacobs

Pameacha Pond Dam Replacement

Description

Located centrally in Middletown, CT, surrounded by residential, commercial, and mixed use properties, Pameacha Pond has become a staple to the local community. Following the dam failure on the northern end of the site, Jacobs Solutions, Inc. was delegated to create a solution for the failing and aging structure. Our Senior Design Team, CE 08, was assigned this project to assist Jacobs in creating suitable dam replacement options. Our team considered four key components when developing a solution: Structural Analysis and Planning, Environmental Repair, Transportation, and Recreation. We developed a primary solution with two alternatives. Our primary solution aimed at preserving the pond by replacing the dam with a gravity-dam that provides safe fishing locations and a look out point, as well as a designated crosswalk on the nearby Pameacha Ave. that leads to an ADA-compliant sidewalk using a switchback to the dam. Managing water quality and contaminant migration, Best Management Practices were applied in the ecological design beyond the dam with a wildlife corridor, erosion control, utilization of bioswales and bioretention systems along CT-17, among others. This aimed at balancing the needs of the community, the needs of the city, and the needs of the environment.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 09

Team

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Caroline Insinna
Sophia Klaboe
Elizabeth Doyle

Faculty Advisor(s)

Wei Zhang

Sponsor

E2 Engineers

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New single-story retail building

Description

This project involves designing a single-story retail building framed with structural steel and supported by a concrete foundation, utilizing a concentric moment frame lateral system. The scope includes determining allowable bearing pressure based on soil data, calculating live, dead, and environmental loads, foundation design, and design of the steel superstructure. The team will use Finite Element Analysis (FEA) software to design the steel superstructure and foundation footings, conducting checks on structural components through hand calculations. Construction drawings will be prepared, including recommendations for reducing the carbon footprint and calculations for carbon emission.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 10

Team

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Everett Nair
Kyle Miranda
Jesse Frazer

Faculty Advisor(s)

Zhang, Wei

Non-UConn Advisor

Cory, Knick

Sponsor

National Guard

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Building 8 Renovations, Bradley CT Air National Guard

Description

Working with the CT Air National Guard 103rd Civil Engineering Squadron, to develop plans to renovate a 3,400 square foot building built in 1962. Converting the space from storage and recreation to a safe, modern, multifunctional office space that is up to toady's building code.

Senior Design 2025 : Civil Engineering Team 11

Team

Quinn Havard

Alexander Foster

Matthew Barber

Lea Brinton

Faculty Advisor(s)

Wei Zhang

Non-UConn Advisor

Garrett Collins and John Bernick

Sponsor

HDR, Inc.

Sponsor Logo

Beacon Falls Station High Platform Upgrade

Description

This project includes the design of a new high level platform for the Beacon Falls railway station. A high level platform is one that is level with the railcars, so that passengers so not have any change in elevation between the railcar and the platform. The station also needs the track realigned with the changing of the platform. This project tasks our group to complete a 15% design of the track realignment, the 350 foot long high level platform, the canopy on top of the platform, and the station parking lot site work.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 12

Team

Tyler Warren
Gabriel Mompean
Jacqueline Torlai
Jennifer Hincapie
Richard Ganser
Romy Reichenberger

Faculty Advisor(s)

Wei Zhang

Non-UConn Advisor

David Jacobs & Randall States

Sponsor

Construction Industries of Massachusetts-Labor Relations Division (CIM-LRD)

MBTA Blue Line Extension Project

Description

The MBTA Blue Line Extension Project involves designing and developing a construction plan for a new station at the intersection of Massachusetts Avenue and Newbury Street in Boston. This station will connect with the existing Hynes Station, improving accessibility and enhancing Boston's transit network. The project focuses on constructing the platform, mezzanine, and entrances to a 15-20% design level, integrating structural, architectural, and geotechnical considerations. Key aspects include pedestrian flow optimization, ADA compliance, and space constraints in this high-traffic urban area. Beyond design, we are developing the construction methodology, sequencing, scheduling, and cost estimation to ensure efficient project execution. A key challenge is minimizing disruptions while delivering a cost-effective solution that optimizes the budget and timeline. Our goal is to create a realistic, well-coordinated plan that aligns with MBTA's long-term objectives for an accessible, sustainable, and commuter-friendly station.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 13

Team

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Jason Benard
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Shaun Supranowicz

Faculty Advisor(s)

Alexandra Hain

Non-UConn Advisor

Peter Scorzelli

Sponsor

Connecticut Army National Guard (CTARNG)

Sponsor Logo

United States Property and Fiscal Office Warehouse

Description

This project involves confirming the feasibility of a site for a 22,000 SF warehouse for the United States Property and Fiscal Office (USPFO) of the Connecticut Army National Guard (CTARNG), and preparing the Foundation and Structural Steel design documents. Our senior design group will be responsible for the foundation and steel structure design, ensuring the facility meets the necessary requirements for shipping, receiving, warehousing, and logistical support for the CTARNG. The new warehouse will include a 4-bay loading area, a customer waiting area, and will be designed to achieve LEED Silver certification. The designs will also account for future connections to subsequent phases, utility penetrations, and other site-specific requirements. Additionally, the site analysis will rely on existing utility drawings, geotechnical reports, and proposed site plans.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 14

Team	Faculty Advisor(s)	Sponsor
Rocco Veneruso Ahmed Zeinalabdin Mujo Kurtovic	Professor Alexandra Hain	Connecticut Department of Transportation (CTDOT)

CTDOT Bridge 01818B Design

Description

We are designing a new bridge in the town Meriden bridge 01818B to address congestion issues.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 15

Team

Aidan Parsons
Gavin Berger
Ethan Shapiro

Faculty Advisor(s)

Lexi Hain

Sponsor

Connecticut Department of Transportation (CTDOT)

Sponsor Logo

Union Maintenance Garage

Description

The Union Maintenance Garage Project incorporates lidar elements and virtual reality to provide a schematic experience to design engineers/architects. This project consists of using lidar samples and importing them into Blender software. After a lidar sample is imported into Blender, it is possible to draw a schematic of a building on top, allowing for engineers to visually conceptualize their design in virtual reality. We are pairing this design with the Meta Quest 3, capable of running Blender software and allowing for a visual experience.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 16

Team

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Anthony Girard
Luis Lopes
Matthew Golka

Faculty Advisor(s)

Alexandra Hain

Sponsor

HNTB Corporation

Sponsor Logo

Goldstar Bridge Rehabilitation

Description

HNTB is currently working on a full rehabilitation of the Goldstar Memorial Bridge, a vital component of Connecticut's transportation network and the largest bridge in the state. The senior design group will develop a small piece of that overall rehabilitation. The group who will gain a deeper understanding of the complexity of large structures and insight into the increasing need for the rehabilitation of essential infrastructure. The Goldstar Memorial Bridge is a prime example of a structure that has reached the end of its service life yet is integral to both the state of Connecticut and cities of New London and Groton. By the end of the project, three rehabilitation design concepts will be proposed. These should include some amount of CAD and calculation support to demonstrate that the concept can be constructed and will support design loads. HNTB will select one concept to take to a simple preliminary design which would include a cost estimate, basic plan set, and design calculations for key structural elements that are being proposed. In summary, this is a unique opportunity to learn how the structural design and project development process works. The Goldstar Memorial Bridge is a key feature of the Connecticut coastline and serves as essential infrastructure for a large portion of the state. All aspects of structural engineering will be touched on during the project, and students will be given the opportunity to develop their own rehabilitation design concepts, plans, and calculations. For any aspiring structural engineer, this project will serve as a rewarding challenge and give any students interested in structures the opportunity to experience what that work will be like firsthand.

CIVIL ENGINEERING

Senior Design 2025 : Civil Engineering Team 17

Team

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Ryan Johns
Timothy Ayers

Faculty Advisor(s)

Edward Weingart

Non-UConn Advisor

William Gorlin, PE, SE

Sponsor

Krenicki Arts and Engineering Institute

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UCONN
KRENICKI ARTS AND ENGINEERING INSTITUTE

Systematic Assessment and Visualization of the Structural Rigging System in UConn's Jorgensen Theater

Description

The Jorgensen Center for the Performing Arts, opened in December 1955, is a historical theater that serves a wide range of events for the University of Connecticut. The center was named for UConn president Albert N. Jorgensen, who oversaw construction. Within this center are two performance spaces: The Albert N. Jorgensen Theater located in the upper level of the building, and the main focus of this project that is the Harriet S. Jorgensen Theater located on the basement level. This space is a proscenium-style theater that houses four-hundred and eighty-five patrons, as well as a double-purchase counterweight rigging system and fully trapped stage. The Harriet S. Jorgensen Theater was not planned in the original construction of the center, but was rather added in after the construction on the Albert N. Jorgensen Theater concluded. Considering its last-minute construction, available data on the plans, structure, and layout are not readily available and have been lost since the transition from hard copy plans to digital ones. This loss of documentation has left the theater with no engineering-specific data, which includes the identification of the steel beams and other steel members, measurements, and capacity. The goal of this project is to understand the structural capacity of the rigging system, and how that interacts and impacts the steel structure, to address ever-creative evolving, and challenging future demands of the theater. This includes supporting flying actors, automation equipment, static and dynamic suspended scenery. The scope of this project includes identifying the steel members within the fly space, develop the structural plan and model , and compute the structural, load carrying capacity of the system overall.

Chemical and Biomolecular Engineering Senior Design Teams

Senior Design 2025 : Chemical Engineering Team 01

Team	Faculty Advisor(s)	Sponsor
Kevin Miller Patrick McKenzie Jacob Crow Carter Correia Michael Fenton (not pictured)	Dr. Wagstrom and Dr. Safran	Bigelow Brook Farm (USDA Small Farms Innovation Project)

Aquaponics Fish Waste Dewatering Device

Description

Aquaponics is a food production system that exploits the mutually beneficial relationship between fish and plants to naturally enhance the growth of both. The foundation of aquaponics is that fish secrete waste into water which is toxic to the fish but contains valuable nutrients that promote plant growth. Thus, in an aquaponic system water moves from fish tanks to plant beds where the plants use the nutrients and clean the water. The clean water is then returned to the fish. This recycling of water and positive usage of fish waste are the primary reasons why these systems have become popular. However, many systems still have excess of solid fish waste, which is where our project comes in. Currently small aquaponics farms produce a sludge byproduct that has little use, so the goal of our project is to separate the sludge so that the solids can be applied as fertilizer and the water can be returned to the system. To do this we propose a device that features gear driven rotation to create a centrifugal force which will drive water through a filter to trap the solids. We strove to make this device easy to use for all farmers, be easily portable due to lack of space in most greenhouses, consume no electricity, and be as cost effective as possible.

CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2025 : Chemical Engineering Team 02

Team

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Benjamin Hansen
Daniel Claffey
Vincenzo Fabrizi

Faculty Advisor(s)

Xiao-Dong Zhou

Non-UConn Advisor

David Daggett

Sponsor

Center for Clean Energy Engineering (C2E2)

Fuel Cell Airplane

Description

The aviation industry accounts for 2.5% of global CO2 emissions. Following the precedent of green transitions set by other high-emission industries such as cement production, there is hope that aviation can move towards sustainable alternative fuels. The goal of our project is to provide proof that advanced fuel cell-powered airplanes can be scaled up. We are using hydrogen fuel whose only emissions are heat and water vapor, leading to cleaner skies. The end goal of this project is for commercial aircraft to be powered using advanced fuel cells. Starting with a remote-controlled model airplane, our project aims to replace the traditional lithium battery power source with a hydrogen-powered Proton Exchange Membrane Fuel Cell (PEMFC). By calculating and measuring the power output requirements needed to fly the airplane, as well as the payload size and weight constraints based on aircraft size, we sourced the appropriate fuel cell. The required flight time is approximately 10 minutes. We determined the payload weight of hydrogen fuel, optimal combinations of motors and propellers, and heat exchange requirements based on a 10-minute flight at cruising altitude. Achieving flight using the PEMFC allows future iterations of this project to take advantage of more advanced solid oxide fuel cells that have high power output for their size.

CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2025 : Chemical Engineering Team 03

Team

Thanasi Dimopoulos
Camila Connolly
Sanjana Srinivas
Anthony Pacheco

Faculty Advisor(s)

Dr. Ioulia Valla

Sponsor

UConn College of Engineering

Designing a Sustainable Aviation Fuel from Biomass through Thermochemical Processes

Description

The aviation industry heavily consumes petroleum-based jet fuel, which significantly contributes to greenhouse gas emissions and environmental degradation. In the United States, jet fuel consumption averages to approximately 1.65 million barrels per day. As the demand for both international and domestic travel continues to grow, finding alternatives to conventional jet fuel is essential in reducing the environmental impact of aviation. Sustainable aviation fuels (SAFs) are emerging as a viable alternative to state-of-the-art jet fuels. These fuels utilize biomass, a renewable and abundant resource, to create a more sustainable fuel solution, which has the potential to significantly reduce greenhouse gas emissions from commercial flights. The objective of our project is to develop a SAF option that is both technically and economically feasible at a macroscopic level while meeting current aviation fuel specifications. Our proposed process converts rapeseed, a renewable feedstock, into SAF through hydrodeoxygenation. This chemical process removes oxygen from biomass by introducing hydrogen molecules to synthesize hydrocarbons. Using Aspen Plus, a widely used process simulation software, our team models the thermochemical process and evaluates the economic and environmental impacts of the proposed SAF. By implementing this method, the project seeks to improve fuel efficiency and performance while significantly reducing carbon emissions. This approach provides a powerful pathway for transitioning the aviation industry toward sustainability while ensuring fuel reliability and performance, with the potential to drive long-term reductions in aviation-related greenhouse gas emissions.

CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2025 : Chemical Engineering Team 04

Team

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Nathan Lawler

Faculty Advisor(s)

Yu Lei

Sponsor

University of Connecticut

Solid-State pH Sensor For Long-Term Marine Applications

Description

Currently, scientists are struggling to continuously monitor pH levels in many marine applications. Measuring the pH of water is important to keep people and marine life safe from harmful substances. The current glass pH sensors on the market are expensive, brittle, and unsuitable for long-term marine monitoring. Our team designed an inexpensive solid-state pH sensor that will monitor levels of pH continuously in marine applications. Our design involves pairing iridium oxide with a proton exchange membrane to achieve a working electrode that is continuously measuring. We tested this electrode over the course of a couple months and consistently monitored it for signs of degradation or accuracy fall off. After finalizing the durability, we proceeded with adapting our oxide onto a small-scale screen-printed electrode to improve manufacturability and reduce the overall cost. By using screen-printed electrodes, each of our sensors will cost only cents to produce, allowing us to market them at a lower price than current sensors. Though there are many cost benefits to our sensor, there are other implications we need to consider. One of these considerations includes the mining of iridium in South Africa, which is costly to the environment and provides dangerous working conditions for miners. Therefore, future researchers should further explore the process of recycling iridium oxide. The anticipated impact for this project will allow scientists to cheaply monitor water sources continuously and accurately for a couple months.

CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2025 : Chemical Engineering Team 05

Team

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Faculty Advisor(s)

Dr. Kristina Wagstrom

Non-UConn Advisor

Murray Gates

Sponsor

Artza Mendi Farm, USDA Small Farms Innovation Project

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COMPOST HEAT AND CO2 RECOVERY

Description

Artza Mendi Farm is a small-scale farm that aims to implement renewable agricultural practices. The owner of the farm, Murray Gates desires to expand operations from egg to vegetable cultivation by constructing a greenhouse heated by compost. Compost piles contain microorganisms that break down simple sugars to produce heat. This process is capable of producing 2.99 MJ of heat per kilogram of food waste. Our objective is to develop a compost heat recovery system (CHRS) that efficiently and economically recovers heat and CO2 for a greenhouse during the late winter and early spring months. Our proposed design utilizes negative aeration to speed up the composting process by pulling heated air from the compost pile. We can send this heated air to the greenhouse by using various unit operations such as a blower, pumps, pipes, and a heat exchanger. Composting produces contaminants that can harm the plants in high amounts, so the heated air passes through a biofilter. To better understand the economic and system feasibility, we designed a model using simulation software such as Aspen Plus. Through combining engineering expertise with agricultural insights, this integrated system will benefit farmers across the northeast and increase the viability of environmentally friendly practices.

CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2025 : Chemical Engineering Team 06

Team

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Joseph Choi
Andy Lin

Faculty Advisor(s)

Prof. Luyi Sun

Non-UConn Advisor

Environmental Protection Agency

Sponsor

US EPA

Sponsor Logo

Design of Aerobic Biodegradation Assay for Evaluating Compostable Packaging Films

Description

Plastic pollution is one of the greatest environmental threats according to the U.S. Environmental Protection Agency, with packaging accounting for 40% of global plastic waste. While environmentally sustainable packaging options exist, these alternatives come with their own challenges that prevent them from completely replacing plastic. These challenges include high energy and resource costs, poor durability and barrier performance, lack of water-resistance, and scalability issues that must be addressed in order to compete against conventional plastic. Our design project proposes a solution in the form of compostable packaging films that incorporates a novel nanosheet coating process recently developed by the Sun Lab. These nanosheet-coated films exhibit exceptional mechanical and barrier properties and can be assembled at low-cost and large-scale, making them a promising substitute for plastic if they can be proven 100% compostable. Our goal was to build a compost test system to evaluate the compostability of these films. To do this, we first designed a lab-scale biodegradation test station in accordance with American Society for Testing and Materials standards. We then began a 45-day test trial of our sample films, regularly monitoring temperature, moisture, and carbon dioxide levels—required measurements for assessing compostability. Although our results showed that our samples were not compostable, our test station will remain in the lab to assess future iterations of these films. Demonstrating the compostable properties of these films would provide leverage for investments in their large-scale production and commercialization, directly addressing the plastic pollution problem by providing a competitive sustainable packaging alternative.

CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2025 : Chemical Engineering Team 07

Team

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Aiden Collentine

Faculty Advisor(s)

Jeffrey McCutcheon

Sponsor

Connecticut Department of Energy and Environmental Protection (CT DEEP)

Sponsor Logo

Durham Meadows Groundwater Contamination: Options for Delivering Clean Drinking Water to Residents and Businesses

Description

Project for solutions to give potable water to residents and companies in affected areas of Durham Meadows with 1,4-Dioxane pollution. Methods and costing estimations for the Department of Energy and Environmental Protection of Connecticut.1,4 – Dioxane is a chemical that is miscible in water and has been known to cause liver and kidney damage from prolonged exposure to drinking water. Our solutions considerations were cost and efficiency as the Department of Environmental Protection for Connecticut sponsored us to find out. We have investigated three classes of solutions: Point of Use, Centralized & Aqueduct. Point of use is a solution that is installed directly inside a residential home or commercial building and provides, in our solution, reverse osmosis membranes that purify the water. Centralized remediation utilizes a facility that directly tackles pollution by breaking down 1,4-Dioxane into constituents of carbon dioxide, in our method this could be done with advanced oxidation or bioremediation. An aqueduct is a type of solution that brings water from a clean source to the affected areas without remediating or separating 1,4-Dioxane in the affected areas. This can be done by taking water from Middletown, CT to bring clean water to the area. Our main goal is to give options and economic analysis to give an appropriate solution for the Department of Energy and Environmental Protection.

CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2025 : Chemical Engineering Team 08

Team

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Joshua Nhan
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Faculty Advisor(s)

Dr. Mu-Ping Nieh

Sponsor

Unsponsored Student Team

Rational Design of Nanoparticles Based on A Thermodynamic Approach

Description

Lipid nanodiscs are small, disc-shaped nanoparticles used in drug delivery and membrane protein research. They are formed through self-assembly of long-chain and short-chain phospholipids. The long-chain lipids like DPPC create a planar lipid region and short-chain lipids such as DHPC stabilize the curved rim. However, determining the correct lipid composition typically relies on trial-and-error, which increases cost, time, and material waste. To address this challenge, we developed a predictive model that estimates nanodisc structure based on molecular inputs and lipid ratios. Using known physical properties such as lipid volume, tail length, and headgroup area, the model calculates how lipids distribute between planar, rim, and solution phases. It also predicts disc geometry (radius, rim height), packing behavior, and partitioning trends. The model uses nonlinear optimization to satisfy key physical constraints such as mass and volume conservation, while minimizing unrealistic lipid distributions. By adjusting lipid ratios, the model simulates how disc size changes with composition. We evaluate consistency through partition coefficients, or in other words, if the ratio of lipid concentrations remains stable across different disc sizes, the system is thermodynamically sound. We validate our predictions by comparing model outputs such as disc geometry and lipid partitioning to experimental data reported in NMR and cryo-EM studies. This tool allows researchers to rationally design nanodiscs and reduce the need for trial and error. It provides a thermodynamically informed framework for optimizing lipid-based nanoparticle systems in both basic research and applied biomedical contexts.

CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2025 : Chemical Engineering Team 09

Team	Faculty Advisor(s)	Sponsor
Jonathan Zilberman Sade' Lawson Kayla Colon Julia Nehez	Yang Qin	Unsponsored Student Team

Agricultural Light Conversion Paint

Description

As population continues to increase rapidly and food sources struggle to meet demands, research in using carbon quantum dots (CQDs) has become more prominent in the agricultural field. Carbon quantum dots are carbon nanoparticles that aid in the process of photosynthesis resulting in an increase of crop yields. Due to their fluorescent properties, CQDs have the ability to convert UV and green light portions of sunlight into blue and red, which leads to an increase in light intensity. Our goal is to synthesize these carbon dots through a hydrothermal synthesis and evaluate their stability on a smaller scale. Additionally, we want to formulate a paint that is compatible with these CQDs while also being cost effective and conforms with FDA standards. To meet these requirements, the paint must be formulated using the simplest ingredients such as alcohols, polymers and surfactants. Once formulated, we will proceed with field testing which will allow us to observe changes in crop growth and yield. As mentioned before, food suppliers are struggling to meet demands, therefore, creating a light conversion paint will be extremely beneficial in agricultural applications, leading to positive impacts on society, the environment, and the economy.

CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2025 : Chemical Engineering Team 10

Team

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Chad Moreau
Noah Kosh
Stephen Sheak (not pictured)

Faculty Advisor(s)

Yu Lei,
Yongku Cho

Sponsor

National Science Foundation

Sponsor Logo

Optimization Of Photobioreactor Design To Achieve Sustainable Algae Growth

Description

Our project harnesses the power of microalgae as a sustainable source of methionine, an essential nutrient for organic poultry feed. The market for organic food is growing as consumer demand for natural and sustainable products increases. Since methionine is an essential amino acid in poultry feed but cannot currently be produced commercially, organic food standards allow the use of synthetic methionine in organic feed. Our group aims to create a scalable bioreactor that grows high density microalgae while being energy efficient and economically viable. Our final solution will pump the microalgae from a stirred tank through a series of tubing to increase light exposure while maintaining the mixing effect. Our project will impact the organic poultry industry and reduce the harmful pollutants released during the synthetic methionine production process.

CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2025 : Chemical Engineering Team 11

Team	Faculty Advisor(s)	Sponsor
Dev Barochia Arthur Silva Austin Gelinas Ethan Taylor	Dr. Brian Willis	Unsponsored Student Team

Green Energy Machine

Description

Our project offers a sustainable and more efficient approach integrating multiple green energy sources for potential enhanced profitability. Many ski resorts still rely on old and inefficient methods for generating power and snowmaking. We want to emphasize the importance of integrating multiple energy sources to create a more efficient power generation system. Our team will take advantage of the higher elevation by integrating a fuel cell, electrolyzer, and water turbine system that will work from the mountain peak to the lodge at its base. This system will optimize water production from the fuel cell near the mountain peak to maximize energy efficiency. Our design combines multiple energy systems to supply electricity to the lodge, lifts, snowmaking machines, and other operations which may require electricity. At the mountain base, a PEM electrolyzer produces hydrogen and oxygen. The system transports hydrogen from the base of the mountain to the peak, where a fuel cell will utilize it for energy production. The system either sells the oxygen to a third party for profit, or it transports the oxygen to the peak to increase the efficiency of the fuel cell. The system then transports the water produced from the fuel cell back down to the base, where it runs a water turbine and produces additional electricity. We must consider the production/manufacturing side of the renewable energy sources we are utilizing for the design, as well as the safety of keeping and storing hydrogen near the lodge. We must also consider the placement of the fuel cell, as its efficiency will decrease as the elevation increases. Our solution is unique because it is tailored to the site’s elevation, and our team relies on the natural topography to generate additional electricity through the water turbine. By integrating multiple renewable energy sources, we aim to increase total profitability and present a more attractive option for our client and potential investors.

Computer Science and Engineering Senior Design Teams

Senior Design 2025 : Computer Science and Engineering Team 01	Team	Faculty Advisor(s)	Sponsor
	Kaitlyn Ha Oleh Stasyuk Sage Pia Isabella Fernandez James Albanese Yarid Tyran	Dongjin Song	UConn College of Engineering

Benchmarking Large Language Models for Time Series Analysis

Description

Consider Time series analysis: the study of sequential data points collected over time which play a crucial role in fields like finance, healthcare, and weather forecasting. Accurate time series analysis enables the understanding of historical trends and the prediction of future events. With the rise of Large Language Models (LLMs), natural language tasks have become more accessible through intuitive Q&A-style interfaces. Given the structural similarities between time series and language data such as temporal dependencies and sequential patterns, LLMs have slowly become adapted for time series analysis. This project explores the intersection of LLMs and time series forecasting. In Fall 2024, CSE SDP Team 01 conducted a comparative study of three emerging time series LLMs: Chronos, One Fits All, and S2IP-LLM, analyzing both their strengths and limitations. In Spring 2025, the team built an interactive interface that allows users to upload their own datasets and perform forecasting using multiple models simultaneously, enabling direct comparisons and emphasizing ease of use for all types of users, not just ones who are technically adept.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 02

Team

Jennifer Fomenko
Shiv Patel
Evelyn Landau
Sophiya Singh
Daniel Kalvaitis
Benjamin Zheng

Faculty Advisor(s)

Dong-Guk Shin

Sponsor

UConn Computer Science & Engineering Department

Sponsor Logo

UCONN
COLLEGE OF ENGINEERING

GUI Development for Machine Learning-Enabled Inverse Analysis of Scattering Experiments

Description

Our project's main goal was to create a web application that enables visualization and inverse analysis of Small Angle Scattering data using pre-trained machine learning models. Part of that goal was ensuring the application we wrote was reponsive, easy to use and understand, performed well on all manner of machines, and has a flexible codebase for future expansion. We accomplished these goals by developing SASGUI, a responsive web-based application with a React TypeScript Frontend, Python Backend, and SQLite database. Headline features include a real-time reactive Small-Angle-Scattering curve graph, capable of displaying uploaded experimental data alongside simulated Small-Angle-Scattering curves that can be generated by adjusting responsive parameter sliders. SASGUI also has the ability to predict the morphology (shape) and structural parameters (dimensions) of nanoparticles by analyzing Small-Angle-Scattering data with a machine learning model, a standout feature for research applications. Finally, SASGUI allows users to save and load application state, which could be used to save work, or to create templates for use in the classroom or the lab.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 03

Team	Faculty Advisor(s)	Sponsor
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Keerat Sawhney	Timothy Curry	
Louis Cundari III		
Jeffrey Gao		
Colin Gorski		
Nauman Chaudhary		

Cloud-based Analytics Platform Development for User Interactions Tracking

Description

This project aims to create a service that can track key components of a user's journey through any given website. Designed to be platform agnostic, the project aims to be easily integrable into any standard website and send data to a database hosted on the cloud. It is then displayed via intuitive dashboards. With this, our sponsor can identify pain points in the user journey.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 04

Team

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Katie Bergstrom
James Kiernan
Ashik Samin

Faculty Advisor(s)

Professor Zhijie Jerry Shi

Non-UConn Advisor

Dr. Raja Hari Gudlavalleti and Allen Legassey

Sponsor

Biorasis

Sponsor Logo

Medical Mobile App for Continuous Glucose Monitoring (CGM) System

Description

Biorasis, Inc., a UConn-based startup located on the Storrs campus, is pioneering the development of miniaturized implantable metabolic sensors aimed at advancing real-time health monitoring. The company's current focus is on creating a next-generation Continuous Glucose Monitor (CGM), called the Glucowizzard, for patients with Type I and Type II diabetes. As part of the system, Biorasis, Inc. requires the development of a robust, smartphone-based Medical Mobile App (MMA) to interface with its implantable CGM device via a Proximity Communicator. The objective of the project was to design and develop an intuitive and reliable mobile application that communicates with the Glucowizzard via Bluetooth Low Energy (BLE), using the Proximity Communicator. Our app enables seamless and secure data exchange between the implanted sensor and the user's mobile device, providing real-time glucose readings, data visualization, and data storage for long-term monitoring. Key milestones of our project included: researching current CGM mobile solutions, designing an accessible and functional graphical user interface (GUI), implementing high-integrity data handling, and successfully integrating the app with Biorasis' Proximity Communicator. This mobile application will play a critical role in supporting Biorasis' mission to improve diabetes management through innovative sensor technology and user-centered digital tools.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 05

Team

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Veeksha Gangaraju

Faculty Advisor(s)

Song Han

Non-UConn Advisor

Liang Zhang

Sponsor

Southern New England Industrial Assessment Center at UConn

Augmented Reality-Assisted Training Application for Energy Assessment Tools

Description

The UConn Southern New England Industrial Training and Assessment Center is a program funded by the US Department of Energy, that aims to provide free energy assessments to small manufacturers. The ITAC works with a variety of engineering equipment used to measure energy consuming behavior of manufacturing equipment. This includes data loggers, current and pressure transducers, high-def IR cameras, combustion analyzers, etc. Often, it can take a while for a new student in the ITAC to comprehend the operations of these devices. Our team was assigned to develop an Augmented Reality (AR)-based training application to assist engineers learning how to use energy assessment tools. This was accomplished utilizing Unity and Microsoft's MRTK framework to develop an application to be deployed on HoloLens 2.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 06

Team

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Ribka Sheikh
Joshua Kaplan
Daniel Skakun
Alex Balan

Faculty Advisor(s)

Suining He

Sponsor

Dr. Suining He

SDP Routes

Description

Our project focuses on creating a UConn-specific mobile application that leverages the Google Maps API to help students efficiently navigate the campus. Navigating UConn's campus can be intimating, so we would like to ease that fear by creating this application. Many students currently rely on Google Maps, which is not always the most effective or user-friendly solution for navigating campus-specific locations. The app's primary objectives are to provide optimized routes to classes, identify study spots, and ensure accessibility for individuals with disabilities.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 07

Team

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Ryan Lagasse
Brian Banaszczyk

Faculty Advisor(s)

Jonathan Ji

Sponsor

UConn Computer Science & Engineering Department

Reinforcement Learning with Oracle Feedback

Description

Using LLMs to train against bias

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 08

Team

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Jai Goel
Truc Ho Nguyen
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Suhaas Nadella

Faculty Advisor(s)

Professor Jonathan Shihao Ji

Sponsor

Pratt & Whitney

Sponsor Logo

Machine Learning in Jet Engine Prognostics

Description

The project involves developing a machine learning model to predict the remaining useful life (RUL) of a jet engine. Our approach leverages different types of recurrent neural networks and transformers to analyze historical data containing operational conditions from each engine's previous flight cycles. We aim to provide valuable insights for predictive maintenance in aviation, allowing engineers to also improve aircraft safety and optimize maintenance schedules.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 09

Team

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Faculty Advisor(s)

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Xinxuan Zhang

Sponsor

Eversource

Prediction Accuracy Enhancement for the Outage Prediction Modeling System

Description

The Outage Prediction Modeling (OPM) system, developed by UConn EEC, offers pre-storm power outage forecasts in electric distribution systems. The machine learning based OPM is trained offline with historical weather data, then applied in forecast mode using weather forecast products for upcoming storms. During the past decade, EEC has been continually enhancing the OPM by expanding its storm database, refining weather data customization methods, and experimenting with diverse machine learning and AI algorithms. In this project, we seek the Senior Design Team's expertise to enhance outage prediction accuracy, particularly for thunderstorms and/or high-impact weather events. Thunderstorms are among the most common weather phenomena in the Northeast region especially during spring and summer seasons. However, the uncertainties inherent in predicting these convective storms make it challenging to accurately forecast the thunderstorm-related outages. This project aims to improve the predictive analytical methods for forecasting outages caused by thunderstorms. The outages caused by high-impact weather events such as hurricanes and nor'easters tend to be underestimated by OPM. We seek alternative methods to enhance the model's outage prediction capabilities for high-impact events, allowing utilities to better prepare in advance.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 10

Team

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Faculty Advisor(s)

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Sponsor

UConn Electrical & Computer Engineering Department

Sponsor Logo

UCONN SCHOOL OF ENGINEERING
ELECTRICAL & COMPUTER ENGINEERING

MITRE eCTF

Description

We’ll be participants in the MITRE Embedded Capture the Flag (eCTF) competition. This embedded security competition, hosted by MITRE Engenuity, spans the spring semester and challenges participants to design, implement, and evaluate secure systems within the context of realistic scenarios which will be released at the beginning of the spring semester. Our primary objective is to develop a comprehensive solution that meets all requirements within the time designated for the Design Phase and the Attack Phase. The MITRE eCTF competition is divided into two distinct phases: \begin{itemize} \item \textbf{Design Phase:} During this phase, we are tasked with designing and implementing a secure system that meets both functional and security requirements which are outlined by the organizers. A Reference Design will be provided at the start of the competition. This design satisfies functional criteria but lacks security. We will then build upon this reference to create a system that adheres to both sets of requirements. Passing the Design Phase is crucial, as only teams that meet functional standards are allowed to progress to the Attack Phase. Additionally, meeting the security requirements is important for scoring Defensive Points. \item \textbf{Attack Phase:} When we successfully complete the Design Phase we enter the Attack Phase, where the objective shifts to finding vulnerabilities in the designs submitted by other teams. Each design that has been validated during Handoff will be made available to other teams for attack. Teams will be able to load other teams’ designs onto a physical microcontroller with a secure bootloader provided by the organizers. This phase emphasizes offensive security skills and rewards teams for exploiting flaws in other participants' systems. \end{itemize}

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 11

Team

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Faculty Advisor(s)

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Sponsor

UConn Computer Science & Engineering Department

Fashion Classifier

Description

In the fashion industry, categorizing items based on attributes like color, fabric, size, fit, and comfort is essential for efficient inventory management, trend analysis, and personalized recommendations. Current solutions often rely on manual tagging, which can be both time-consuming and prone to errors. Our project proposes a machine learning model that automates the classification of fashion items into various categories, utilizing publicly available datasets. Dataset Collection and Preprocessing: • Gather and preprocess public datasets containing images of fashion items labeled with attributes like color, fabric, size, fit, and comfort. • Ensure data diversity to account for variations in lighting, angle, and item presentation. Model Development: • Develop a machine learning model capable of multi-label classification, identifying multiple attributes of a fashion item simultaneously. • Experiment with different ML models (ex. Convolutional Neural Networks and Transformers) to achieve optimal accuracy. Model Training and Validation: • Train the model on the collected datasets and validate its performance using appropriate metrics (ex. precision, recall, and F1-score). • Address potential challenges such as imbalanced data, where certain attributes like specific colors or fabrics may be underrepresented.

Senior Design 2025 : Computer Science and Engineering Team 12

Team

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Faculty Advisor(s)

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Sponsor

UConn Computer Science & Engineering Department

UCONN Navify - Indoor Building Navigation

Description

Navigating through buildings can be challenging, especially for first-time visitors. This issue particularly affects college students who need to find their classrooms. Our app aims to simplify building navigation by allowing users to input a starting and ending location, then displaying a path through the floor plan. Additionally, users can set preferences for their route, such as choosing to use stairs or elevators. The app will leverage a model to convert floor plans into a graph that can be easily traversed, providing an optimal route based on the user's preferences.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 13

Team	Faculty Advisor(s)	Sponsor
Alexander Hamilton Chikwendu Mgbechi Maanit Malhan Aravind Adusumalli Mehreen Khan	Jake Scoggin	Unsponsored Student Team

Husky Dining

Description

Husky Dining is a web app designed to improve the campus dining experience for students and faculty. It allows users to browse dining hall menus, check hours of operation, and track meal plan balances with ease. The platform also supports sharing Flex Passes and dining points, making it easier for commuters and students to access meals. Developed with the goal of combating food insecurity and enhancing the UConn dining experience, Husky Dining offers a modern, user-friendly interface to make campus dining more accessible and efficient.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 14

Team

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Faculty Advisor(s)

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Sponsor

Dr. Bing Wang

Husky Hotspot

Description

The Husky Hotspot aims to revolutionize the dining hall experience for students. Current challenges faced by students include difficulty in finding their preferred meals at dining halls, inaccurately reported menu items, as well as long wait times at dining halls. As a college student these challenges can easily become an obstacle that negatively affects eating patterns and wastes precious time, amounting to problems that could impact a student's academic and personal success. So what can be done? This application integrates artificial intelligence as well as social features and personalized recommendations in order to enhance the dining hall experience and allow students to make efficient decisions on their meal choices based on peer opinions and generated suggestions. By combining real-time updates, user preferences, and community feedback we're creating a comprehensive platform that will change how students interact with the dining hall, as well as set a foundation for a platform that will continually improve the dining experience.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 15

Team

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Sponsor

UConn College of Engineering

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UCONN COLLEGE OF ENGINEERING

Building a Machine Learning Model to Interpret Virtual X-ray Diffraction Patterns

Description

X-ray diffraction (XRD) is an important tool for material science, allowing researchers to understand material microstructures and characterize material properties. It is especially useful for studying materials while they are subjected to extreme conditions like high temperatures and pressures. However, manual analysis of diffraction patterns is time-consuming and reliant on expert interpretation. Furthermore, manual analysis cannot accurately quantify solid and liquid phase fractions for a melting material, which contains a mix of both phases. Our project, under the guidance of Dr. Avinash M. Dongare (Materials Science) and Dr. Qian Yang (Computing), focused on developing machine learning models to automatically analyze XRD patterns and predict the fraction of the material in the solid and liquid phases. Using molecular dynamics data of melting copper from Dr. Dongare's GEMMS lab, we created a data processing pipeline to generate a large dataset of simulated XRD patterns. Then, we developed, trained and tested various machine learning models. Our best model achieved extremely high accuracy in predicting solid fractions, achieving an R^2 score over 0.99. Our XRD analysis approach can significantly reduce analysis time and provide precise quantitative results, enabling more efficient and accurate materials characterization workflows.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 16

Team

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Faculty Advisor(s)

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Non-UConn Advisor

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Sponsor

Cigna

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ParkUC - Tracking Parkinson's with personalized insight

Description

Parkinson's is a neurodegenerative disease which affects one million people in the United States and six million people worldwide. This disease impacts the quality of life through rigidity, stiffness, tremors, and other symptoms, and despite having no known cure, there are several effective medical treatments that can be implemented. The goal of this project is to create a mobile application that improves the quality of life for Parkinson’s patients by tracking symptom progression and recommending treatment options. The completed application includes a medication tracker, Parkinsons detection tests, and unintrusive, passive symptom tracking. Data collected on the user’s symptoms are presented in graphs, paired with data analysis to show the users’ health trends and specialized treatment recommendations. The application also features accessibility features for users with tremors or other difficulties using mobile devices, such as voice-activated commands.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 17

Team

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Faculty Advisor(s)

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Sponsor

Unsponsored Student Team

Code Quality Analysis

Description

In modern software development, maintaining clean, efficient, and maintainable code is crucial to the success of any project. However, as codebases grow, they often become more complex, making it increasingly challenging for developers to manage code quality. Issues such as poor object orientation, high coupling, unused code, duplicated code, and overly complex logic can lead to significant technical debt, making the codebase harder to maintain, extend, and debug. These problems not only slow down development but also increase the risk of introducing bugs. This project aims to address these challenges by developing a code analysis website that allows users to select constraints and forms of analysis which then detect and highlight key issues in codebases. The goal is to provide actionable insights that help maintain code quality, reduce technical debt, and ultimately improve the software's overall robustness and scalability.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 18

Team	Faculty Advisor(s)	Sponsor
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Shane Jacob	Yufeng Wu	Student Team
Harsh Patel		
Jai Pandia		

AITime

Description

Navigating the academic and social landscape of a large university can be overwhelming for students. To address this challenge, we developed AITime, a cutting-edge, cloud-native mobile application designed to streamline and personalize the student experience at the University of Connecticut (UConn). Leveraging the power of artificial intelligence (AI) and machine learning (ML), AITime aims to serve as a central hub for all aspects of student life, connecting users with campus organizations, events, and resources. The app offers personalized recommendations based on user interests, academic schedules, and past interactions, making it easier for students to discover clubs, events, and opportunities that align with their preferences. AITime provides real-time updates on upcoming activities, ensuring that students are always informed and engaged with the UConn community. With an intuitive, user-friendly interface, AITime promotes accessibility and convenience, helping students maximize their time on campus while fostering stronger connections within the university ecosystem. Our mission is to create a more connected, informed, and engaged campus environment, ultimately enriching the overall student experience at UConn.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 19

Team

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Hanna Hollenbeck
Tageria Davis

Faculty Advisor(s)

Jake Scoggin

Sponsor

Unsponsored Student Team

HuskyBuddies

Description

HuskyBuddies is a mobile application designed exclusively for UConn undergraduate students. The platform's primary function is to connect the user with other students based on shared courses in their academic schedules. Within the settings page, the user can customize their profile by adding personal interests (e.g., Sports, Technology), setting study preferences (e.g., library, coffee shop), establishing a preferred name, uploading a profile picture, and building their current semester course schedule. After profile completion, the user can access the main matching interface where they can sort other students based on course overlap, browse potential connections by shared interests, and send friend requests to compatible students. Once a connection is established through mutual friend acceptance, the user can initiate private conversations with their connections to discuss course materials, coordinate study sessions, and exchange contact information to strengthen academic relationships. The application features a dedicated events section where the user can schedule study sessions with connections using the integrated calendar, create custom events (e.g., club meetings) visible to other students, and discover and attend events posted by other students. This platform facilitates academic collaboration and social networking within the UConn community through a course-centric approach to student connections.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 20

Team

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Faculty Advisor(s)

Herzberg, Amir

Non-UConn Advisor

Zachary Murtishi

Sponsor

NUWC

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NAVSEA WARFARE CENTERS NEWPORT

Reconfigurable Test Fixture for Digital Integrated Circuits

Description

This project aims to design and develop a physical device with a graphical user interface to test the functionality of different integrated circuits. The graphical user interface will be a PC application that the user is able to easily access and understand where the user should only have to select the type of integrated circuit to test before getting the results. This application is also design so that new integrated circuits can have test implemented easily, making it useful even for future integrated circuits.

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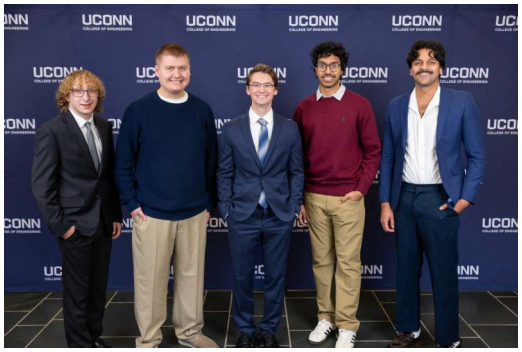

Team

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Faculty Advisor(s)

Professor Zhijie Jerry Shi

Non-UConn Advisor

Monica Sadil

Sponsor

Diplomeet

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Diplomeet Website Prototype

Description

The current research and commitment process for higher education institutions is expensive, overzealous, and impersonal. Traditional research methods do not provide high school students with convenient, thorough, and specific answers to help high school students make informed decisions about their futures. Diplomeet is an ed-tech start-up idea aiming to reduce college research costs for high school families by embracing what makes students unique. The UCONN senior design team was tasked with creating a prototype website that provides personal and specific answers to high school students during their college research and commitment process. The website performs back-end and front-end functions to match high school students with currently enrolled college students. High school students receive personalized college student matches based on similar demographic backgrounds, interests, and career goals. The goal of the website is for students to quickly build user profiles so they can be accurately matched with appropriate college students.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 22

Team

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David Nicholas Zavarelli

Faculty Advisor(s)

Zhijie Jerry Shi

Sponsor

BOTL Farm

Grazing Plan Module Development for farmOS

Description

farmOS is an open source farm management software written as a drupal distribution. The software is used by several farms in CT including our sponsor, BOTL Farm, a pasture-based sustainability-focused livestock farm in Ashford, CT. Our team worked on implementing a grazing module with features that are 'farmer first' and considered real-time needs of farmers working in areas where they may lack network connection. Features we implemented include: graphically presenting actual vs. planned grazing events for an asset, automated shifting of grazing event in case of overlapping schedules, and easy one-click deletion of grazing events.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 23

Team

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Non-UConn Advisor

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Sponsor

Pratt & Whitney

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Robotic Engine Diagnostic Algorithm

Description

PW are looking for an efficient algorithm to scan the entire surface of plane parts to measure plane health, such as plane wings, plane fans, jet engines, etc. The algorithm (preferably Python) must completely scan the plane parts in a reasonable time yet be compressed enough to fit into the matchbox car-like components. The premise of the algorithm is similar to an automatic vacuum cleaner that turns when hitting a wall (sometimes edges in this project's case) and avoids defects when running into them. The algorithm should be showcased and tested using a virtual simulation (PyTorch or PyBullet).

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 24

Team

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Sponsor

Captured Sun

Mobile App Development for Tracking Political Happenings

Description

This project is in collaboration with Captured Sun, a software startup based in Austin, TX. Captured Sun is currently developing two major platforms: Parchment, which reimagines the computer desktop, and Forum, a civic digital interface designed to help users engage with and understand the U.S. political system. This project focuses on Forum, an iOS mobile app that aims to consolidate scattered political information—such as election dates, candidate profiles, and campaign donations—into a cohesive and accessible experience. The goal is to allow users to track political happenings at the local, state, and national levels while gaining insight into where political donations are going and how power flows within the system. Although parts of the app are already built, the development team will contribute by building out a strong, scoped portion of the app. The backend is built using Node.js and is hosted on a remote-access server, while the mobile application is developed in Swift for iOS. With existing interest from organizations and individuals, Forum has significant potential for impact and expansion once deployed.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 25

Team

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Sponsor

Draper Laboratory

System Modelling of TAK Technology as a Proposed Wildfire Mitigation Common Operating Picture

Description

Due to climate change creating warmer and dryer conditions for active fires, wildfires in recent years have been increasingly devastating across the United States. Despite this, there is no one Common Operating Picture (COP) for wildfire mitigation, leaving local municipalities to rely on intuition, institutional knowledge, or out-of-date tools. While this may be functional, a standardized technology or system for fire mitigation would help all parties involved to efficiently learn and implement fire suppression methods based on real time evidence. We propose using Draper Laboratory's Team Awareness Kit (TAK) as a potential COP for wildfire mitigation. Our team has created a SYSML model of this technology through MagicDraw Cameo Systems Modeler, which showcases the relationships between the TAK system and the firefighters performing a fire suppression mission. The model additionally can edit and initialize various properties that need to be monitored throughout the mission, which can be a useful tool for planning and allocating resources for missions.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 26

Team

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Faculty Advisor(s)

Wei Wei

Sponsor

UConn IASE/ Industrial Assessment Center

Web-based Data Management and Analytics Toolkit for UConn Industrial Training and Assessment Center

Description

As the UConn ITAC carries out its daily activities, especially energy assessments for the manufacturing facilities, a variety of data is generated, including photos, videos, audio recordings, transcripts, energy bills, equipment manuals and specs, sensor measurement data, etc. The UConn ITAC team will also compile energy assessment reports in LaTex on Overleaf to be delivered to the clients. There is a great demand from the team to create a centralized toolkit that can curate and organize the data properly, perform engineering analysis, and generate report files in a streamlined manner. The goal of this project is to develop a web- based suite of applications that can solve these pain points of the UConn ITAC team operations.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 27

Team

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Josiah Mendez

Eleanor O'Mahoney

William Egbunike

Faculty Advisor(s)

Shin,Dong

Sponsor

Dr. Dong-guk Shin

Bone GPT

Description

In this senior design project, we are implementing a data visualization component and an LLM interface framework onto the Shin Bone Lab website. Our goal is to improve the functionality and interface of the website given the outdated interface. Additionally, we want to provide bone scientists accurate summary statistics fetched from our proposed LLM and have scientists view different studies and statistics from Laravel. Scientists can have greater modalities to select different visualizations and obtain summary statistics with greater ease with a chatbot interface. Furthermore, we enhanced the capability of the LLM with retrieval augmented generation that enables scientists to fill in study information more efficiently.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 28

Team

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Zuhayr Huseni (not pictured)

Faculty Advisor(s)

Bing Wang

Sponsor

UConn Computer Science & Engineering Department

UConn One Stop Housing

Description

The goal of this project is to create an online web application that aggregates off-campus housing options for the convenience of UConn students as they search for housing each semester and/or school year. Utilizing JavaScript for the application design and a Python web scraper to collect listings from various websites, we plan to create a simple web application that presents house and apartments listings in an organized manner. The application will allow users to search for house listings, filtering them based on their specifications and preferences. Users also have the option to create accounts on the website through NetID Single Sign-On. When users make an account on our application using their UConn NetIDs, they will be able to save listings to their account to go back to at any time.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 29

Team

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Faculty Advisor(s)

Dr. Song Han

Sponsor

UConn, Dr. Imani

Digital Twin for Cooperative Robotic Additive Manufacturing

Description

Our Cooperative Robotic Additive Manufacturing (CRAM) system advances 3D printing through coordinated robotic arms and a real-time digital twin. Developed by CSE Team 29 and ECE Team 22, this project addresses limitations of traditional gantry-based 3D printers, such as fixed build volumes, slow layer-by-layer deposition, and restricted geometries. Using two robotic arms, CRAM enables faster fabrication and nonplanar deposition for large complex prints. The ECE team develops a custom slicer for nonplanar toolpaths, allowing robotic arms to navigate intricate geometries, and designs motion planning algorithms to prevent collisions in shared workspaces. The CSE team handles part decomposition to assign subparts to individual arms, builds a digital twin for real-time monitoring and control, and integrates sensor data, including thermal imaging, for feedback and optimization. Built on ROS2, RViz, and Rerun, our platform streamlines operations and enhances print precision. CRAM aims to improves surface quality, part strength, and manufacturing speed, enabling new possibilities for advanced additive manufacturing. This system highlights the potential of cooperative robotics and digital twins to enhance production processes.

COMPUTER SCIENCE AND ENGINEERING

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Team	Faculty Advisor(s)	Sponsor
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Muhammad Anwer		
Shawn Green		
Morony Solis		

Anti-phishing Webmail

Description

Phishing emails are one of the main attack vectors harming Internet users. We will build and experiment with a prototype system, our custom-built version of the Tuta Mail webmail service, to defend against these threats. The system would be an addition to the web-based email service, that will add support for the defense against phishing emails. The main defense mechanisms include authentication of messages from trusted senders (using digital signatures), ability to send signed messages, and a user-interface mechanism to train users to detect (phishing) messages that appear as if they were sent by one of the senders trusted by the user.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 31

Team

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Noor Sharaf
Gabriel Jackson

Faculty Advisor(s)

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Non-UConn Advisor

Asif Amin

Sponsor

Belimo Americas

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Gas Monitors Calibration Chamber 2.0

Description

Belimo, a company specializing in heat, ventilation, and air conditioning solutions, creates gas monitors that help consumers detect harmful levels of toxic gases such as CO and NO2. At the core of these monitors are gas sensors which need to be properly calibrated. Our project aims to create an application that interfaces with electronic components inside of and around an improved "calibration chamber" for mass calibration of these sensors. Additionally, a database will be created to store information concerning operators, calibrated sensors, and reference sensors. The application automates the process of sending and receiving data to and from sensors, opening and closing valves, and controlling fans, all through the use of an Arduino microcontroller. The goal of this collaborative effort is to enhance metrics such as the calibration time, number of sensors calibrated per batch, and ease of use for the operator.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 32

Team

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Non-UConn Advisor

Dr. Yusuf Ransome

Sponsor

AromaKIT - Dr. Ransome

Sponsor Logo

AROMAKIT

AromaKIT

Description

The objective of this project to enable an individual to reprogram their subconscious mind using Cognitive Behavioral Therapy (CBT) techniques, neuroscience, and aromatherapy via a portable device that: (1) projects affirmations that the person can see repeatedly, especially before they go to sleep, (2) complements the visual affirmations with positive audio that repeats the positive information (or specific audio frequencies) in specific sequences and doses, (3) activates essential oils a person can breathe in during specific sleep cycles.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 33

Team

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Brianna Washington
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Non-UConn Advisor

Diane Dorfer

Sponsor

Cobblestone Farm

Ask Aunt Nellie

Description

The Ask Aunt Nellie project is a community source database for farmers looking for farm supplies and services. The goal was to build a platform which would allow farmers to perform three core functions. First, search for relevant information. Second, submit new businesses or service providers for other farmers and third to request information from the community. Originally envisioned as a collection of Google Sheets, our team was challenged to build a user friendly, replicable and maintainable web application to host this data. The Ask Aunt Nellie project is the brainchild of Diane Dorfer of Cobblestone Farms. Inspired by her Great Aunt Nellie, a farmer who passed away during her teen years. She wanted to build a project to share the intergenerational knowledge her Great Aunt could have shared with her. Three years ago, Diane submitted a proposal to Northeast SARE requesting grant funding to build what became the Ask Aunt Nellie project, which grew from the collection of spreadsheets to a protype website.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 34

Team

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Franklin Gosnay
Jacob Baclawski
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Paul Adamski

Sponsor

Pratt & Whitney

PW Secure Embedded Architecture with Cyber Monitoring and with Actuation Control

Description

The primary goal of this project is to create a secure embedded architecture that communicates to the outside world with a simple ethernet protocol. After establishing the user environment with a secure boot and COTS anti-tamper protections, cyber monitoring software will be developed that will detect and isolate cyber attacks. If the monitor detects specified attacks (criteria defined by the students), the software will log the suspected attacks and verify normal operation of the stepper motor function is maintained. If normal operation cannot be maintained, the SW/HW will induce a power on reset of the specified hardware and attempt to restore normal operation. Students should employ attacks with protections disabled and then enabled to demonstrate the affects on each state. Students should evaluate the latest NIST quantum-resistant cryptographic algorithms to create the secure boot process. In particular, the secure load and boot functionality previously developed for the Xilinx board by prior SDP’s may be utilized, or it can be newly developed.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 35

Team	Faculty Advisor(s)	Sponsor
Awab Ali Selma Alsubai Sabrina Schlusselberg David Cheng David Datz (not pictured)	Suining He	Cognizant Technology Solutions

Mobile Modular Assistant (MoMoA)

Description

The overall goal of our project is to create a drone that can perform the actions of three modules: two given modules and a third, decided module. The two given modules are as follows: a module to pick fruits / vegetables and a module to follow a dog with a flashlight. The fruit/vegetable picking module will enable the drone to identify and pick ripe fruits and vegetables accurately while avoiding any obstacles that may be encountered along the way. The dog walking module will allow the drone to follow a dog with a flashlight, making sure that it can track the dog accurately and navigate its environment efficiently. The third, decided module is the trash picker module which will enable the drone to identify and pick trash.

Senior Design 2025 : Computer Science and Engineering Team 36

Team

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Steven Schwartz
Marcello Pollak
Wiliam Cario
Aidan Mcdonald

Faculty Advisor(s)

Wei Wei

Non-UConn Advisor

Kerri Raissian

Sponsor

UConn Center for Advancing Research, Methods and Scholarship in Gun Injury Prevention (ARMS)

Sponsor Logo

Analytics and Visualization for ARMS Survey Data

Description

This project aims to create a data analytics and visualization platform to analyze and visualize collected survey data between two waves. It will allow users to obtain the weighted average of any particular variable for either the entire sample in a given wave or for a subset. For example, users could obtain the weighted average of how many households own a gun, and then combine that same filter with another for females in the sample. Users should also be able to compare trends across waves 1 and 2 on the platform. Once developed, the data portal will reside on ARMS's website to provide public access.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 37

Team

Nikhil Vishwanath

Jared Garcia

Tanner Swanson

Cecil Ho

Joseph Bellemare

Faculty Advisor(s)

Amir Herzberg

Non-UConn Advisor

Robert Lafreniere

Sponsor

United States Navy

Autonomous Undersea Vessel (AUV) to Inspect hulls of ships in the open ocean or entering ports

Description

Determining requirements for and creating a dataset and machine learning model in order to allow an Autonomous Undersea Vessel (AUV) to perform inspections of ship hulls below the waterline using sonar data and report anomalous objects to human operators.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 38

Team

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Kilraen Corbett
Garrett Willoughby
Archit Bhargava

Faculty Advisor(s)

Dong-Guk Shin

Sponsor

UConn School of Nursing

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ScratchSense AI

Description

The ScratchSense AI project is an advanced tool that leverages machine learning and pose estimation to detect and analyze mouse scratching behavior in video recordings. In collaboration with University of Connecticut School of Nursing, ScratchSense AI aims to efficiently and accurately expedite previously tedious portions of research with mice that required extensive manual labor.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 39

Team

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Colin Acerbi

Faculty Advisor(s)

Bing Wang

Sponsor

Dr. Bing Wang

Private 5G Network Prototype for Smart Manufacturing

Description

We will utilize the OpenAirInterface (“OAI”) Radio Access Network (“RAN”) stack and the OAI 5G Core stack. These projects are open source and allow engineers to implement their own private 5G controllers, base stations, and antennas. These stacks are primarily developed using the C programming language. The implementation of these two stacks will be our primary goal and demand the most time. To implement the RAN stack, we must have a virtual machine installed in our computers in order to download the UE software and simulated hardware on the OpenAirInterface 5G Core webpage. We will contact UConn ITS to help install RedHat onto our computers by mid-November. After downloading the software needed, we must set up the channel emulator. The setup is a multi-step process that, when established allows us to run simulations and test different real-world scenarios that affect the network's performance. We must have a working basic network topology by the end of the fall semester to confirm its effectiveness to continue with gathering metrics of the prototype network. Our CV camera will ideally be implemented using the OpenCV library, which can be used with Python or C++. Since the focus is on 5G networking, the CV implementation should use existing solutions and algorithms as much as possible. The CV only needs to facilitate basic perception of the robot's location and surroundings. The robot will be an off-the-shelf kit using an Arduino or Raspberry Pi computing board. We will build a simple course that demonstrates the robot’s ability to navigate its environment thanks to the CV camera connected to the 5G network. These details will be further fleshed out as we prototype our network and choose the features that we want to showcase the most. Working with the computing board will take place in the beginning of the 2025 spring semester to get the necessary measurements from the benchmarking utilities earlier mentioned.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 40

Team

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David Reyes Fajardo
Nitin Nathan
Kashyap Rao
Raida Nasim

Faculty Advisor(s)

Suining He

Sponsor

UConn Computer Science & Engineering Department

Mobility Data Analytics for Smart Cities

Description

Mobility Data Analytics for Smart Cities - Analyzing data trends for e-scooters across large cities to figure out patterns and trends related to how they are used, helping city governments and scooter sharing companies improve infrastructure and allocate demand for scooters respectively.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 41

Team

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Alex DiRenza

Max Montoya

Eduardo Alves

Faculty Advisor(s)

Jonathan Shihao Ji

Sponsor

UConn Computer Science & Engineering Department

Large Language Models for use in Storytelling Games

Description

Using large language models we have built a system that can be used to design a fantasy world in the style of role playing games such as Dungeons and Dragons in order to assist those running a game by generating characters and locations within the world which the players can use.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 42

Team

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Rayna Spicher
Owen O'Donnell
Muskan Ghetiya
Raj Patel

Faculty Advisor(s)

Timothy Curry

Non-UConn Advisor

Bryan Knouse

Sponsor

OWL Integrations

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Visual Shark Monitoring

Description

Using OWL Integration's Cluster Duck Protocol paired with their DuckLink IoT devices we use machine learning at the edge to monitor for sharks. Using a USB camera connected to a Google Coral Board we take images and classify those images into two classes, shark or non-shark. The images taken by the camera are run through a Convolutional Neural Network (CNN) that was trained with over 5,000 images of different species of shark, dolphins, sea turtles, and fish. The output of the CNN is the class of the image along with the confidence level of the model. This output is then sent from the Coral Board to a DuckLink device and will then be sent off to a database for other applications to use or just to keep as a record.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 43

Team

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Faculty Advisor(s)

Zhijie Shi

Non-UConn Advisor

Holly Beum

Sponsor

Interface Technologies

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Interface Technologies

Bear Detection and Deterrence

Description

We developed a device that detects the presence of a bear and tries to scare it away. Using images from an infrared camera, a Raspberry Pi runs a Python script that determines if a bear is in front of the device. Upon detection, an alarm is triggered with lights and sounds.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 44

Team

Matthew Ghanie
Eric Pinos
Ethan Durnell
Zaynah Bhura
Caleb Buzas

Faculty Advisor(s)

Wei Wei

Sponsor

Movia Robotics

Robot Control through Participant Position and Posture Detection for Human Robotic Interaction

Description

Create a system that enables a robot to mimic the actions of a child. System for capturing segmenting and characterizing body posture and movement. The system uses an optical camera mounted in the head of the robot to capture participants in front of the robot. By utilizing skeleton localization libraries to analyze the imagery we can extract the posture of a person. The intention is to build a system that can first extract body position, posture and gestural movements then provide real-time information of the participants body part's position relative to the robot for immediate use to alter the posture of the robot, and finally store them for later use in other processes. A list of deliverables and requirements follows below. Since the camera can be moved the process of detecting the position of the participant will incorporate the relative orientation and position relative to the robot center of axis. The goal will be to detect three main parameters of the participant. 1. The overall position of the participant relative to the robot. 2. The position and orientation of the participants head and face. 3. The overall posture and gestures of the participants' torso, head and arms.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 45

Team

Matt Foley
Tyler Wang
Makenzie Jones
Mohamad Hamadi
Luke Pepin

Faculty Advisor(s)

Jake Scoggin

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UConn College of Engineering

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Blockchain Ticketing

Description

The UConn Blockchain Ticketing System is a full-stack solution designed to combat fraud and enhance fairness in the student ticketing process for athletic events. Motivated by rising demand and ongoing issues with unauthorized resales, our project provides a secure, transparent, and accessible way for UConn students to claim and use tickets. Our system uses Vue.js to deliver a user-friendly interface where students can log in with their UConn NetID, browse and claim event tickets, and manage their digital ticket wallets. Administrators use a parallel interface to create events, release tickets, and monitor access. At the heart of our backend is the Ethereum blockchain, where smart contracts ensure the immutability and authenticity of ticket data. By cryptographically linking each ticket to a verified student identity, we prevent black-market resales and enhance transparency across the system. We use MySQL to store off-chain data including student and event details. Our Users Table tracks NetIDs, privilege levels, and a points-based system that rewards responsible participation. Our Events Table logs essential event details and release schedules. This hybrid approach allows for real-time data handling while preserving the integrity of our blockchain components. The system focuses on three core goals: 1. Fraud Prevention – using blockchain to link tickets to specific students. 2. Accessibility – with a clean, intuitive frontend and built-in safeguards like error alerts and return systems. 3. Efficiency – through automation, smart contracts, and scalable backend design. Together, these innovations offer a scalable and secure model for ticketing that builds a stronger, more equitable campus experience. GitHub Repository: https://github.com/lpep64/Blockchain-Ticketing

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 46

Team

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Prathyush Miyala
Rany Kamel
Faiz Farooqui
Dylan Nascimento

Faculty Advisor(s)

Dr Jonathan Ji

Sponsor

Dr. Shiri Dori-Hacohen

Bias Detection with Technology-Assisted Review Tools

Description

Our project aims to develop an advanced review tool leveraging LLMs to identify and reduce biases in medical documents. The platform allows users to upload medical documents, from which text is extracted and, after some preprocessing, analyzed by six specialized bias detection models. Sentences flagged for potential bias are presented to reviewers alongside context, enabling users to validate the results. Correctly identified biases are stored as positive examples with user explanations; incorrect ones are stored as negative samples. All labeled data contribute to ongoing model fine-tuning, creating a feedback loop that enhances bias detection accuracy over time.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 47

Team

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Adarsh Rao Makarla
Zachary Figuenick
Pierson Faulk
Benjamin Acorda

Faculty Advisor(s)

Dongjin Song

Sponsor

US Census

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The Opportunity Project University

Description

The Opportunity Project (TOP) brings together technologists, government, and communities to rapidly prototype digital products—powered by federal open data—that tackle real-world problems for people across the country.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 48

Team

Aidan Parilla

Amogh Chaubey

Tony Abouakar

Andrew Ishikawa

Darshan Patel

Faculty Advisor(s)

Bing Wang

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Connecticut Education Network

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CEN
Mission Driven | Member Focused

Large Language Models Training for Connecticut Education Network

Description

Project title: Large Language Models Training for Connecticut Education Network

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 49

Team

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Vanshika Gupta
Amin Sheikh
Peiqi Li

Faculty Advisor(s)

Dr. Amir Herzberg

Non-UConn Advisor

Mike Knas

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The Hartford

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The Hartford

Applying Differential Privacy in Sensitive Vehicle Telematics

Description

Our project worked with The Hartford and focused on researching and prototyping Differential Privacy (DP) techniques for use in insurance data analytics. We began by conducting a comprehensive investigation into the fundamentals of DP, including its mathematical foundations, privacy-utility trade-offs, and its relevance to the insurance industry. This included reviewing and comparing existing tools, datasets, and use cases, as well as exploring the broader ethical and regulatory implications of privacy-preserving data analysis. To bring our research into practice, we developed a full-stack prototype system showcasing DP in action. We utilized SUMO (Simulation of Urban Mobility) to generate synthetic vehicle telematics data, representative of real-world insurance applications. This data was then processed using OpenDP's PyDP library to apply differential privacy to sensitive data points, introducing calibrated noise while preserving overall utility. We computed vehicle risk scores on both raw and differentially private datasets, enabling a comparative analysis of the privacy-utility trade-off. These results were visualized using heatmaps and other interactive graphics. To bring our work all together, we created an interactive website to host the prototype and make Differential Privacy accessible to a broader audience. The website allows users to explore our dataset, simulate custom vehicle trips, view differentially private outputs, and learn about DP's relevance and benefits in real-world insurance contexts. The site also features educational resources explaining DP concepts and its critical role in enabling secure, ethical analytics in regulated industries.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 50

Team

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Yichong Wu
Tamilore Sodiya
Daocheng Mo
Yuwang Ma

Faculty Advisor(s)

Wu Yufeng

Sponsor

UConn College of Engineering

RPi OS

Description

RPi OS aims to teach the basics of OS development and prepare students for navigating Linux-like environments. The simplified functions that closely imitate Linux approach to system design give an entry point to students overwhelmed by the scope of a functioning Linux OS. A beginner-friendly Raspberry Pi 4 is chosen as the hardware for RPi OS.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 51

Team

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Rishabhsinh Virpura
Ebubechukwu Jack-Davies
Bailin Liao
Wilson Huang

Faculty Advisor(s)

David Strimple

Sponsor

UConn Computer Science & Engineering Department

RC Car Remodeling

Description

Our project is all about transforming a regular RC car into a high-tech remote-controlled vehicle that you can control with a gaming controller. By adding a microcontroller (Raspberry Pi) to the RC car, we'll create a more intuitive and engaging control system that most users will find easy to use. The modified RC car will have the following features: Gaming controller integration for precise and comfortable control Live camera feed streaming to a mobile app Wireless connectivity for remote operation This project brings together hardware modification, software development and wireless communication to turn a regular RC car into a high-tech gaming-style remote control vehicle. The idea is to make RC car operation more accessible and enjoyable by using familiar gaming controller interfaces while adding modern features like a live video feed and performance tracking. Technical Focus Areas Hardware integration and circuit design Controller input processing and motor control Mobile app development for video streaming and car control Wireless communication and security implementation User interface design for intuitive operation The end result is going to be a modernized RC car that provides a more immersive and user-friendly experience through combining gaming technology with traditional RC vehicles.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2025 : Computer Science and Engineering Team 52

Team

Peiling(Alina) Wu
Changxian Duan
Nehal Gupta
Praneeth Sundararajan

Faculty Advisor(s)

Dr. Song Han

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Dr. Song Han

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SCHOOL OF COMPUTING

Software-Defined Radio-based 5G NSA/SA Framework Deployment and Evaluation

Description

This project aims to deploy a Software-Defined Radio (SDR) based 5G NSA/SA framework to support advanced Internet of Things (IoT) applications. The student team will utilize open-source SRSRAN software stack to design and build a 5G base station capable of supporting multiple User Equipment (UE). Key project components include configuring the 5G network environment and conducting comprehensive performance testing (throughput, latency, and reliability). This research is crucial for advancing wireless communication technology, as reliable high-speed connectivity is fundamental to enabling next-generation IoT systems. The project is supervised by Dr. Han and Mr. Mondal from the school of computing at the University of Connecticut

Computer Science and Engineering Stamford Senior Design Teams

Senior Design 2025 : Computer Science and Engineering Stamford Team 01

Team

Sakib Nazmus
Akhil Jannu
William Lee
Dedeep Singu (not pictured)

Faculty Advisor(s)

John Iacovacci

Non-UConn Advisor

State Street Global Advisors

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State Street Global Advisors

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Sentiment Analysis in the Financial Sector

Description

This project extracts sentiment from earnings call transcripts using fine-tuned NLP models like BERT. The system scores sentiment by topic (financial metrics, macro trends, regulation) and time, helping institutional investors interpret qualitative insights to support financial decisions. A custom dashboard enables visualization and drill-down analysis of paragraph- and keyword-level sentiment trends.

Senior Design 2025 : Computer Science and Engineering Stamford Team 02

Team

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Savar Jain
Romick Jean-Baptiste

Faculty Advisor(s)

John Iacovacci

Non-UConn Advisor

Henry Orphys

Sponsor

Neural Tax Networks

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Neural Tax Networks

Description

Neural Tax Networks aims to reduce confusion during tax season using AI to assist with accessible tax and accounting research. Our product provides reasoning solution - system analyzes and applies the law. It incorporates declarative logic rules with natural language processing. Our system retains the solution and reasoning for future access and provides an "audit trail".

Senior Design 2025 : Computer Science and Engineering Stamford Team 03

Team

Toyi Shimizu-Ruffner
Jan Ulloa
Jainil Desai
Ignacio Deleon
Kevin Hernandez
Yuzhuo Zhang

Faculty Advisor(s)

Professor Bradford

Sponsor

Stacks / EQWELL

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STAC - IT

Description

STAC-IT is a mobile planning app designed to streamline social outing planning by centralizing scheduling, polling, and activity suggestions. It integrates smart recommendations based on availability, location, and preferences, using AI for generating stacked activity plans. Built using React Native, Django, and Firebase, the app simplifies group coordination.

Senior Design 2025 : Computer Science and Engineering Stamford Team 04

Team

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Karima Hamada
Ananya Jonnakuti
William French
Trang Tran
Dylan Young

Faculty Advisor(s)

Phillip Bradford

Non-UConn Advisor

Sarbjeet Singh Rayat

Sponsor

Pre.VC

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Pre Innovations: Gamified Startup Investing

Description

Pre Innovations revolutionizes startup pitch events by transforming them into interactive, data-driven experiences through the use of PreMoney®, a virtual investment currency. The platform enables audiences to act as mock investors, providing real-time feedback and investment signals to founders during live or remote events. This gamified approach boosts engagement, helps identify high-potential startups, and provides valuable performance insights to presenters. Developed using Flutter with Firebase and Google Cloud Platform backends, the app features dynamic leaderboards, hybrid (in-person and remote) participation, and post-event monetization through access to pitch content. The product was built using a hybrid Agile-Waterfall methodology with continuous iteration to support evolving user needs and scalable event experiences.

Senior Design 2025 : Computer Science and Engineering Stamford Team 05

Team

Paul Kwon

Lyles Williams

Max Senchukov

Joseph Vincento

Faculty Advisor(s)

Philip Bradford

Sponsor

Dr. Amin Boroomand, Woods Hole Institute

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Gush

Description

Gush is a personality-based dating app promoting authentic connections through blind conversations. Users are matched by personality and engage in conversation before seeing each other's photos. Built using React Native and Spring Boot, with infrastructure on Render and Firebase, it includes a token-based monetization model to encourage meaningful interactions.

Senior Design 2025 : Computer Science and Engineering Stamford Team 06

Team

Peter Vaichus

Tom McCarthy

Joshua Pintacasi

Faculty Advisor(s)

Phillip Bradford

Sponsor

Culture Tech

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Open Up Art

Description

Culture Tech is a SaaS startup delivering solutions to museums and other organizations for licensing and rights management. The company's primary product is MONA, a software which allows users to upload their collections, track licenses, and set up automated workflows for the licensing process. We worked on adding an integration to a Digital Asset Manager (DAM), Resourcespace, in MONA, so clients can import their collections directly from their DAM. Using technologies like Java, VueJS, and Docker, we developed this new integration using modern software development methodologies.

Electrical and Computer Engineering Senior Design Teams

Senior Design 2025 : Electrical and Computer Engineering Team 01

Team	Faculty Advisor(s)	Sponsor
Steven Tran Alton Laville Mohammad Khan Cullen McDermott	Liang Zhang	Northwest Corner Farm

Sustainable Greenhouse Seedling Warming System

Description

The objective of this project is to design and develop an efficient, seedling heating system run entirely on electricity.

Senior Design 2025 : Electrical and Computer Engineering Team 02

Team

Julia Lord
Kevin Le
Jackson Landino

Faculty Advisor(s)

Professor Ali Bazzi, Ph.D

Non-UConn Advisor

Joshua Gemmell

Sponsor

Hartford Steam Boiler (HSB)

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Frequency-Related Power Quality Monitoring for Critical Equipment at Moderate-Sized Facilities

Description

Hartford Steam Boiler (HSB) aims to understand the sources of frequency-related power quality issues on the performance and reliability of their insured equipment for its moderate-sized facility clients. The team had been tasked with developing a cost-effective and business-oriented solution for monitoring frequency-related power quality and characterizing harmonic-related interruptions.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 10

Team

Weipeng Zhou

William Elliott

Alexander Fabris

Faculty Advisor(s)

Liang Zhang

Non-UConn Advisor

Amin Asif

Sponsor

Belimo Americas

Gas Monitor Calibration Chamber 2.0

Description

Belimo is a company that primarily works in HVAC field devices. These consist of damper actuators, sensors or meters, and valves. They sell these products to generate income and are considered a market leader in HVAC solutions. The Belimo gas monitor is used to make sure safe levels of harmful gases are maintained in certain environments. The type of gases that are monitored may vary depending on the setting. The gas monitor is primarily used in indoor parking areas, warehouses and manufacturing facilities, boiler rooms, and transportation areas. The device is used to make sure the levels of gas in these areas are safe for humans, and it will sound an alarm if the level of gas reaches a certain threshold. Calibration of the gas monitor involves calibrating the sensors that are used within the monitor. This is done by using one reference sensor that is already calibrated to detect how much gas is in an area and then calibrating all the other sensors in the area to read that same level of gas. Currently, Belimo has a box prototype with 10 PCBs in it, one reference (pre-calibrated) sensor per PCB and 7 uncalibrated sensors. A gas is released into the box through a valve, spread around with a fan, and then the value of the reference sensor on each PCB will be pushed to all the other 7 uncalibrated sensors on the same PCB. Again, this is happening on all 10 PCBs synonymously. A blower fan will then be activated to push all the gas out of the box. Currently this process takes 30 minutes per batch, yielding 70 new calibrated sensors (7 per PCB, 10 PCBs in the calibration chamber). The goal of our project is to increase the efficiency of calibrating these sensors, both by increasing total yield and decreasing time per batch.

Senior Design 2025 : Electrical and Computer Engineering Team 03

Team

Adrian Torres Maginot

Grace Wanderling

Faculty Advisor(s)

Junbo Zhao

Sponsor

CTNG

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Renewable Energy Microgrid at SRMR, East Lyme

Description

The objective of this project is to design a renewable energy microgrid for the Stones Ranch Military Reservation (SRMR) in East Lyme, Connecticut, a facility used by the Connecticut National Guard (CTNG). The CTNG plans to implement a new microgrid capable of a substantial return on investment within 25 years. By researching and analyzing current energy usage and selecting suitable renewable energy sources, we will propose a microgrid structure that reduces the facility's energy costs and increases energy efficiency. The microgrid will incorporate solar panels (photovoltaic), battery storage, geothermal heat pumps (GHP) and backup generators to reduce cost, provide efficiency, and increase reliability.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 04

Team

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Kevin Demiraj

Faculty Advisor(s)

Shalabh Gupta

Non-UConn Advisor

Eli Warren

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Pratt & Whitney

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Optical Inspection Probe for Jet Turbine Engine Fan Blades

Description

The fan blades in a fan rotor stage of a gas turbine engine can be subject to damage caused by a variety of different factors. For example, foreign objects can strike a fan blade causing Foreign Object Damage (FOD), surface erosion can occur, or vibratory response can produce high cycle fatigue that can lead to damage, to name a few. Such damage may be randomly located (FOD) or it may be statistically more likely located in certain regions; e.g., along the leading edge of a fan blade, and more specifically at certain regions of a fan blade leading edge. Current practices for inspecting fan blades involve a manual inspection of each fan blade by a technician when the turbine engine is shut down. Inspections of this type are time intensive, costly, and require skilled technicians. There is a need for a more efficient and less costly process that can be used to inspect fan blades. One potential solution is an Optical Inspection System (OIS) deployed at low speeds (~<500 rpm) and a processing system to determine if any appreciable FOD is present leading to a pass/fail decision and potentially drive a manual inspection. The OIS will send image data to the FADEC (Full Authority Digital Engine Control) for processing/storage and can be offloaded for review.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 05

Team

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Brendan Picarelli

Faculty Advisor(s)

Necmi Biyikli

Sponsor

Pratt & Whitney

Feasibility of Using Eddy Curent for Fan Blade Tip Deicing

Description

Some jet turbine engines include a system for deicing the fan blades to prevent balance/vibration issues associated with the added mass of the accumulated ice. Example fan blades and ice accumulation are shown in figure 1. Most of these systems do not directly heat the blade tips where ice accumulation could cause significant problems. Eddy currents are formed when a moving or changing magnetic field intersects a conductor or vice versa. These circulating eddies of current create electromagnets with magnet fields that oppose the effect of applied magnetic field. Eddy current probes senses this formation of secondary fields to find out the distance between the probe and target material.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 06

Team

Kenroy Hinds

Evan Anderson

Ethan Schrader

Faculty Advisor(s)

Ashwin Dani

Non-UConn Advisor

Eli Warren

Sponsor

Pratt & Whitney

Delta Sense Inlet Debris Monitor

Description

Existing Foreign Object Damage (FOD) sensor types thus far have applied an Inlet Debris Monitor System (IDMS) consisting of conductive inlet ring(s) looking for absolute change in charge that attempts to relate charge to FOD entering inlet, hence passing to engine Fan and Compressor.

Senior Design 2025 : Electrical and Computer Engineering Team 07

Team

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Yao Hua Li

Faculty Advisor(s)

Lei Wang

Non-UConn Advisor

Benjamin Stirgwolt

Sponsor

Belcan

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Mobile Modular Assistant

Description

This project aims to develop a modular drone with a standardized interface, allowing it to be easily reconfigured for various tasks. By designing interchangeable modules, the drone can adapt to different objectives without requiring a complete redesign. For example, one module functions as a vegetable identifier, using image recognition to assess the ripeness of fruits, aiding in agricultural monitoring. Another module transforms the drone into a dog walker, enabling it to follow a dog during nighttime walks while providing illumination with a built-in flashlight. This flexible, multi-purpose design enhances the drone's utility across diverse use cases, making it a powerful and adaptable tool.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 08

Team

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Lei Wang

Non-UConn Advisor

Rick Baruffi

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Draper Laboratory

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DRAPER

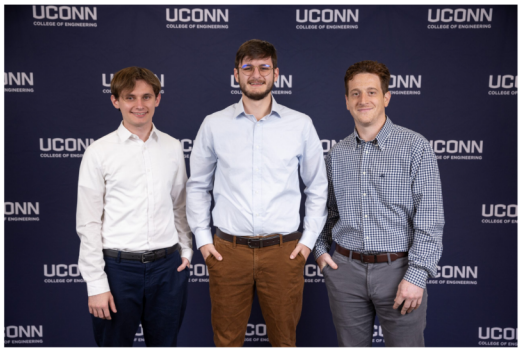
Robotic Perception Sensor Characterization Platform

Description

Project Focus: Developing a flexible and extensible platform for evaluating perception sensors for a variety of applications on UAVs. The Engineering Challenge: Small robotics often require the integration and fusion of multiple sensors to create a single localization estimate. Often robotics projects do not have the resources to create realistic prototype platforms for multiple sensors, resulting in crude mockups, simulations, and engineering judgement being used to select navigation sensors early enough in project timelines to ensure selected sensors are properly integrated into the final platform. In 2023-2024, a joint ME/ECE team designed, constructed and flew a quad-rotor UAV (see figure 1) featuring a sensor attachment platform on all six faces of the drone, with each platform housing four different electrical and communication connection ports. The drone is capable of carrying more than seven pounds of sensors for over a 15-minute flight time, and accommodates the various wiring and connectivity needs of a dynamic suite of sensors. Description of Problem/Project: This year's project will result in the creation of an electromechanical interface that would allow for the rapid integration and changing of different sensors including EO and IR cameras, various COTS IMU assemblies, LIDAR, radar, etc. on a supplied UAV. Students would be tasked with designing an electromechanical mounting schema that is capable of toolless mounting and unmounting of sensors from multiple points around an existing UAV. The interface must be able to support multiple communication protocols and multiple voltages to power the sensor. It is expected that the project will culminate in the delivery of 6 vehicle side interface packages and 10 sensor-side interface packages. Additionally, the team will be required to refine existing power distribution methods on the existing UAV.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 09



Team

Redjan Cipi
Christopher McNamara
Ryan Brand

Faculty Advisor(s)

Dr. Sung-Yeul Park

Non-UConn Advisor

Dr. David Daggett

Sponsor

Center for Clean Energy Engineering (C2E2)

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Fuel Cell Powered RC Airplane

Description

The Fuel Cell Powered RC Airplane project explores three primary challenges: the control system, data acquisition (DAQ), and a DC-DC boost converter. The control system enables precise dual-throttle operation of four brushless motors—two powered by a battery and two by a Proton Exchange Membrane (PEM) fuel cell. Using a Spektrum-branded transmitter and receiver, we developed a control scheme that supports independent motor control for different flight phases. This configuration allows for seamless transitions from takeoff (battery) to cruise (fuel cell), and back to battery power for landing. The DAQ system is built on an Arduino Uno R4 WiFi. It integrates sensors to measure motor current, battery voltage, output motor power, airspeed, altitude, and cargo hold temperature, recording all flight data onto a 64GB microSD card. A pitot-tube-based airspeed sensor and a high-current Hall effect sensor ensure accurate real-time measurements during flight. The DC-DC boost converter was originally developed to step up the Solid Oxide Fuel Cell's (SOFC) low input of 0.7V at 75A to 5V at 10.5A. However, due to the extremely low input voltage and high current, we were unable to build a single-converter design that met the target output in practice. As a result, we designed a test converter with components that simulate the voltage drop the high-amperage boost converter would experience, in order to determine the minimum input voltage required for proper operation. This minimum was found to be approximately 3.3V. Below this value, we observed significant output malfunction. These tests successfully demonstrated the number of SOFCs required in a series configuration—where individual voltages are added together—to overcome the limitations of a single 0.7V cell. We recommend using five SOFCs in series, yielding a total input voltage of 3.5V. This recommendation sets up both future senior design teams and our sponsors at UConn C2E2 for continued success.

Senior Design 2025 : Electrical and Computer Engineering Team 12

Team

Witold Klos

Erin Mitchell

Faculty Advisor(s)

Yishu Bai

Sponsor

Biorasis

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Continuous Glucose Monitoring (CGM) System

Description

This project allowed our team to work with Biorasis on improving their fully implantable Continuous Glucose Monitor (CGM) device that has the potential of changing lives around the world. The miniaturized implantable device is powered by an integrated silicone solar array which generates voltage from a series of nine infrared light emitting diodes (LEDs) located on an external wearable device (proximity communicator). The power supply of the wearable device is a 800 mA/hr, 3.7V Lithium-Polymer battery pack used to power the LEDs as well as other systems used to receive optical signals at various frequencies that correspond to blood glucose molarity levels. Our ECE team was tasked with improving the power efficiency of the system by designing a pulsing algorithm that controls the duty cycle of the LEDs. Once embedded onto the microcontroller of the wearable device, the algorithm will allow us to see how power consumption is affected as we vary the duration of the LEDs' on/off states. Each duty cycle was tested extensively in a laboratory setting to ensure the accuracy of the implant's frequency output within 5% error. This solution allowed for significant improvement in power efficiency and increased battery life of the wearable device while maintaining accurate blood sugar level measurements collected in real time. PCB design, layout and fabrication of the Arduino UNO microcontroller "breakout shield" were completed to allow for interfacing the Arduino UNO board with Biorasis ASIC and sensor electrodes.

Senior Design 2025 : Electrical and Computer Engineering Team 14

Team

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James Weber

Faculty Advisor(s)

Dr. Shalabh Gupta

Non-UConn Advisor

Sikorsky Aircraft Corporation

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Sikorsky Aircraft Corporation

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Development of User-Enabled Flight Controls for Energy Efficient Aircraft Operation

Description

In this project, students will utilize the open-source flight control software PX4, implemented from within Simulink, to add a pilot assist mode to the flight control software. This flight mode, when engaged, will help the pilot maintain an optimal flight regime for energy efficiency at lower battery percentages.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 16

Team

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Bryan Knouse

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OWL Integrations

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OWL

Design of DuckLink-based Device for Maritime Environment

Description

With the goal of minimizing human-shark conflicts in coastal regions, OWL Integrations is partnering with UConn engineers to develop a device that can accurately detect the presence of a shark. By empowering OWL Integrations' Internet-Of-Things (IOT) DuckLink hardware and ClusterDuck software protocols with Google's Coral Development Board, joint CSE and ECE teams have developed an artificial intelligence (AI) -powered floatation unit capable of real-time autonomous shark detection. Equipped with an onboard camera, the unit captures underwater images and runs a machine learning (ML) model to accurately identify sharks. Upon detection, alerts are transmitted using long range (LoRa) to the OWL's data management system (DMS), enabling timely warnings to beach authorities and the public.

Senior Design 2025 : Electrical and Computer Engineering Team 17

Team

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Sponsor

Interface Technologies

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Automated Bear Detection and Deterrence System

Description

Over the course of the last decade, the amount of bear conflicts in Connecticut has risen dramatically. According to the Connecticut Department of Energy and Environmental Protection, conflict reports have risen to over 3000 in 2022 from around 500 in 2015. This is a dramatic increase. Because of this, the need for a device that can effectively deter bears from Connecticut Residents' properties has risen. This device should cost $300 so it is affordable for the average consumer, although an initial prototype will cost more. According to DEEP and other studies, loud sounds and light is an effective deterrent for black bears. This project aims to use an Infrared camera paired with an AI detection model to detect the encroachment of bears onto properties. Using the output of this model, a bright light and loud sound will be activated to scare the bear away. The Computer Science team (CSE Team 43) is working on developing a Bear detection model to host on a Raspberry Pi. The ECE team is responsible for the design of the device, including but not limited to the Camera setup, speaker amplification and output, light output, and power distribution. A system design model can be seen in Figure Two. Figure One shows the completed physical device complete with a light and sound deterrent.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 18

Team

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Sponsor

Legrand

Multicore Optical Fiber Coupling

Description

Future large-scale data centers will require higher bandwidth, high density optical interconnects, and the bandwidth (BW) density at the switch front panels can be improved by replacing pluggable transceivers with on-board optics with ASIC integration. To address the future requirements for the high channel count optical connectivity, multicore fiber (MCF) may find its application opportunities in the high bandwidth high density optical interconnects for data centers, since it offers a large scalability of the channel count.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 19

Team

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Dominic Chrostowski

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Necmi Biyikli

Non-UConn Advisor

Barry Hardman

Sponsor

Centrix Dental

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centrix
MAKING DENTISTRY EASIER

Automated In-Line Flocking Machine

Description

The objective of this project is to provide improvement to the manufacturing process of an in line automated flocking machine. Centrix Dental currently uses a manual process to produce their flocking applicator sticks. This consists of the use of a circular fixture that holds around 600 polypropylene sticks. Both ends of the sticks are then dipped in glue and subsequently sprayed with electrostatically charged flock after the glue is dried. Finally, the excess flock is blown off while the sticks are cut in half to produce two final products, or twice the number of sticks originally placed in the fixture. Changing to an automated system provides multiple advantages for Centrix, such as an increased production rate and the elimination of the need for an employee to complete this process. Last year's ME/ECE senior design team provided a preliminary analysis of how the automated process should be undertaken. However, further steps will be taken to move from theoretical analysis to a complete design that can be used directly in Centrix Dental's manufacturing facility. Factors such as a gluing station, flock box, blowoff station, and UV curing are the main aspects to be focused on. With regards to the flock box, there is a need for a rotating brush to ensure the flock is evenly distributed onto the applicator tip. Additionally, it is imperative that the correct motor is employed to rotate this brush, whether that be a DC or pneumatic motor. Many approaches can be taken to address the blowoff station as well. This component may be solved using a small handheld vacuum or a larger industrial sized model, depending on the required rate of air flow. This report provides further details on the most effective design for an automated process.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 20

Team

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Joseph Pereiro (not pictured)

Faculty Advisor(s)

Ashwin Dani

Non-UConn Advisor

Richard Gigliotti

Sponsor

Dominion Energy

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Dominion Energy®

Feedwater Flow Control Optimization at Millstone Power Station

Description

Dominion Energy is an energy company headquartered in Richmond, Virginia. Dominion Energy operates the Millstone Power Station in Waterford, Connecticut. The Millstone Power Station produces enough electricity to power an estimated two million homes. Feedwater pumps are the pumps in the water-steam cycle of a nuclear reactor system that control the amount of water being sent to the steam generators. The first operating unit at the Millstone Power Station, Unit 2, implements a control algorithm for its feedwater pumps that optimizes the amount of water flow to the steam generators. Dominion Energy has expressed a need to implement a similar control algorithm for the feedwater pumps in the second operating unit, Unit 3. Dominion Energy wants to develop a control algorithm for the feedwater pumps in Unit 3 through the use of a software model. The software model must accurately model the physical system.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 21

Team

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Sponsor

NUWC

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NAVSEA WARFARE CENTERS NEWPORT

Reconfigurable Test Fixture for Digital Integrated Circuits

Description

A system capable of testing common digital integrated circuits used in printed circuit board assemblies will enable laboratory staff to both verify the working operation of the integrated circuits kept in inventory for unit sustainment and service and assist technicians in their efforts to debug these assemblies should they fail acceptance testing. This system should be easily extendable with the use of test scripts that allow specific tests for different integrated circuits. A PC application will interface an electronic test fixture containing the integrated circuit under test to a host PC capable of controlling the test fixture and performing the specified tests. This program should also be capable of generating reports describing the outcome of each test, including descriptions of specific failures. This system would be composed of two distinct parts: 1. A test fixture in which the integrated circuit is inserted for evaluation and contains all necessary electronics to perform testing of these components' logic tables. The on-board electronics should be capable of generating logic-level voltages to both power the device under test as well for application to the chip's logic inputs. The test fixture should also be capable of reading the device's output signals for evaluation of the device's logic functions. 2. A PC application allowing a user to control the test fixture and run a test script for a given integrated circuit. This application should be capable of controlling the electrical signals generated by the test fixture as well as reading the outputs recorded by the test fixture. This application should also be able to store test results of all integrated circuit diagnostics that detail the specific tests performed as well as any failures observed.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 22

Team

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Shan Zuo

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UConn, Dr. Imani

Digital Twin for Cooperative Robotic Additive Manufacturing

Description

This project involves developing a Cooperative Robotic Additive Manufacturing (CRAM) system with a Digital Twin. The entire processing pipeline is being developed, including part decomposition, slicing, motion planning, and execution, as well as sensor integration and feedback. The system is specifically designed to produce 3D printed parts with several benefits over traditional 3D printers. While it has allowed for the creation of complex geometries, 3D printing still has several flaws, including surface quality defects, part strength, and manufacturing speed. These defects can be fixed with the CRAM setup, and the multiple arms will allow for increased fabrication speeds. The robotic arms also have additional degrees of freedom when compared with traditional 3D printers, which allows for complex orientations and nonplanar layer depositions. The ECE team is focused on solving the nonplanar slicing and motion planning problems, in addition to developing the physical system. Typical 3D printers have a slicer, which constructs a toolpath for the printer to follow in order to recreate the modelled part. These slicers do not support the complex movements enabled by the robotic arms. As a result, we must develop a slicer that can create layers along nonplanar surfaces to fully utilize these capabilities. Additionally, since multiple robotic arms will be operating in a shared space, planning must occur to ensure these toolpaths do not lead to conflicts.

Senior Design 2025 : Electrical and Computer Engineering Team 23

Team

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Faculty Advisor(s)

Sung-Yeul Park

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UConn Electrical & Computer Engineering Department

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Prototype Arc Testbed

Description

Currently, there is a lack of accessible and reliable testbeds for studying electrical arcs under controlled conditions. Most existing setups are either too costly, too complex, or inadequate for comprehensive research and education purposes. This project aims to address this gap by designing and building a prototype arc testbed that is affordable, user-friendly, and capable of generating and measuring electrical arcs in a controlled environment. This testbed will be used to study arc formation, sustainment, and extinguishment, as well as the associated electrical characteristics.

Senior Design 2025 : Electrical and Computer Engineering Team 24

Team

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Faculty Advisor(s)

Ali Gokirmak

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Upgrade and Automation of Monochromators

Description

This project upgraded and automated a non-functional motorized monochromator to be used in the optical characterization of semiconductor materials. A monochromator is machine that splits white light into its component wavelengths using a system of mirrors that mimic a prism and isolates a specific band of light for testing. Outdated or non-functional components were replaced with a new power supply, stepper motor, and motor control circuitry. USB communication was implemented to allow users to adjust the output wavelength using simple computer commands. The system was calibrated using a spectrometer to ensure accuracy within ±1 nanometer. The upgraded monochromator reliably produced at least ten visibly distinct wavelengths of light across the visible spectrum.

Senior Design 2025 : Electrical and Computer Engineering Team 25

Team

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Dr. John Chandy

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MITRE Embedded Capture the Flag

Description

MITRE's Embedded Capture the Flag (eCTF) is a collegiate embedded security competition that pits teams from schools around the world against one another in an effort to capture one-another's flags. eCTF is a two phase competition. In the first phase, teams are tasked with designing a secure embedded system based on a set of challenge requirements. The second phase offers teams the opportunity to analyze the designs from other schools, exploiting security vulnerabilities in order to capture flags. Uniquely, all designs run on a real physical embedded device, opening the competition up to physical/proximal attacks.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 26

Team

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Granit Kastrati

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OMG Inc.

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OMG ROOFING PRODUCTS

Energy Optimization in an Induction Welding System

Description

RESTRICTED

Senior Design 2025 : Electrical and Computer Engineering Team 11

Team

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Non-UConn Advisor

Erik Freidenfelds

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Pfizer

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Energy Consumption and Efficiency Initiatives for Building 100

Description

The goal of this project is to evaluate the energy consumption of Building 100 and develop recommendations to reduce energy use, lower operation costs, and enhance sustainability that aligns with corporate objectives.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2025 : Electrical and Computer Engineering Team 13

Team

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Non-UConn Advisor

Michael Briscoe

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ASNE

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Electric Powered Boat

Description

This project, part of the PEP (Promoting Electric Propulsion) initiative, aims to design, build, and test an unmanned electric-powered hydroplane for the 2025 ASNE competition. With funding and oversight by the American Society of Naval Engineers (ASNE), our team will enhance the previous year's design by addressing its limitations and integrating new innovations. Key objectives include achieving a 2-mile course completion at a minimum speed of 10 mph, optimizing payload capacity, and ensuring compliance with technical constraints such as battery capacity and motor power. This project will push advancements in sustainable marine technology, aligning with the broader goal of promoting electric propulsion in naval engineering while also promoting the sport of boat racing as a whole.

Senior Design 2025 : Electrical and Computer Engineering Team 15

Team

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Yang Cao

Non-UConn Advisor

William Villano

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Collins Aerospace

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Aircraft Communications Tester

Description

Investigate, design, test, and build a low-cost aircraft communication tester that. The design should be able to test aircraft equipment that use the ARINC 429, CAN, and MIL-STD-1553B communication standards. Furthermore, this design should be programmable through the usage of non-volatile memory. While the listed communication standard is required, an implementation that allows for expansion to other standards after design completion is ideal.

Environmental Engineering Senior Design Teams

Senior Design 2025 : Environmental Engineering Team 01

Team

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Lucy Temple
Adisa Gjonbalaj
Kaitlyn Lombardi

Faculty Advisor(s)

Alexander Agrios

Non-UConn Advisor

Jim Ericson

Sponsor

Haley Ward, Inc

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HALEY WARD

Rocky Neck State Park On-Site Wastewater Treatment Upgrade

Description

ENVE01 has been tasked with redesigning the on-site wastewater treatment system at Rocky Neck State Park, to preserve the environmental integrity of the site. The park is over 700 acres in size, featuring campsites with a capacity of nearly 1,000 campers, as well as a recreational beach area. There are 7 bathhouses throughout the site, used by campers and beachgoers. During the peak summer season, the park sees a flow of 25,000 gallons per day. The current septic systems on the site are over 50 years old, and many of them have experienced failures. Bride Brook, the stream that runs through the 82 acres of biodiverse and environmentally protective marsh on the site, is seeing elevated levels of nitrogen, phosphorus, and pathogens, threatening the critical ecosystem. The septic systems on the site are likely a source contributing to this contamination. ENVE01 plans to tackle the septic system issues faced by Rock Neck by integrating pretreatment systems, redesigning and replacing faulty system elements, and optimizing the treatment process.

Senior Design 2025 : Environmental Engineering Team 02

Team

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Faculty Advisor(s)

Timothy Vadas

Sponsor

CHA Consulting, Inc.

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USDA/NRCS Farm Road Design

Description

Working with CHA Consulting, our team will be designing the access road, erosion controls, and stormwater infrastructure on a farm in Smithfield, Rhode Island. Our site has livestock present, and these designs must mitigate potential pollutants and flow from the addition of the road. Our designs were developed using RI Natural Resources Conservation Services [NRCS] design standards, and in accordance with the RI Department of Environmental Management [DEM] and RI Department of Transportation [DOT] standards.

Senior Design 2025 : Environmental Engineering Team 03

Team

Xinhao Li

Katrina Frazer

Nicholas Candow

Faculty Advisor(s)

Amvrossios Bagtzoglou

Sponsor

Loureiro

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Remediation of LNAPL at an Industrial Site

Description

UConn Senior Design Team 03 will be working alongside Loureiro Engineering to develop a remedial strategy for a former industrial site where over thirty underground storage tanks housed a variety of jet fuels, chlorinated solvents, and mineral oils. The tanks have been removed or abandoned, but light non-aqueous phase liquid (LNAPL) contamination remains on-site. The students will mirror the engineering consultants' process by reviewing soil and groundwater data to create a site conceptual model and use the model to design a remedial approach to remove the extractable LNAPL.

Senior Design 2025 : Environmental Engineering Team 04

Team

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Kateryna Pekar

Faculty Advisor(s)

Amvrossios Bagtzoglou

Sponsor

Eljen

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Synthetic Alternative to ASTM C-33 Sand

Description

The Eljen GSF (Geotextile Sand Filter)is an alternative for onsite septic leach field systems. Each GSF Module (see figure below) is made up of a geotextile fabric and a plastic core material that work together to provide vertical surface area and oxygen transfer. The GSF System applies treated effluent to the soil, increasing the soil's long-term acceptance rate. A Specified Sand layer provides additional filtration and prevents saturated conditions. ASTM C-33 sand is well documented and available throughout the country. It is a primary component for construction. With the expansion of civil projects across the country, the availability of ASTM C-33 sand for onsite wastewater projects is diminishing. If an alternative were available for a similar or reduced price, it would increase the use of onsite system use. Some original work was done on the use of geotextiles was done by Dr. Rein Laak and his Ph.D. students at UCONN in the 1970s. The sponsor has access to this research material and papers from them on the geotextiles as well. The objective of this project is to identify a material that is readily available around the US that mimics the filtering ability of ASTM C-33 sand. Options for consideration could include recycled glass, non-woven fabrics, or a combination of components.

Senior Design 2025 : Environmental Engineering Team 05

Team

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Faculty Advisor(s)

Alexander Agrios

Sponsor

Arcadis

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Optimizing Nitrogen Removal at the York Wastewater Treatment Facility

Description

Working with Arcadis, our team is designing a treatment process to optimize nitrogen removal at the York Wastewater Treatment Facility (WWTF) in York, ME. Coastal wastewater treatment facilities are facing stricter nitrogen limits in their NPDES (National Pollutant Discharge Elimination System) permits due to the impact of excess nitrogen on water bodies. High nitrogen levels contribute to eutrophication, leading to harmful algal blooms, oxygen depletion, and marine habitat degradation. In preparation for these regulatory changes, we are optimizing the aeration process by evaluating and implementing alternatives to achieve an effluent nitrogen concentration of 8 mg/L. Our design approach follows guidance from Metcalf & Eddy, TR-16 Guides for the Design of Wastewater Treatment Works, and NPDES permit requirements, ensuring compliance with industry standards while enhancing treatment efficiency.

Senior Design 2025 : Environmental Engineering Team 06

Team

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Lily Johnson
Suki Zheng
Cody Voorhies

Faculty Advisor(s)

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Non-UConn Advisor

Elizabeth Doerfler, Jacob Ducharme, Mariusz Jedrychowski

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Wright-Pierce

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WRIGHT-PIERCE
Engineering a Better Environment

Optimization of Water Quality in Drinking Water Distribution System

Description

The Waterford Utilities Commission (WUC) in Waterford, Connecticut, uses a consecutive Public Water System (PWS) that is facing water quality issues such as disinfection byproducts (DBPs) levels exceeding regulatory limits and insufficient chlorine residual concentrations, which can pose a risk to human health. Free chlorine can decay over time due to biological or chemical reactions in the distribution system, which is exacerbated by high water age between the chlorine treatment and the water exiting the distribution system at the customer's tap. Using a hydraulic model of the mid-pressure service zone, we designed and modeled our selected alternatives as part of an updated distribution system with improved water quality. First, we developed a hydraulic model of the impacted service zone to locate areas with high water age as a basis for potential causes of water quality issues. Then, we evaluated and designed two solutions: a water main flushing program and an active mixing system with THM removal for the storage tank. Flushing allows water to be expelled from the system, reducing the overall age of the water in the system temporarily, as well as removing sediment, scaling, and biofilm buildup that depletes chlorine residuals. An active mixing system reduces the likelihood of "dead zones" in the storage tank, pockets of water that decrease chlorine residuals and encourage microbial organism growth. Active mixing also keeps the water moving and allows THMs to be exposed to the atmosphere and volatilize.

Multidisciplinary Engineering Senior Design Teams

Senior Design 2025 : Multidisciplinary Engineering Team 01

Team

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Isabel Angulo

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Dr. Jorge Paricio Garcia

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SedMed

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Force Setting Mechanism for Toilet Lift Assist Device

Description

SedMed's Lift Assist device is a gas spring powered toilet seat lifter that mounts directly onto any toilet and provides assistance to those with mobility issues getting on and off the toilet. A variable amount of force depending on the hole that the gas spring is positioned in lifts approximately 80% of the labeled user's weight. The objective of this project is to modify the design of the weight changing mechanism such that the weight setting can be changed with just one hand, users can change and view the weight setting without bending down, the gas spring quick release pin cannot slip out of a hole or automatically engages if it is not properly inserted into a hole, and the redesign of the aesthetic/appearance allows the device to reach a wider range of audiences.

Senior Design 2025 : Multidisciplinary Engineering Team 02

Team

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Milo Barron

Faculty Advisor(s)

Jorge Paricio Garcia

Sponsor

Off Center Farm

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Design of a DIY Ventilation System for High Tunnels

Description

This senior design project aims to address engineering and design challenges associated with creating an efficient, independent DIY instructional ventilation control system for a High Tunnel, also known as a plastic tunnel in farming. High Tunnels are widely used in agriculture to extend the growing season and protect crops from adverse weather conditions. However, during the hot days of summer, maintaining optimal temperatures and humidity levels inside these tunnels becomes a significant challenge. The goal of this project is to design an open-source DIY ventilation control system that can effectively interface with existing agricultural components including fans, motorized louvers, and temperature/humidity sensors. Existing systems are costly and overcomplicated for the needs of lower volume small operations, who need something easily replicable and accessible. The system extracts hot air from one end of the High Tunnel to the other ensuring a stable internal environment conducive to plant growth. This is in response to configured temperature and/or humidity data, leveraging accessible software with a robust expansion potential. ensuring a stable internal environment conducive to plant growth. The final product will be CAD models, component selection, and a thorough instruction set so that any farmer may 3D print their own control system, thus providing a sustainable and energy-efficient solution in an accessible product.

Senior Design 2025 : Multidisciplinary Engineering Team 03

Team

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Samantha Wilkins

Faculty Advisor(s)

Jorge Paricio

Sponsor

Pratt & Whitney Institute for Advanced Systems Engineering

Airframe Cabin Configuration to Eliminate Overhead Bins

Description

This project reimagines the interior airframe configuration of long-haul configured narrow-body jets, such as the Airbus A321XLR, by removing overhead bins and installing a central retrofittable cubby system for carry-on bags. This central solution in the mid-cabin of the aircraft is accompanied by large, more accessible lavatories and a walk-up refreshment and snack galley. This aims to improve operational efficiency, enhance passenger comfort and accessibility, and improve overall amenities for long-haul flights while preserving the current passenger capacity and structural integrity of narrow-body jets.

Senior Design 2025 : Multidisciplinary Engineering Team 04

Team

Samia Begum

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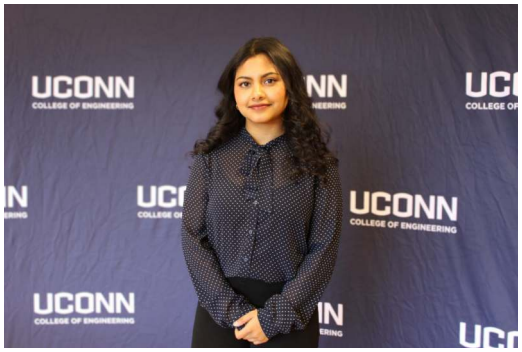
Sponsor

Dr. Edith Barrett and Mr. William Wiggin



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UCONN
COLLEGE OF LIBERAL ARTS AND SCIENCES

Recylable Wheelchair Ramp

Description

This project's objective is to develop design specifications for a wheelchair ramp that is modular, reliable, and sustainable. The project will use PET for multiple reasons; it is lightweight enough to be of feasible weight to maintain modularity, it's use in the ramp makes the idea more marketable as a ramp "made of plastic bottles" in an economy increasingly focused on sustainability, and it is unique which contributes to the nonobviousness aspect of patentability for the structure. By using repurposed material, material costs can be cut, the concept is more marketable and unique in today's competitive world, and, most importantly in the context of the current climate crisis, sustainability can be ethically achieved. By accomplishing these goals, the project has the potential to have a lasting impact on not just the disabled individuals who will be directly served, but on everyone through its indirect environmental benefits.

Senior Design 2025 : Multidisciplinary Engineering Team 05

Team

Lela Romeo

Faculty Advisor(s)

Julian Norato

Sponsor

UConn, Dr. Julian Norato

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Efficient Gradient-based Optimization of Path-dependent Sequencing Problems

Description

Combinatorial problems are ubiquitous in engineering design and manufacturing. These problems typically arise whenever it is necessary to determine an optimum sequence of steps that maximizes or minimizes a quantity of interest. Examples include the optimal sequence of welding operations to minimize weld-induced distortion or simply the tightening sequence for a pattern of bolts to minimize contact-induced stresses. This project poses a mathematical method of conversion from a combinatorial problem to a differentiable, non-combinatorial problem that can be efficiently solved using gradient-based nonlinear programming methods. In its initial stages, it was decided to use a classic combinatorial problem known as the Traveling Salesman problem as a proxy. This problem evaluates the shortest distance traveled between "cities" or a random set of points. To make the evaluation more realistic, the points were then randomized to allow for the program to evaluate unique cases after the initial evaluation period. Then, by creating a new mathematical method that focuses on a history-dependent solution, we were able to create and implement an equation that creates one linear solution based on the desired parameters.

Senior Design 2025 : Multidisciplinary Engineering Team 06

Team

Ash Torbic

Faculty Advisor(s)

Dr. Jorge Paricio Garcia, Edward Weingart

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Krenicki Arts and Engineering Institute

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Design of Operable Theatrical Evil Dead Chainsaw Prop

Description

This project aims to create and build a design for a chainsaw prop that can be used in a production of Evil Dead The Musical. Within the context of the show, the chainsaw is attached to a character's arm after their hand has been cut off. Practically, this means that the prop needs to be hollow so that the actor can hide their arm inside. There will also be padding on the opening for additional comfort and support. The chainsaw prop also needs several special effects to aid in the illusion of a fake chainsaw. These effects include a moving chain and smoke effect.

Mechanical Engineering Senior Design Teams

Senior Design 2025 : Mechanical Engineering Team 01

Team

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Faculty Advisor(s)

Martin Huber

Non-UConn Advisor

Spencer MacLeods and Andrew Dieterle

Sponsor

Aerogear

Sponsor Logo

Rotating Heat Treat Fixture

Description

This project aims to enhance temperature uniformity during the quenching process, addressing the risk of warping in large components caused by uneven cooling. To achieve this, the team is improving Aero Gear's existing rotating fixture design through key innovations, including developing a method to accurately measure the fixture's RPM, modifying the turbine design to improve strength and manufacturability, researching high-temperature machinable materials, and producing a final, optimized fixture. The fixture incorporates a nitrogen-jet-powered turntable system designed to evenly distribute temperature, reducing defects and optimizing mechanical properties. Graphite, chosen for its exceptional thermal stability, machinability, and high-temperature resistance, and alumina, selected for its thermal expansion properties, ensure durability and compatibility under demanding conditions. Operating in a vacuum furnace at temperatures up to 1525°F, the fixture seamlessly integrates into Aero Gear's production line while being easily replicable to minimize downtime. This initiative leverages advanced engineering and material science to deliver a robust, scalable solution that reinforces Aero Gear's commitment to precision, quality, and innovation in aerospace manufacturing.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 02

Team	Faculty Advisor(s)	Sponsor
Shiddhi Patel Carly Fresher Dax Avery	Jorge Paricio	UConn College of Liberal Arts and Sciences

Affordable Recycled Wheelchair Ramp

Description

Tasked with creating a commercial wheelchair ramp that is made of recycled materials, is more affordable than the existing ramps on the market, and is modular so that it can be put together without professional help. Continuation project from SD 2022-2023 and SD 2023-2024.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 03

Team

Justin Piciacchio
Brihalia Kenton
Christopher Carafeno
Kevin Harmeling

Faculty Advisor(s)

Tom Mealy

Non-UConn Advisor

Aaron Smith

Sponsor

Architectural Metals LLC

Sponsor Logo

Resistance Swim Machine/Hot Tub

Description

Our goal is to use the parts from two hot tubs and reverse engineer them to complete a finished design that the sponsor can use to build the machine. We will supply dimensions, fluid flow analysis, and a complete bill of materials for our sponsor to use when building the machine.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 04

Team

Noah Hyman
Ian Pichs
Aldin Sabovic
Christopher Capozzi
James Arnold

Faculty Advisor(s)

Chang Liu

Non-UConn Advisor

Michael Briscoe

Sponsor

ASNE

Sponsor Logo

Electric Powered Boat

Description

This Senior Design project includes producing an unmanned electric boat. The purpose of the unmanned boat will be completing the 2-mile course at the Promoting Electric Propulsion Competition while carrying a payload of 60lbs. For this year's team, it will be important to evaluate new propulsion systems and hull designs. To produce faster speeds, hydroplaning hulls will be used. To account for increased weight and suboptimal surface conditions battery capacity will be increased, and higher performing motors will be sourced. The cooling system will be designed to be as minimal as possible to reduce points of failure/leakage.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 05

Team

Enrique Venegas Abraham
Puente Cruz
Riddhi Patel
Ben Johnson

Faculty Advisor(s)

Dr. Vito Moreno

Non-UConn Advisor

Tessa Turner

Sponsor

ASSA ABLOY

Sponsor Logo

ASSA ABLOY

Lower Carbon Luxer One Locker System

Description

Identify and test alternative materials for Luxer One Locker Systems to reduce carbon footprint, cost, and weight while maintaining resilience and security.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 06

Team

Marc Lopez

Ryan Le

Ziqing Ai

Faculty Advisor(s)

Wajid Chishty

Sponsor

Belcan

Sponsor Logo

Belcan

Mobile Modular Assistant (MoMoA)

Description

The multidisciplinary team will choose an off-the-shelf (COTS) drone that fits the needs of the systems engineering design challenge. The objective of this project is to design a drone (example shown in Figure 1) with a common module interface so that it can be easily repurposed for different objectives. The scope of this project defines two module applications with the potential of a third module application to be defined by the student team. The two module applications are: 1) Garden Fruit/ Vegetable Picker – the drone should be able to identify and pick different fruits. 2) Dog Walker – the drone should be able follow a dog walking at night with a flashlight. Figure 1. Example Drone with Camera (Team will Choose another Drone to Fit Requirement Needs.) The team will meet early in the Fall semester of 2024 as a large group with the sponsor to be sure all communication and design requirements of the subgroups are well understood. The current scope plan is shown in Figure 2 and is subject to be modified after the first meeting. The UMich students will be responsible for the drone selection and the design/build of the common module user interface. A simple prototype of the interface will be sent to UConn for testing so that the modular components can be tested and designed in parallel. The UConn students will design the module components under the configuration requirements so that they can be interfaced with the UMich drone. In particular, the UConn ME team will be responsible for designing the end effectors, identify the servo motors, and design/build the module rig so that it is compatible with the interface connections. The UConn ECE team will be responsible for circuit design, microcontroller programming, device instrumentation (servo motors, sensors, etc.). The UConn CSE team will be in charge of research and programming of algorithms for object recognition and tracking. Interface and integration of the work and functionalities developed by different teams will

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 07

Team

Arun Govindaram
Sean Harvey
Joseph Alvin
Luis Raya-Hernandez

Faculty Advisor(s)

Rajiv Naik

Non-UConn Advisor

Micheal Balestra

Sponsor

Belimo Americas

Sponsor Logo

Solid-Core Butterfly Valve

Description

One of Belimo's larger valves is a 14" size BFV. The 14” BFV produced today is a hollow-core stainless steel disc utilizing a single piece, full-length stem design. The challenge will be creating a similar cost, fully solid disc design as opposed to the hollow disk that compensates for the extra solid core material and achieves a similar level of strength.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 08

Team	Faculty Advisor(s)	Sponsor
Ata Deniz Kumbasar Tyler Fernand	Rajiv Naik	Belimo Americas

Regulator System for Consistent Burst Testing

Description

ME08 and MEM02 have been tasked with identifying and designing a test rig that can maintain 5000 psi of water pressure with minimal variation in pressure. The test rig will be used to perform hydrostatic leakage and burst-pressure tests on characterized control ball valves (CCV) made by Belimo to verify that the valves will not leak or fail beyond their maximum operating pressures. The burst test pressurizes a flow vessel in increasing intervals to determine its maximum pressure. This test can be destructive, so proper safety measures must be considered in the design of the rig. It is also important that the regulator/regulator system that pressurizes the water moving throughout the rig is accurate and does not fluctuate. As a group, we are expected to research the fundamentals of hydraulics, identify and size components, and put together a test rig that is capable of supplying pressures up to 5000 psi for the ball valves to be tested. Once the best design is identified, a prototype, consisting of only the essential parts to build and maintain pressure, will be constructed and subjected to a series of tests to verify acceptable pressure control can be achieved. Any necessary modifications and troubleshooting will be made, the final design tested, and the results demonstrated to Belimo for final acceptance. We are to provide all schematics, CAD designs, analysis and test results, bill of materials, and our interim and final reports.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 09

Team

Caleb Heydon

Faculty Advisor(s)

Alexei Poludnenko

Sponsor

Belimo Americas

Gas Monitor Calibration Chamber 2.0

Description

The purpose of this project is to improve the calibration process of the sensors located on the PCB boards while maintaining accuracy and safety. The gas monitor calibration chambers that are made by Belimo are currently used in various locations such as boiler rooms, loading docks, indoor parking, chiller rooms, warehouses, etc. The chambers effectively detect CO and NO2 gases by having a PCB that holds several sensors. The sensors require calibration within a medium-sized, square-shaped chamber that can accommodate up to eight PCB boards. A crucial safety requirement is ensuring the enclosure is airtight, as any gas leaks could pose significant hazards. The entire process is controlled by the control panel that is open to customization and the chamber is mounted on the table at atmospheric pressure and room temperature conditions. Belimo desires to make the calibration process more efficient by minimizing the time required and increasing the chamber's capacity to hold a larger number of PCB boards. They also are in need to create a robust base structure to hold all the necessary components and provide easy access for the operator to work in the chamber. Nonetheless, a key aspect of the project is ensuring the selected materials meet the required size specifications and are compatible with the gases used in the process. The chamber needs to encapsulate the air tightly, ensuring even airflow and the capacity to hold a substantial number of PCB boards without compromising accuracy.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 10

Team

Nathan Camara

Tyler Berendsohn

Syed Asar

Faculty Advisor(s)

Vito Moreno

Non-UConn Advisor

Ken Dreier

Sponsor

Burt Process Equipment

Sponsor Logo

BURT PROCESS EQUIPMENT
Partners in Global Water Quality

Thermoplastic Welding Optimization

Description

Our sponsor, Burt Process Equipment (BPE), tasked our team with qualifying their thermoplastic welding processes according to the DVS standard. This involved performing tensile and bend tests on different weld types fabricated by BPE and comparing the results to the expected values outlined in the standard. Once the welds were tested and qualified, the BPE team fabricated a polypropylene storage tank. This tank was then filled with water to measure the displacement of its walls, and the results were compared to an FEA simulation conducted using Ansys and Autodesk Inventor. The purpose of this analysis was to evaluate how stress was distributed in the tank with and without steel girths installed. By aligning the FEA model with the actual tank's measured displacements, we simulated various girth configurations—adjusting their size and placement—to assess their effect on stress distribution throughout the tank walls and welds. Ultimately, our goal was to optimize steel girth configurations to enhance the tank's structural integrity under hydrostatic loading conditions. Based on our findings, we provided recommendations for the most effective girth placements and sizes to improve the overall performance and longevity of BPE's plastic liquid storage tanks while minimizing material usage to enhance cost efficiency and sustainability.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 11

Team

Justin Schneider
Leo Zanyk
Connor Carrington
Donnie Mellon
Ved Patel

Faculty Advisor(s)

Martin Huber

Sponsor

Capewell Aerial Systems

Sponsor Logo

Adjustable Hull Tiedown Fitting

Description

Capewell Aerial Systems is the global leader in descent and aerial delivery systems. As an integral part of aerial descent systems, Capewell currently manufactures hull tiedown fittings that allow for aerial delivery of maritime craft to military operations. Capewell manufactures a multitude of different fixed in place hull tiedown fittings in order to accommodate different hull angles across different makes and models of watercraft. The scope of this project involves designing a new hull tiedown fitting that is adjustable allowing it to be used across different watercraft models, regardless of hull angle. This project explores a hull tiedown fitting that uses a ball interface housing in order to adjust the latch interface, called the ball and spigot. Once adjusted to the desired pitch and roll, the tiedown fitting housing is spot drilled to allow for two pins to be pressed in and hold the ball and spigot in place.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 12

Team

Nicholas Hyder
Thomas Dennehy
Leah Brennan

Faculty Advisor(s)

Vito Moreno

Non-UConn Advisor

Barry Hardman

Sponsor

Centrix Dental

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centrix MAKING DENTISTRY EASIER

In-Line Automated Flocking Machine

Description

The objective of this project is to provide improvement to the manufacturing process of an in line automated flocking machine. Centrix Dental currently uses a manual process to produce their flocking applicator sticks. This consists of the use of a circular fixture that holds around 600 polypropylene sticks. Both ends of the sticks are then dipped in glue and subsequently sprayed with electrostatically charged flock after the glue is dried. Finally, the excess flock is blown off while the sticks are cut in half to produce two final products, or twice the number of sticks originally placed in the fixture. Changing to an automated system provides multiple advantages for Centrix, such as an increased production rate and the elimination of the need for an employee to complete this process. Last year's ME/ECE senior design team provided a preliminary analysis of how the automated process should be undertaken. However, further steps will be taken to move from theoretical analysis to a complete design that can be used directly in Centrix Dental's manufacturing facility. Factors such as a glueing station, flock box, blowoff station, and UV curing are the main aspects to be focused on. With regards to the flock box, there is a need for a rotating brush to ensure the flock is evenly distributed onto the applicator tip. Additionally, it is imperative that the correct motor is employed to rotate this brush, whether that be a DC or pneumatic motor. Many approaches can be taken to address the blowoff station as well. This component may be solved using a small handheld vacuum or a larger industrial sized model, depending on the required rate of air flow. This report provides further details on the most effective design for an automated process.

Senior Design 2025 : Mechanical Engineering Team 13

Team

Matt Reilly
Nick Helstern
Jake Pardi

Faculty Advisor(s)

Professor Naik

Non-UConn Advisor

Rajiv Naik

Sponsor

Chamberlin Mill

Sponsor Logo

CHAMBERLIN MILL

Chamberlin Mill Shingle Saw Documentation

Description

Chamberlin Mill Inc. is a nonprofit organization dedicated to the preservation of a historic circular sawmill in Woodstock, CT. Their mission is to sustain this site for the benefit of current and future generations of a largely forgotten industrial background of New England. This preservation and sustainment consist of both physical efforts to restore the circular saw and the documentation of its function in a virtual format. As part of the effort to virtually document the saw's function, ME13 will be responsible for both completing the CAD model of the circular saw and creating a working animation. This includes creating parts that will be incorporated into a model that was started by a previous school effort. Adjusting these parts to accurately match the scale of the previous model, documenting any previous measurement inaccuracies, and animating all moving components will be within the scope of the CAD aspect of the project. A mechanical analysis of the saw mechanism will be performed to deduce the forces involved on the gear mechanism. This process will be mostly analytical and will involve the use of skills learned from previous courses from the Mechanical Engineering curriculum such as Design of Machine Elements.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 14

Team

Krish Kaneria
Noah Black
Derek Mockalis

Faculty Advisor(s)

Julian Norato

Non-UConn Advisor

Mark Gurvich, Michael Streeter, Michael King

Sponsor

Collins Aerospace

Sponsor Logo

Collins Aerospace

Design and Optimization of Advanced Aircraft Structures

Description

In collaboration with Collins Aerospace, Power and Controls, this project focuses on developing computational FEA-based capabilities to analyze and optimize the structural integrity of a critical aircraft composite structure. Advanced composite materials offer significant weight reduction compared to traditional metallic designs and provide the advantage of being optimized specifically for expected conditions, treating material properties as an outcome of optimization rather than a fixed input. However, the efficiency of such an optimization process depends on the type of structure and enhancement criteria, where conflicting objectives may arise. To address these challenges, a representative composite structure will be down-selected for detailed follow-up consideration. The effort will focus on generating an efficient parametric FEA-based modeling description to facilitate analysis and optimization while accounting for key structural requirements such as vibrations. Additionally, expected uncertainties in load and service conditions will be considered to ensure robust performance, ultimately leading to the development of optimized design implementations.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 15

Team

Roudy El Khoury

Lily Minozzi

Reid Carlson

Faculty Advisor(s)

Ravi Gorthala

Sponsor

CTNG

Sponsor Logo

Renewable Energy Microgrid at SRMR, East Lyme

Description

The objective of this project is to design a renewable energy microgrid for the Stones Ranch Military Reservation (SRMR) in East Lyme, Connecticut, a facility used by the Connecticut National Guard (CTNG). The CTNG plans to implement a new microgrid capable of a substantial return on investment within 25 years. By researching and analyzing current energy usage and selecting suitable renewable energy sources, ME 15 proposed a microgrid system that reduces the facility's energy costs and increases energy efficiency and sustainability. The microgrid will incorporate solar panels (photovoltaic), battery storage, geothermal heat pumps and backup generators to reduce cost, provide efficiency, and increase reliability.

Senior Design 2025 : Mechanical Engineering Team 16

Team

Xander Raymond
Andrew Cote
Elliot Dean

Faculty Advisor(s)

Wajid Chishty

Non-UConn Advisor

Rick Baruffi

Sponsor

Draper Laboratory

Sponsor Logo

Robotic Perception Sensor Characterization Platform

Description

Our project aims to design a system that allows for the rapid swapping of sensors onto an unmanned aerial vehicle using electromechanical interfaces that connect various sensors to the mission computer. Built on an airframe designed by last year's team, six universal, drone-side interfaces will allow for both mechanical and electrical connection to be made with ten sensor-side interfaces that are unique to each sensor. This project serves to reduce the cost and time required to test different sensor combinations early in robotics projects by providing a test bed that can support a variety of sensor types, sizes, and communication protocols.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 17

Team

Minh Trinh

Samari Adan-Cabanas

Amara Ambrosi

Zackary Persaud

Faculty Advisor(s)

Vito Moreno

Sponsor

EA Patten

Sponsor Logo

Automated Tube Layout Fixture

Description

EA Patten is a manufacturing company that fabricates tubes for various industries. A layout fixture is created for each tube geometry before being sent to production. Layout blocks are used to set the height and angle of each tube, and currently each of these set-ups is done manually. The goal of this project is to design, fabricate and demonstrate a layout gauge that can be used to grip a layout block and automatically set the height and angle of it using manual coordinates. This automatic gauge has to decrease current set-up time, decrease human error and maintain the tolerances required by EA Patten.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 18

Team

Haaris Nadeem
David In
Catherine Peng
Piotr Nizielski

Faculty Advisor(s)

Professor Reza Shehki

Sponsor

Eljen

Sponsor Logo

Synthetic Alternative to ASTM C-33 Sand

Description

Our team was tasked by Eljen to find an alternative secondary filtering material to replace the ASTM C-33 sand used in their Geotextile Sand Filter (GSF). The GSF is a septic leach field and the secondary filtering material provides extra treatment to the effluent that is passed through the system, namely reducing the amount of total suspended solids (TSS) and biochemical oxygen demand (BOD) in the effluent. The replacement secondary filtering material must replicate the ASTM C-33 sand's properties of filtering, non-clogging, and facilitating the growth of a biomaterial layer.

Senior Design 2025 : Mechanical Engineering Team 19

Team	Faculty Advisor(s)	Sponsor
Evi Ashkenazi Ian Hoffman Lucy Lyttle Ryan Whaley	Dr. Ryan Cooper	Envipco

Unmotorized concept to break glass bottles

Description

The scope of our project is to analyze, develop, and validate an unmotorized concept for breaking glass bottles in a reverse vending machine (RVM) for our sponsor Envipco. The machine we are working on is Envipco's Flex TRI machine. There are certain kinds of bottles that tend to break consistently, but issues arise with thicker-walled bottles and bottles that have a wrapping or coating that prevents it from breaking properly. The goal is to reach 85% or higher consistent breakage for all sizes of bottles up to a maximum size of a 2L champagne bottle.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 20

Team

Andrew Faichney
Ryan Riley
Zachary Wirth
Riley Martin
Gavin Lin

Faculty Advisor(s)

Ugur Pasaogullari

Non-UConn Advisor

John Urbanowicz

Sponsor

HyAxiom

Sponsor Logo

Fuel Cell Mover

Description

This project, sponsored by HyAxiom, Inc., focuses on designing a lifting and transport mechanism for their hydrogen fuel cell power plants. Our solution leverages a hydraulic toe jack system for lifting, coupled with custom rigging adaptations and a custom trailer to ensure safe and efficient operations. The design process incorporates rigorous engineering analysis, including structural simulations and ergonomic considerations, to meet the sponsor's requirements for reliability, safety, and cost-effectiveness. This project seeks to streamline maintenance and logistic processes, enhancing operational efficiency for HyAxiom’s fuel cell system storage.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 21

Team

Patrick Dobrowolski
Alexander Grzelak
Reino Martin Sawan
Lillian Aube
Jack Valentine

Faculty Advisor(s)

Professor Sheiki Reza

Sponsor

UConn College of Engineering

Sponsor Logo

UCONN SCHOOL OF ENGINEERING

Wind Tunnel Testing

Description

The objective of this project is to develop a Computational Fluid Dynamics (CFD) model capable of accurately predicting the internal and external flow behavior of an uncharacterized blunt object, provided by the University of Connecticut’s College of Engineering. The supplied geometry has not been previously tested, and the project team is responsible for modeling the pressure differentials and velocity profiles within the object. To accomplish this, the team will design both the object and a robust mounting system capable of withstanding the operational conditions of the wind tunnel (Figure 1). Successful completion of this project will enhance the visibility and capabilities of UConn's wind tunnel, serving as a valuable asset for attracting future research sponsors and collaborative projects.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 22

Team

Luke Sordi
Thomas Pino
Thomas Maclaughlin
Nicholas Sabillon

Faculty Advisor(s)

David Giblin

Non-UConn Advisor

Daynamar Delgardo-Nieves

Sponsor

NUWC

Sponsor Logo

Underwater Cylinder Capture Mechanism

Description

In collaboration with the Naval Undersea Warfare Center (NUWC), the team has been tasked with developing a new way to stop underwater projectiles. The scope of this project is to design and fabricate a mechanism that has the capability of stopping an underwater cylindrical projectile without causing serious damage to the object. It can be assumed that the projectile will be neutrally buoyant, have a parabolic nose, and be made of steel alloy. The capture mechanism will be in a fixed position and must be adaptable to different environments, scalable to different projectile sizes and energy efficient. The team is also responsible for building a projectile device, (which will be traveling 10 ft/s), replicating the one being used at NUWC‘s test site. The final capture design does not need to be suitable for long-term operational testing in the field.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 23

Team

Alec Carrington
Kevin McEntarfer
Christopher Velleca

Faculty Advisor(s)

Dr. David M. Pierce

Non-UConn Advisor

Daynamar Delgardo-Nieves

Sponsor

NUWC

Flathead Fasteners Test Fixture

Description

The Naval Undersea Warfare Center (NUWC) requires a reliable and repeatable method for testing flat head fasteners under tensile loading. To improve accuracy and consistency in evaluating these fasteners, this project aims to design, fabricate, and demonstrate a universal test fixture. The fixture will be compatible with an Instron-type testing machine and capable of accommodating flat head fasteners with 82-degree and 100-degree head angles. It must also support various fastener diameters to ensure wide range of compatibility in testing. The outcome of this project will provide a standardized approach for tensile testing fasteners in a safe and repeatable manner.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 24

Team

Benjamin Rosen
Jordan Hunter
Catherine Nguyen
Jason Cressotti

Faculty Advisor(s)

Dr. Alexei Poludnenko

Sponsor

NUWC

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NAVSEA WARFARE CENTERS NEWPORT

Unmanned Undersea Vehicle (UUV) Internal Impeller Propulsion

Description

The team must design and build a functional Unmanned Underwater Vehicle (UUV) which utilizes an internal impeller propulsion system. Current UUV's are designed with an external propulsion system, typically a propeller located at the aft end of the vessel, though this type of propulsion can cause issues during launch, which is why the team will be using an internal propulsion system. The vehicle must reach a speed of 5 knots and an acceleration of 0.5g, or 4.9 m/s^2. The vehicle must also propel itself out of a tube which is closed at one end. The prototype will be tested to prove the functionality of the system and to ensure the project requirements are met. Figure 1 shows the completed painted prototype, and Figure 2 shows the ANSYS simulation of the flow through the water ducting inside the UUV with the impeller rotating.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 25

Team

Akshay Zaveri
Benjamin Lombard
Drew Snowdon

Faculty Advisor(s)

Dr. Tianfeng Lu

Non-UConn Advisor

Dr. Kostyantyn Partola

Sponsor

Peter Paul Electronics

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Fugitive Hydrogen Emissions System

Description

The process of methane extraction and delivery involves reducing high pressure methane down to a lower pressure that can be transferred through sales lines. This regulation process renders methane that is at too low of a pressure to enter the sales line, so it is released to the atmosphere. Due to the introduction of new legislation regarding methane emissions in natural gas wells, natural gas companies are at risk of large fines if methane emissions are not curbed. To avoid fines and decrease methane emissions, Peter Paul desires to create a self-contained system that captures the low-pressure methane and compresses it to the sales line pressure, and to investigate the feasibility of a system that uses no electricity, but rather only the higher-pressure drive gas to compress lower-pressure gas to desired pressure. The proposed solution uses a piston/cylinder system with an external spring to return the piston to its reloaded position. The design constraints for the proof-of-concept prototype are 100psi as the high-pressure, 5psi as the low-pressure, and 25psi as the sales line pressure gas. The system successfully achieves targeted sales line pressure with a 74% piston stroke efficiency while losing no gas to the atmosphere. The final prototype automates valve timing using pressure transducers, a microcontroller, and solenoid valves to allow for continuous cycling. The power to drive the electrical components is modeled after the available power of car batteries with solar panels that are located on the well heads.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 26

Team

Johanna Datta

Audrey McCarthy

Faculty Advisor(s)

David Giblin

Non-UConn Advisor

Erik Freidenfelds (Air Compliance Lead, Pfizer)

Sponsor

Pfizer

Sponsor Logo

Energy Consumption and Efficiency Initiatives for Building 100

Description

The objective of this project is to assess energy consumption of Building 100 (material management and office space) to understand electricity, steam and chilled water use and identify opportunities for improvement that translate into energy reduction.

Senior Design 2025 : Mechanical Engineering Team 27

Team

Tarun Nori

Riley Chamberlin

Katelyn Cislo

Owen Lotito

Tomas Verardi

Faculty Advisor(s)

Nejat Olgac

Sponsor

Pursuit Aerospace

Sponsor Logo

Hands-Free Resistance Welder

Description

Pursuit Aerospace is a global manufacturing company specializing in complex aircraft engine components. They have 16 locations, with this project being at the Eastford location. Pursuit's manufacturing practices have been built using Kaizen teachings, a Japanese business philosophy focused on continuously improving products and processes. The manufacturing floor consists of single-piece flow lines for part families instead of batches, allowing for better in-process inspection, minimal part travel, and dwell time. The Hands-Free Resistance Welder project was initiated by a senior design group at UConn during the 2021-2022 academic year. They made substantial progress designing and building the right-sized machine with the necessary electrical components and programming for motor operation. However, due to time constraints, they could not complete an automatic weld on the insulation blanket. All materials from the previous project have been preserved, and this group has been provided access to all CAD models, PLC programs, and design iterations by Pursuit. Using these resources, this group aims to iterate and develop this machine for production. The main reason for incorporating this machine into production is to eliminate the current welding process, which has the operators put an average of 420 tacks in one insulation blanket. This is extremely taxing on the operator, mainly their wrists, because of the repetitive motion of tacking the blankets. It also introduces human error, increasing the probability of non-conforming parts. Implementing the machine will significantly enhance production efficiency by significantly reducing manual intervention, reducing the risk of non-conforming parts, increasing production speed, and creating an ergonomic method to weld these parts.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 28

Team

Sam Walikonis
Andrew Lombardi
Josh Roy
Brendan Power

Faculty Advisor(s)

Nejat Olgac

Non-UConn Advisor

Allen Roy

Sponsor

Pursuit Aerospace

Sponsor Logo

Pursuit AEROSPACE

Right-sized Material Slitter

Description

The objective of this project is to design and demonstrate a piece of equipment that is capable of handling different sizes and thicknesses of coil stock and can split the material into specified widths with high precision.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 29

Team

Delton Wentworth Hollister Tryon
William Burns

Faculty Advisor(s)

Julian Norato

Non-UConn Advisor

Bill Graves

Sponsor

Pratt & Whitney

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Quantification of Non-Linear Aluminum Honeycomb Properties

Description

The overall objective of the project is to perform compression and shear tests on samples of aluminum honeycomb over a range of load rates to be able to characterize the aluminum honeycomb material. The aluminum honeycomb is characterized in terms of its compression and shear properties, anisotropy, load rates, and composite material support.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 30

Team

Kevin Purcell

Alyson Neves

Anne Scheller

Faculty Advisor(s)

Jason Lee

Non-UConn Advisor

John Tirone

Sponsor

Pratt & Whitney

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Experimental and Analytical Investigation of Bolted Joint Loosening Due to Vibration

Description

This project began in 2021 when Team ME 41 was tasked with designing and fabricating a simple test rig to measure the effects of transverse vibration on bolted joints. Team ME 41 based the design on the Junker Test, a machine that simulates real-world vibrational conditions acting on a bolted joint. In 2022, Team ME 40 continued the work by identifying relationships between various bolt parameters, such as thread size, vibration amplitudes, and initial preload, and their effects on loosening. Most recently, in 2023, Team ME 37 created loosening curve models to better understand the correlation between bolt parameters and their susceptibility to loosening. This project is currently ongoing with Team ME 30 in 2024, continuing the investigation of bolted joint loosening caused by vibrations, focusing on three key objectives: 1. Increased deflection sensitivity to detect relative motion as small as 0.001”. 2. Evaluate preload loss under both transverse and axial loading to replicate real-world conditions. 3. Develop a 2D finite element analysis (FEA) model to predict deflections and assess the stiffness of the test rig.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 31

Team

Jashanpreet Singh

Anthony Glorioso

Jack Stobbie

Daniel Drysdale

Faculty Advisor(s)

Jason Lee

Non-UConn Advisor

Matthew Zizzi

Sponsor

Pratt & Whitney

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Effects of Inflation Holes on Bulb Seal Performance

Description

This project investigated whether inflation holes affect the sealing performance of bulb seals, used in aircraft engine bleed valves. Bulb seals are cylindrical rubber gaskets with a hollow interior. It is believed that sealing performance is improved by putting small holes on the high-pressure side with the intent of the seals inflating once pressurized. This would improve the ability of the compliant rubber to fill imperfections in a sealing surface. A pressure vessel was designed and manufactured that could hold over 60 PSI and include an interchangeable bulb seal region. Tests were conducted to see the steady state pressure that bulb seals, both with and without holes, can hold while receiving a continuous supply of air from a compressor. Numerous trials with various bulb seals were conducted to compare bulb seals with varying inflation hole count. Based off the data, ME31 concluded that the inflations holes do have a positive effect on bulb seal performance. The seals with no holes consistently held less pressure compared to seals with holes. This shows that the holes do inflate the seal, leading to better sealing capabilities and less leakage across the seal.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 32

Team

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Faculty Advisor(s)

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Non-UConn Advisor

Eli Warren and Scott Goyette

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Airframe Cabin Configuration to Eliminate Overhead Bins

Description

This project reimagines the interior airframe configuration of long-haul configured narrow-body jets, such as the Airbus A321XLR, by removing overhead bins and installing a central retrofittable cubby system for carry-on bags. This central solution in the mid-cabin of the aircraft is accompanied by large, more accessible lavatories and a walk-up refreshment and snack galley. This aims to improve operational efficiency, enhance passenger comfort and accessibility, and improve overall amenities for long-haul flights while preserving the current passenger capacity and structural integrity of narrow-body jets.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 33

Team

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Gas Turbine Instrumentation Egress Fitting Validation Rig

Description

The increasing complexity of gas turbine engines has led to the need to develop smaller components. These small components would allow for easier installation and would be better suited for the needs of the engines. One such component that has become too large for use is the compression seal egress fitting. This fitting is used to seal pressure differentials when routing wires and instrumentation through the walls of the turbine engines. Pratt and Whitney seeks to develop smaller versions than the currently used models, which requires the need for rigorous testing to confirm they are up to standard. This project focuses on creating a testing rig to validate various pressure sealing methods so Pratt and Whitney can test their own egress fittings in the future. The pressure vessel will be able to test fittings to conditions that exceed the normal operating conditions of turbine engines, which will prove their reliability.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 34

Team

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Faculty Advisor(s)

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Sponsor

Pratt & Whitney

ME 34: Fiber Optic Inspection Probe for Jet Engine Turbine Blades

Description

This project aims to design and evaluate the feasibility of a fiber optic inspection probe for real-time assessment of jet engine fan blades during post flight spool-down periods. Traditional inspection methods require manual visual checks post-shutdown, which are labor-intensive and prone to inconsistency and error. The proposed solution must deliver high-resolution imaging capable of detecting and characterizing Foreign Object Damage (FOD) including nicks, scratches, and dents. While also remaining within a strict dimensional envelope of 4 × 3 × 2 inches. This remote observation solution aims to improve inspection accuracy, reduce inspection times, and minimize reliance on manual visual checks.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 35

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Delta Inlet Debris Monitor

Description

This project focuses on the design and evaluation of a delta-shaped Inlet Debris Monitoring System (IDMS) tailored for effective debris detection and monitoring. The work involves adapting existing full-hoop sensor technology to a delta-shaped configuration through extensive research and analysis. A dedicated test rig with a delta-shaped opening will be developed and fabricated to assess the system's performance using particles with varying characteristics. Initial experiments will employ vertical particle drops to evaluate sensor signals, followed by iterative modifications to optimize signal conditioning.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 36

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Pratt & Whitney

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Pratt & Whitney
An RTX Business

Eddy Current Feasibility for Preventing Fan Blade Ice Build Up

Description

This project aims to determine the feasibility of using heating coils that induce eddy currents to prevent ice buildup on jet engine fan blade tips. With eddy current probes already built into the fan case for blade tip arrival timing, it is possible that a second use of the probes for eddy current heating can be implemented on future engines. Previous static testing, static modeling, and low-speed dynamic testing have proved that induction currents in metals paired with the material's resistivity generate heat. To further demonstrate the eddy current heating principle in a dynamic setting, the senior design project includes a rotating computer simulation to predict the effects of different applied power values, materials, and blade distances to the coil/probe. A high-speed physical test rig (maximum 250 RPM) with material coupons (Aluminum and Titanium Alloy) and an induction coil will be built to compare the model to physical results. Due to safety requirements and lab capabilities, the high-speed tests will not match the true operating speeds of a jet engine, but the computer model tuned from empirical tests can potentially be used to extrapolate heating conditions to the high speeds of a commercial or military jet engine.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 37

Team

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Pratt & Whitney

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High Cycle Fatigue Small Stressed Volume Design

Description

High cycle fatigue (HCF) testing is used to analyze the behavior of metallic alloys in various aerospace applications. It is known that specimens with lower stressed volumes tend towards higher fatigue resistance. Aerospace components can have stressed volumes smaller (<10-6 in3) than traditional fatigue specimens. To capture the true fatigue capability of these components, small volume specimens are required. Another challenge with HCF is the time required to test specimens. To be capable of testing accurate stressed volumes in an efficient manner, the project scope is to design specimens and a fixture that can simultaneously test multiple specimens in a load frame. The team is tasked with demonstrating the ability to manufacture the specimens and fixture with simple manufacturing machinery and maintaining a uniform, uniaxial force distribution on each test specimen throughout the duration of testing.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 38

Team

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Sponsor

SedMed

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Force Setting Mechanism for Toilet Lift Assist Device

Description

This project focuses on redesigning a gas spring-powered toilet lift assist mechanism to enhance its functionality, safety, and accessibility for elderly and physically impaired users. The current design requires two-handed operation for weight adjustments and positions the adjustment mechanism beneath the seat, making it difficult for users with limited mobility to operate. The primary goal is to modify the weight adjustment mechanism to allow single-handed operation and eliminate the need for users to bend or crouch during use. Additionally, the project aims to improve safety by ensuring the gas spring quick-release pin cannot disengage unintentionally, preventing potential harm. Secondary objectives include improving the device's aesthetic appeal to make it suitable for residential use, ensuring it integrates seamlessly into home environments. This semester we were able to run trial and error on concept ideas. We started off thinking about design concepts that revolved around a pulley and clamp system that would allow the seat to stay stationary while the weight setting was changed. After analysis and thinking about the engineering processes that would go along with this design concept, we came up with a better idea that involves a lever and a design iteration of the weight changing mechanism involved in the original design used by SedMed. This new design iteration meets the requirements asked by SedMed but will be rigorously tested and refined to meet sponsor approval, ensuring it provides an innovative, practical, and reliable solution.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 39

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Sponsor

Sikorsky Aircraft Corporation

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Torsionally Compliant Gear for Torque Split Gearbox

Description

The objective of this project is to design and test a torsionally compliant spur gear to be used within the gearbox on the Sikorsky CH-53k King Stallion. This helicopter utilizes a split torque gearbox, which takes the power from three engines and divides it into four separate spur gears that act on the main rotor gear. These gears are connected to a flexible quill shaft, which allows for select amounts of rotational deformation and ensures that each gear transfers the same amount of power to the main rotor gear. The task is to move the torsional compliance from the quill shaft to the web of the gear so that the gear is torsionally soft but radially stiff. Within our project, Ansys FEA software and physical testing was utilized to calculate the torsional and radial stiffness of each of our design considerations, and the design consideration that performed the best was given as the recommendation to the sponsor.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 40

Team

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Faculty Advisor(s)

Ryan Cooper

Sponsor

Sweet Acre Farm

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SWEET ACRE FARM

Compost and Mulch Spreader

Description

The ME-40 team was tasked with creating a machine capable of assisting Sweet Acre Farm in efforts to curate their crop beds. Sweet Acre Farm employs a method consisting of dumping wheelbarrows of compost along the beds and spreading with rakes. For area between the beds, wood chips are tossed down from 5-gallon buckets. The current method is both inefficient in cost and time. To combat the issues faced, ME-40 was looking to adapt a commercial manure spreader to meet the needs of SAF. However, due to unseen circumstances, the team pivoted to creating a smaller scale model and individual components. These subcomponents will consist mainly of a beater, a rake system, and an auger. The compost will be moved through the beater and rake system to ensure an even and proper spread, while the auger is used to move the wood chips to be deposited at the proper location. The project will result in a group of subcomponent machines that could be further evaluated and grown to act as “drop-in” parts for a full sized spreader and could be used to greatly improve efficiency of the process.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 41

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Sponsor

Triumph Engine Control Systems

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TRIUMPH
SYSTEMS, ELECTRONICS AND CONTROLS

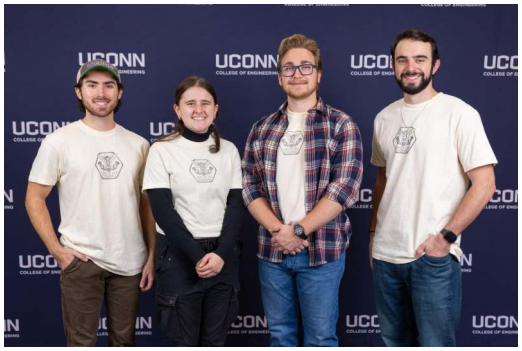
Portable Thermal Load Cart

Description

In the aerospace industry, components are often complex and operate under extreme thermal conditions. These conditions generate significant heating and cooling demands—collectively known as thermal loads—which must be accurately replicated during testing. To properly test these components, a system is needed to replicate the heating and cooling conditions they experience. The Portable Thermal Load Cart is a specialized system designed to continuously simulate these thermal loads by removing or adding heat at the component's exit, then feeding the conditioned fluid back to the inlet at predefined inlet conditions. Developed to enhance Triumph Engine Control Systems' testing capabilities, this portable solution replaces an outsourced stationary load cart, providing improved flexibility and efficiency in thermal load delivery. To replicate the aircraft heat sink and load, the system uses hot and cold fluid loops, engineered to meet specific temperature and flow requirements. To meet Triumph's needs, the final design is modular, ensuring cost-effectiveness and adaptability across various testing environments.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 42



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Faculty Advisor(s)

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Non-UConn Advisor

Thomas Bacon

Sponsor

Union Bee Company

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Process to Create Improved Durability Beehive Frame

Description

Creating an automated manufacturing method to produce a new design of beehive frame. New design has been proven to be more durable in initial strength testing but requires new method of manufacturing. The goal of the project was to create an efficient and cost-effective manufacturing method to make the new design commercially viable.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 43

Team

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Faculty Advisor(s)

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Sponsor

Windham Dental

Root Canal Disinfection: Syringe Injection Force Evaluation

Description

The objective of this project was to identify the range of forces applied to a syringe containing bleach solution, that would cause the solution to breach the apical foramen during the disinfection stage of a root canal procedure. The apical foramen is a small opening at the root of a tooth where arteries, veins and nerves pass through. If the bleach solution, used to disinfect the canal, breaches the apical foramen, it can result in permanent nerve damage. Two models were used to quantify a range of forces that would cause breaching of the foramen: an experimental model and a mathematical model. The experimental model involved a testing rig designed to enable a repeatable procedure with minimal variability. The rig consisted of a weight loader, syringe holder, force sensor, and data acquisition (DAQ) system. The syringe holder stabilized a 3mL luer lock syringe fitted with a 20-gauge beveled needle, to which a root canal-prepared tooth sample was cemented using dental cement. Known weights were applied to the syringe plunger in 0.5 kg increments to determine whether the bleach solution breached the tooth's apical foramen, and if so, the applied force at which this occurred. The mathematical model evaluated the syringe, needle, and tooth assembly as a fluid dynamic system. The fluid velocity and pressure at the tooth's apical foramen were calculated for each applied force to assess whether the bleach solution would breach the apical foramen in a living patient. After measuring the area of each tooth sample's apical foramen using a confocal laser microscope, with values ranging from 1057.825 μm to 33538.239 μm, the force at which the foramen breached was correlated with the foramen's cross-sectional area. Both experimental and mathematical results suggested that there is a potential for the bleach solution to breach the apical foramen during the disinfection stage of a root canal procedure.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 44

Team

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Faculty Advisor(s)

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Sponsor

Zachry Nuclear Engineering, Inc.

Pipe Freezing in Stagnant Lines

Description

The objective of the Pipe Freezing in Stagnant Lines project is to research the relationship between ice formation and pipe lengths in a stagnant ‘dead leg’. Zachry Nuclear Engineering provides engineering design and project management services to the nuclear power industry. Specifically, Zachry strives to fully understand the relationship between ambient air temperatures, and the fluid heat transfer within the dead legs of their cooling system. This understanding is essential in the nuclear power industry to prevent full freezing of the cooling system in non-winterized areas causing power plants to have issues during atypical cold fronts.

Senior Design 2025 : Mechanical Engineering Team 45

Team

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Sponsor

University of Connecticut

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Design Of A Flame Sampling Flow System, Heated Catalytic Chamber, And Mass Spectrometer Interface

Description

We were tasked with designing a flame sampling flow system, a heated catalytic chamber, and a mass spectrometer interface. These three components when used in conjugation will build an experimental facility to enable the analysis of the gas products of flames & thermochemical catalytic reactions with an Atmospheric Pressure Interface - Mass Spectrometer (API-MS). There are two modes of operation for this flow system. In mode one flow reacts in the catalytic test chamber then into the API-MS for data collection. The flows temperature is controlled by a PID program. Flow will reach temperatures of up to 823K, and its pressure will allow for manual adjusting. In mode 2 the flow is sent through a flame sampling system where mixing of the flow and flame will occur. After mixing the gaseous products are sampled with the API-MS. The goal of the project is to build a system that can analyze the gaseous products sampled with a dilution probe from a burner-stabilized premixed flame or of a catalytic reaction.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 46

Team

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Sponsor

Dr. George Lykotrafitis

Description

Underwater autonomous drone

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 47

Team

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Sponsor

Dr. Mihai Duduta

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THE ROBOT INCUBATOR

A Robotic platform to Build Dielectric Elastomer Soft Robots

Description

The objective of this project is to develop an automated manufacturing system capable of producing dielectric elastomer actuators (DEAs) without human intervention. The current procedure to produce such devices requires each step to be done by hand. By eliminating manual procedures, production time and defects are reduced and devices with more complex geometries can be manufactured.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 48

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Kremer lab

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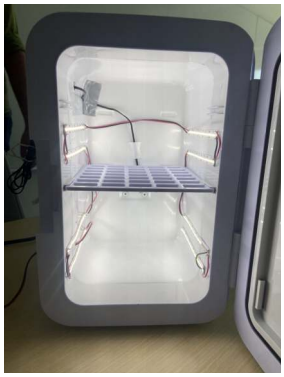

Design of Environmentally Controlled Incubators for Growing Marine Microalgae

Description

The purpose of this project is to design an affordable open-source incubator model for microalgae with optimal temperature detection and control mechanisms. Additionally, this process will minimize the intensity of temperature fluctuations in the incubator and provide a well-distributed source of heat for the microalgae to grow. As global warming continues to threaten various ecosystems, it is important to understand how increasing temperatures will impact certain species. Microalgae can be considered the backbone of aquatic ecosystems, thus it is important to test how increasing temperatures impact the species to determine if the changes pose a detriment to aquatic ecosystems in the future.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 49

Team

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Sponsor

Center for Clean Energy Engineering (C2E2)

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Fuel Cell Powered RC Airplane

Description

An investigation of the feasibility of a Fuel Cell Powered RC Airplane as proof of concept to both the Center for Clean Energy Engineering and the greater aeronautical community.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 50

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Sponsor

NIUVT

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NATIONAL INSTITUTE FOR UNDERSEA VEHICLE TECHNOLOGY

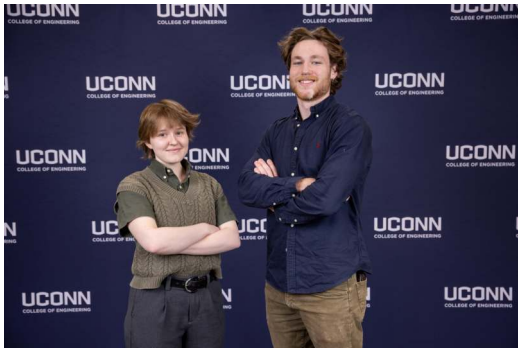
Evaluating Impedance Variability in Lithium-Ion LFP Cells under Controlled Short-Circuit Conditions

Description

The effect of external resistance induced shorting on the impedance response of lithium-ion batteries of varying states of health before, during, and after charging cycles will be determined. Multiple machine learning models will be created to estimate shorting resistance of LFP cells. The highest performing machine learning model will be embedded into a microcontroller of a programmable charger for a live demonstration of impedance-based shorting resistance estimation.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 51



Team	Faculty Advisor(s)	Sponsor
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Quantum Computing Applied to Swarming Robotic Systems

Description

This project seeks to combine quantum algorithms and classical reinforcement learning to guide a swarm of autonomous agents through a two-dimensional environment. The agents are initialized at an arbitrary location, must avoid obstacles while searching for a target, and may obey leader-follower dynamics. The integration of quantum algorithms must operate efficiently on modern quantum computers through IBM Platform. Our team analyzes solutions using Grover's algorithm and variational quantum algorithms to establish the best framework to proceed with. Variational quantum circuits are shown to have greater efficiency and wider applicability. Our team adapts existing methods to better suit the engineering problem at hand through the use of Python.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 52

Team

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Osama Bilal

Sponsor

Dr. Osama Bilal / UConn Vibrations Lab

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Accessible Platform for Reprogrammable Acoustic Metamaterials

Description

The purpose of this project is to create accessible platforms that are capable of displaying interactions between matter and ultra-low frequency waves. These platforms will hold a metamaterial composed of magnetic disks as unit cells, as well as magnetic boundaries as the unit cell bounds. In addition to being durable and cost-effective, the platforms must reduce frictional force as much as possible to ensure the results provided by them are purely the propagation and attenuation of the waves through the unit cells. Because these platforms are being built in a lab, it is important to ensure they are reproducible in other labs in accessible ways. Thus, the platforms must be constructed using materials and manufacturing methods that are relatively cheap and easily available. This project will produce two different platform designs, with one more similarly modeling current air bearings and one using water rather than air as the working fluid. Our sponsor has a system capable of displaying ultra-low frequency wave interaction with matter by using an air bearing table, as shown in Figure 1; however, the air bearing alone can cost more than $3,000. This system is also reprogrammable, meaning that it can be changed very quickly in time without stopping the experiment. The ability of the system's metamaterial to interact with ultra-low frequencies introduces many exciting possibilities, such as early warning for seismic, tsunamic, and volcanic activity. While interaction between frequency waves and matter has been studied before, it has never been done in a manner that is monetarily viable for all university labs. In addition, all previous research has been conducted using air to reduce friction. It is difficult to use alternative platforms to the air bearing, especially since the unit cells and boundaries utilize magnetic forces for material self-assembly. However, this is ultimately is a challenge we can overcome.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 53

Team

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VRC metal Systems

Sponsor

UConn, Dr. Imani

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Wire Arc Additive Manufacturing System Development

Description

This project aims to develop an advanced robotic welding system with capabilities for Wire Arc Additive Manufacturing (WAAM) to improve precision and efficiency. The system will integrate a Fanuc six-axis robotic arm and a Fronius welder, enhanced with thermal sensors to provide real-time feedback for optimizing welding and additive manufacturing processes. Using ROS 2, the robotic arm will be programmed to perform complex repairs, 3D manufacturing tasks, and WAAM operations with high accuracy. The Fronius welder will be algorithmically controlled to ensure consistent quality and performance across different materials. The system will be built and tested in a temperature-controlled lab within the Engineering Science Building to maintain stable conditions. Safety features such as a welding curtain, ventilation/filtration systems, and automated safety stops will be included to protect users and equipment. All procedures will comply with UCONN Environmental Health and Safety (EHS) regulations.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 54

Team

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Adam Florkiewicz

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UConn, Dr. Zhao

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Computational Thermal Fluids Laboratory

Detonation for Small-Scale In-Space Propulsion

Description

Researching heat transfer and equivalency ratio effects on small-scale RDE applications using H2 / O2.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 55

Team

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Sponsor

UConn, Dr. Zhao

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Computational Thermal Fluids Laboratory

Turbulent Combustion and Radiative Heat Transfer within Gas Turbine Combustors

Description

This project investigates the role of radiative heat transfer in Rich-Burn, Quench-Mix, Lean-Burn (RQL) combustors using high-fidelity computational fluid dynamics (CFD) simulations and advanced radiation modeling. Historically, combustion models have primarily characterized heat transfer as predominantly convective, with radiation contributing only a small percentage. However, recent research suggests that radiative contributions may be significantly underestimated, particularly in modern gas turbine engines operating at higher temperatures and pressures. This discrepancy underscores the need for a more detailed analysis of radiative effects within RQL combustors. To address this, a model combustor was meshed, and a turbulent combustion and radiative heat transfer model was applied. Baseline reacting flow simulations were conducted within a simplified combustor geometry to validate simulation procedure and parameters against experimental data, as an experimental rig for the complex combustor geometry has yet to be constructed. High-quality meshes were then generated for the complex combustor geometry to support further analysis. Recent research indicates that radiative heat transfer may play a more significant role than traditional combustion models have typically accounted for. This validated simulation framework lays the groundwork for further investigation into the thermal effects within gas turbine engines.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 56

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Acc Masters

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Computational Engineering and Design

Deep Learning-Assisted Geometry Alteration Detection

Description

This project integrates geometric data with machine learning to automate the process of CAE using two machine learning models. The first model predicts field data from a given geometry, while the second generated geometry based on field data. By training with simulated datasets in Abaqus, these models automate design evaluation which improves prediction accuracy as well as reduce computational costs. This automation makes engineering analysis more efficient and scalable for real-world applications and can also provide an extra layer of security when it comes to ensuring data is accurate.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 57

Team

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We-Xite Laboratory

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Flow Control By Curved Subsurface Metamaterials

Description

The goal of this project is to design a curved metamaterial subsurface capable of passive flow control. Attenuating unstable disturbances in fluid flow has significant practical applications, particularly in delaying the transition from laminar to turbulent flow, which can substantially reduce drag on vehicles moving through a fluid. While metamaterial-based flow control has been numerically and experimentally validated for flat surfaces, real-world applications will require adaptation to curved geometries. This challenge serves as the motivation for this project. The project involves two key analyses. First, dispersion analysis of the flat metamaterial geometries are considered to understand what behavior in these materials leads to flow stabilization behavior. Then, 2-way fluid-structure interaction (FSI) simulations are used to further analyze and understand how these metamaterials work in flow control scenarios. The FSI model is based on past experimental data for a flat metamaterial case, ensuring its accuracy. Additionally, curved geometries were directly analyzed to show how the addition of curvature significantly changes how these materials interact with waves and vibrations, which will need to be taken into consideration for the practical design of a curved subsurface metamaterial. With continued development, curved metamaterial subsurfaces have the potential to enable faster, more efficient, and longer range travel for both underwater and airborne vehicles, offering exciting applications across multiple industries.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 58

Team

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Sponsor

Acc Masters

Bubble Dynamics and Boiling Phenomena in Liquid Hydrogen

Description

The project explores the physics and heat transfer phenomena in bubble dynamics and in the characteristics of nucleate pool boiling in liquid hydrogen (LH2) for applications in energy storage and transfer technology. Building on existing knowledge of bubble departure characteristics and heat transfer aspects of the cryogenic liquid, as well as research into the boiling of water, the project seeks to further characterize the boiling curve of liquid hydrogen as well as develop working models for observing bubble growth and the effect of different surface morphologies on boiling.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 59

Team

Caitlin Judge

Faculty Advisor(s)

Osama Bilal

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We-Xite Laboratory

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Wave Control Through Active Metamaterials

Description

The goal of this project was to create a bistable deployable metamaterial that, when deployed, can redirect or attenuate waves in a body of water. The unit cells were designed to hold 200 grams of weight in each stable state, be quickly and consistently deployed, and, as a full material, work to attenuate waves at a wide range of frequencies. The project began with the unit cell design which used origami metamaterials as the main bistable structure as well as a motor and propeller to produce the force required for deployment, as well as incorporate spinning structures into the design which can be used to manipulate wave control based on factors such as angular velocity. The unit cells were tested for deployment and bistability and were adjusted to improve the efficiency of the system. Once created, the unit cells were duplicated and arranged in the x and y direction to test for wave propagation and attenuation both while the material was stationary, and spinning. This was modeled numerically and experimentally which allowed for comparison of the resulting dispersion and FRF plots to observe bandgaps in the frequencies being tested.

MECHANICAL ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 60

Team

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Faculty Advisor(s)

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We-Xite Laboratory

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Multi-stable Metamaterial for Sound Wave Control

Description

The objective of this project is to design and test a multi-stable metamaterial system for sound control. The design process involves using COMSOL, MATLAB and SOLIDWORKS to optimize the unit cell design. Magnets are used in the design's structure to achieve multi-stability. Uni-directional gear system is used to reduce error while keeping one-way transition between states. Numerical result is validated through experiment. Stepper motors are integrated in 1D metamaterial system.

Management Engineering and Manufacturing Senior Design Teams

Senior Design 2025 : Management and Engineering for Manufacturing Team 01

Team

Alvin Joseph

Luis Raya-Hernandez

Faculty Advisor(s)

Dr. Rajiv Naik

Non-UConn Advisor

Michael Balestra

Sponsor

Belimo Americas

Sponsor Logo

Development & Prototyping of Cost-Effective Butterfly Valve Design for Enhanced Reliability

Description

The Butterfly Valve (BFV) Solid-core Disc Design project, sponsored by Belimo Technology USA, Inc., aims to develop a cost-effective, durable, and manufacturable solid-core stainless steel disc for a 14” BFV used in commercial HVAC systems. The project addresses challenges associated with the current hollow-core disc design including debris causing leakage and a high reject rate in production by developing solid-core disc designs with a single-piece full length stem and a two-piece stem. Disc designs undergo FEA analysis, business analysis, and prototyping before component inspection, assembly, and testing is performed onsite at Belimo to evaluate performance under real-world conditions.

Senior Design 2025 : Management and Engineering for Manufacturing Team 02

Team

Andrew Fiano

Maheshwar Budhoo

Faculty Advisor(s)

Rajiv Naik

Non-UConn Advisor

Michael Delia

Sponsor

Belimo Americas

Sponsor Logo

High-Pressure Valve Testing Circuit: Enhancing Performance and Efficiency by 5-10% for Belimo

Description

This project focuses on the implementation of a pressurized testing system in the Belimo water verification lab. The circuit will but used by Belimo operators including Stephen Ercoli who primarily tests the standards for new valves that have been manufactured. These standards are a premise for how the valves should react during realistic pressure measures. The design of the circuit must be confined to the limitations of Belimo's water verification lab which provides an area of about 6 feet by 6 feet for our Circuit. This space comes with a source of electricity and city water, which will be the driving source of the pressurization build-up. This circuit will be built in the Castleman building and will provide us with facility air that is up to 90 PSI, however, the final validation will be conducted in Belimo's testing lab. Key components of the rig include a high-pressure pump, needle valves for precise flow control, shut-off valves, and relief valves that manage and monitor pressure safely. To enhance the safety of our rig, the valve that is being tested will be in a confined space with transparent glass to allow for visualization. These tests will be focused on every valve within a manageable range that Belimo produces as well as flow bodies. These valves will undergo two tests, a low-pressure test that will last for 10 minutes, then a spike test that is 5x the pressure and then brought down as quickly as possible.

Senior Design 2025 : Management and Engineering for Manufacturing Team 03

Team

Alron D'Mello

Faculty Advisor(s)

Dr. Rajiv Naik

Sponsor

Chamberlin Mill

Sponsor Logo

CHAMBERLIN MILL

Operational Model of a Shingle Saw to Promote Historical Preservation and Community Engagement

Description

Create an CAD model and operational animation of a 1800s shingle saw for educational and demonstration purposes. Also conduct a comprehensive mechanical analysis to understand power and torque requirements of the machine.

Senior Design 2025 : Management and Engineering for Manufacturing Team 04

Team

Drew Belcourt
Hunter Wolcott
Evan Stern

Faculty Advisor(s)

Craig Calvert and Rajiv Naik

Sponsor

Central Wire Industries

Sponsor Logo

Wire Tensions Sensing System to Reduce Strander Downtime and Maintenance Costs by $500,000 Annually

Description

This project focuses on developing a wire tension sensing system to enhance the efficiency and reliability of Central Wire Industries' (CWI) wire stranding machines. Frequent wire breakages, caused by inconsistent tension settings, result in significant production delays and increased maintenance costs, amounting to approximately $500,000 annually. To address this issue, the proposed system will integrate load cell-based sensors capable of providing real-time tension data, allowing operators to detect and mitigate potential failures before they occur. This proactive solution builds upon a previous design that only detected wire breaks after they happened, shifting the approach from reactive to preventative maintenance. The project involves selecting and designing a sensor that can operate effectively within the constraints of CWI’s high-speed (3000 RPM) rotating stranders, developing a functional prototype, and integrating the system with CWI’s existing control infrastructure for seamless real-time data transmission. By optimizing wire tension settings and minimizing unexpected downtimes, this system will significantly improve production quality, efficiency, and overall cost savings for CWI.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

Senior Design 2025 : Management and Engineering for Manufacturing Team 05

Team	Faculty Advisor(s)	Sponsor
Muneeb Syed Peter Cohen Abdullah Alrz	Ravij Naik	HORST Engineering

Increasing Efficiency and Throughput by Automating the Valve Stem Measurement Process

Description

This Project aims to enhance production efficiency for Horst Engineering by automating critical processes in valve stem manufacturing. This project focuses on two main objectives: improving the measurement accuracy of valve stems and automating their cutting process. By leveraging advanced technologies like the Keyence system and diamond wire saws, the project seeks to streamline operations, reduce variability in product dimensions, and significantly increase throughput.

Senior Design 2025 : Management and Engineering for Manufacturing Team 06

Team

Jake Fones
Sara Rhodes
Connor Anthony

Faculty Advisor(s)

Rajiv Naik,
Craig Calvert

Sponsor

Jaypro Sports

Sponsor Logo

Design and Implementation of a Raw Material Management System to Decrease Station Downtime by 50%

Description

Jaypro Sports is a manufacturer of high quality sporting equipment such as basketball hoops, soccer goals, and football field goals, among many other products. During the manufacturing process, raw materials must first be cut at the saw workstation before bending or additional processing takes place. The current process for moving raw materials to the saw involves forklift transportation of large bundles from outdoor storage before using the overhead gantry crane to further navigate the inside of the facility. This process must be repeated for each cutting cycle, which creates multiple limitations on the overall production process. To address Jaypro Sports' operational needs, our team designed and implemented a semi-automated raw material storage, loading, and unloading system integrated directly at the cutting workstation within the production process. The final product features a four-tier storage rack with roll-out arms and a custom scissor lift for bundle retrieval and loading. Its placement adjacent to the cutting area is critical for optimizing workflow and ensuring smooth integration with existing operations. This system can successfully free up crane availability for the material handling department and enable saw operators to switch between materials without causing production downtime. This project is expected to decrease downtime by 50% and increase throughput by 20% over the next year. Further, if this project is proven successful at the bandsaw station, this system can be implemented at two other workstations within the facility to further increase production throughput and decrease downtime leading to labor savings of $56,250 and increased work opportunity of $280,000.

Senior Design 2025 : Management and Engineering for Manufacturing Team 07

Team

Wilson Chiu
Simon Choi
Keyang Zhao

Faculty Advisor(s)

Professor Craig Calvert and Professor Rajiv Naik

Sponsor

PepsiCo Frito-Lay

Sponsor Logo

Optimization and Configuration of the Maintenance Storage Crib to Reduce Manufacturing Overhead Costs

Description

This project focuses on the optimization and configuration of the maintenance storage crib at the Frito-Lay plant in Killingly, Connecticut (KLY), with the goal of reducing the manufacturing overhead costs in the maintenance department. Critical aspects of the project include aligning physical inventory with the SAP EAM system, addressing communication issues between departments regarding part ownership that affect part flow, and the design of engineering solutions to storage density and efficiency within designated segments of the Crib Area. To achieve these goals, the Senior Design (SD) Team will: focus on optimizing critical spare parts inventory and updating the Bill of Materials (BOM) for better workflow efficiency; use queue theory to track the movement and impediment of critical parts; and use engineering software to model and simulate the viability of various storage solutions and part configurations. Success depends on accurate system integration, effective adoption by the Operations and Maintenance teams, and ensuring that all customizations meet the site's specific requirements. The project is constrained by a defined timeline, limited on-site equipment, and the necessity of coordination with PepsiCo's larger objectives. Key aspects that need to be carefully monitored include system performance under high operational loads, employee adoption of the newly created operating procedures, compliance with agency and federal regulations, and accurately representing the site's physical inventory with a virtual catalog. Focusing on these principles to produce a communications deliverable to resolve ownership issues, a manufacturing-focused deliverable to trace part flow, and an engineering-focused deliverable to improve storage capacity and safety will improve KLY's mechanical efficiency.

Senior Design 2025 : Management and Engineering for Manufacturing Team 08

Team

Melissa Gallagher
Asirva Alahari
Labiba Islam

Faculty Advisor(s)

Craig Calvert and Rajiv Naik

Non-UConn Advisor

Adam Pongan

Sponsor

Prysmian Group

Sponsor Logo

Identifying the Cause of Corrosion in Irradiation Vaults to Prevent Wire Print Removal During Crosslinking to Reduce Reworking Cost estimated at $200,000 Annually

Description

This report outlines the ongoing efforts to address corrosion-related challenges in Prysmian Group's irradiation vaults, where high ozone concentrations lead to material degradation and wire print removal during crosslinking. The project's goal is to mitigate these issues by developing solutions that reduce scrap material and improve production efficiency, ultimately saving the company an estimated $200,000 annually in rework costs.

Senior Design 2025 : Management and Engineering for Manufacturing Team 09

Team

Heet Faldu
Rehmat Shaikh
Somaneen Kheav

Faculty Advisor(s)

Craig Calvert and Rajiv Naik

Non-UConn Advisor

Tom Brien

Sponsor

Sikorsky Aircraft Corporation

Smart Manufacturing - Implementing AI in Six Sigma - Streamlining Processes and Reducing Variation by 5%

Description

This project explores how Artificial Intelligence (AI) can be integrated into Six Sigma methodologies to improve real-time process control and quality assurance in aerospace manufacturing, specifically within Sikorsky's production environment.

Senior Design 2025 : Management and Engineering for Manufacturing Team 10

Team

Jada Vercosa

Faculty Advisor(s)

David Giblin, Rajiv Naik, and Craig Calvert

Non-UConn Advisor

Daynamar Delgado-Nieves

Sponsor

NUWC

Sponsor Logo

Development and Construction of a Modular Underwater Cylinder Capture Mechanism to Increase Portability by 100%

Description

This project, sponsored by the Naval Undersea Warfare Center (NUWC), aims to design and develop a modular, portable underwater cylinder capture mechanism. The system will replace the energy-reliant pressurized water capture method and the labor-intensive search and retrieval method currently used in the respective indoor and outdoor testing environments. The objective is to capture a neutrally buoyant cylinder moving at 10 ft/s underwater with minimal impact or damage. The background of the project is rooted in the need for more efficient, scalable, and adaptable underwater projectile capture methods. Current solutions are either energy consumptive or require manual labor to operate effectively. Our proposed design seeks to mitigate these issues while maintaining reliability and safety. The approach consists of developing multiple designs while optimizing them for underwater environments. Initial prototype development and testing include above-water validation in controlled settings before transitioning to full underwater trials. Evaluation methods include force distribution analysis, damage assessment, and repeatability testing. Results so far include the fabrication of a test cylinder model and the reconstruction of a projectile launcher for controlled testing. Testing phases are scheduled for mid-March, with an initial focus on above-water trials before moving to underwater environments. Collaborating closely with NUWC ensures that our designs align with operational needs. Recommendations moving forward include refining materials for corrosion resistance, testing larger projectiles, and optimizing buoyancy and anchor systems for quick deployment. The final deliverables will include a tested and validated capture mechanism, a fully documented development process, and recommendations for future improvements.

Materials Science and Engineering Senior Design Teams

Senior Design 2025 : Materials Science and Engineering Team 01

Team

Wilson Li
Case Ballard
Mark L Xu

Faculty Advisor(s)

Fiona Leek

Non-UConn Advisor

Betty Kay Ward, CG Navaneeth

Sponsor

ASSA ABLOY

Sponsor Logo

PEMKO Geared Continuous Hinge Bearing Optimization

Description

Research, test, and analyze different polymers and coatings for usage in polymeric bearings within geared continuous hinges to pass A156.26 Grade 1 testing. The bearing materials will be analyzed based on their mechanical properties in terms of strength, creep, ductility, and wear resistance. In terms of the coatings, they will be analyzed based on properties such as friction, wear resistance, and adhesion.

MATERIALS SCIENCE ENGINEERING

Senior Design 2025 : Materials Science and Engineering Team 02

Team

Connor Skrtich
Christian Pulido
Daniel Saccone (Not Pictured)

Faculty Advisor(s)

Fiona Leek

Non-UConn Advisor

Michael DeLuca, Ken Dreier, Rob Hansen, & Joshua Jones

Sponsor

UConn College of Engineering

Sponsor Logo

Thermoplastic Tank Optimization Through Weld Analysis

Description

Burt Process Equipment creates thermoplastic liquid storage tanks using advanced welding techniques. Without previous quantitative data collected, they are unable to further optimize their current tank design. As such, we are tasked to test their current welds in accordance with the Deutscher Verband für Schweißen und verwandte Verfahren e. V or German Welding Society (DVS) standards in order to compare their welds with industry benchmarks to see if they are able to reduce the amount of materials used to create their tanks. To do so, we are employing traditional specimen testing methods like tensile and bend testing to compare their welds along with polarized light microscopy and differential calorimetry scanning in order to optimize their welding processes.

MATERIALS SCIENCE ENGINEERING

Senior Design 2025 : Materials Science and Engineering Team 03

Team

Justin Coe
Victoria Bradford

Faculty Advisor(s)

Dr. Lesley Frame

Non-UConn Advisor

Steiny Duong, Sarah Siddiqui, Vincent Mangino

Sponsor

General Dynamics Electric Boat

Ductility Dip Cracking in Welded 70/30 CuNi

Description

This project, sponsored by General Dynamics Electric Boat (GDEB), aims to address Ductility Dip Cracking (DDC) in 70/30 Copper-Nickel (CuNi) alloys, a solid-state cracking phenomenon that affects weld integrity and complicates manufacturing and repair in marine applications. Understanding the mechanisms behind DDC is essential for developing strategies to improve the weldability and durability of these alloys. The project will investigate the effects of welding parameters, alloy composition, and microstructure on DDC susceptibility through a combination of experimental and computational analysis. To achieve this, 70/30 CuNi cast specimens will be produced at the UConn foundry, welded at GDEB, and subsequently analyzed. The welding process will utilize Gas Tungsten Arc Welding (GTAW) with controlled variations in heat input to assess their impact on DDC formation. The team will conduct microstructural characterization using techniques such as Visual Light Microscopy (VLM) and Energy Dispersive X-ray Specroscopy (EDXS) to examine secondary dendrite arm spacing (SDAS) and interstitial segregations. Additionally, Density Functional Theory (DFT) simulations may be employed to model the role of defect inclusions in influencing DDC susceptibility. By developing data-driven weldability process maps, this project will provide GDEB with guidelines to optimize welding parameters, minimize cracking, and enhance weld quality. These findings will contribute to improving first-time weld success rates, reducing repair and scrapping costs, and advancing marine welding technology. The research will not only benefit GDEB but also have broader implications for the marine industry and manufacturers utilizing CuNi alloys in corrosion-resistant applications.

Senior Design 2025 : Materials Science and Engineering Team 04

Team

Adin Jennings
Christian Sabatini
Daniel Saccone

Faculty Advisor(s)

Drew Cietek and Fiona Leek

Non-UConn Advisor

Jason Kumnick and Anna McDonald

Sponsor

Central Wire Industries

Sponsor Logo

Wire Integrity Evaluation in Cold Drawing of 304 Stainless Steel

Description

The objective of this project is to evaluate and characterize the microstructure and mechanical properties of wires produced by Loos and Co. for medical applications. The goal is to understand how thermo-mechanical processing affects the microstructure and properties of 304 stainless steel wires and how processing, properties, and performance are interconnected. Specifically, this project seeks to determine if ductility is a function of the radius and how this may impact the wires Loos and Co. produces. Additionally, this study will analyze and compare Loos and Co.'s specimen preparation routine for two different characterization tests with similar routines developed by the team, aiming to determine the optimal approach for microstructural analysis. Expected outcomes include: understanding the microstructural evolution from the initial state to the fully drawn condition, including identifying whether TRIP or TWIP is more dominant, evaluating Loos and Co.'s sample preparation methodology, recommending additional analysis techniques, and developing a refined sample preparation routine for VLM and SEM.

MATERIALS SCIENCE ENGINEERING

Senior Design 2025 : Materials Science and Engineering Team 05

Team

Leena Alam

Sam Beauchemin

Marta Rivers

Faculty Advisor(s)

Bryan Huey

Non-UConn Advisor

Vincent Palumbo

Sponsor

Mott Corporation

Sponsor Logo

mott
MISSION CRITICAL PRECISION

Optimization and Degradation Testing of Functional Coatings for Porous Metal Filters

Description

Mott Corporation would like to understand the characteristics of several different coatings that directly impact the performance in their applications. The degree of hydrophobicity/hydrophilicity imparted by each coating type, resistance to mechanical wear, chemical exposure, and influence of substrate alloy type and pore size/morphology are all contributing factors. The correlation between these coating variables and the underlying porous substrates is not well documented.

Senior Design 2025 : Materials Science and Engineering Team 06

Team

Wesley Roser

Benjamin Gwinnell

Michael D'Andrea

Faculty Advisor(s)

Dr. Lesley Frame

Non-UConn Advisor

Graham Clark

Sponsor

Otis Elevator Company

Cast Iron Microstructure Optimization for Wear Resistance

Description

This project focuses on researching and developing new cast iron alloys for elevator cable drums, which require high wear resistance. The goal is to optimize both the alloy composition and microstructure to enhance its wear resistance.

MATERIALS SCIENCE ENGINEERING

Senior Design 2025 : Materials Science and Engineering Team 07

Team	Faculty Advisor(s)	Sponsor
Morgan Xu Isabel Sterett	Fiona Leek	UConn College of Engineering

Medical Gel Formulation

Description

RESTRICTED

MATERIALS SCIENCE ENGINEERING

Senior Design 2025 : Materials Science and Engineering Team 08

Team

Carter Densk

James Coleman

Faculty Advisor(s)

Alexander Dupuy

Non-UConn Advisor

Bill Graves

Sponsor

Pratt & Whitney

Sponsor Logo

Pratt & Whitney
A United Technologies Company

Quantification of Non-Linear Aluminum Honeycomb Properties

Description

The overall objective of the project is to perform compression and shear tests on samples of aluminum honeycomb over a range of load rates to be able to characterize the aluminum honeycomb material. The aluminum honeycomb is characterized in terms of its compression and shear properties, anisotropy, load rates, and composite material support. Compression and shear tests are performed at a range of load rates to record the maximum strength of the honeycomb at increasing load rates. This data provides insight into how the aluminum honeycomb will respond to load rates that exceed testing limitations. As each sample deforms, the viscoplastic responses and deformation are documented to be related to the maximum strength of the honeycomb. Due to the unique cell structure of the honeycomb, the anisotropy is quantified as well to provide further insight into the relationship between orientation and strength in shear tests. The material used also exhibits foaming adhesive within the structure. This adhesive is only present in specific locations, however in these locations, the foaming adhesive provides a bonding support to the aluminum honeycomb allowing for a much higher maximum strength. In these areas the material acts as a composite material and compression and shear tests and characterizations are performed to calculate and quantify the impact of the adhesive in these regions. In collaboration with the Mechanical Engineering team, finite element models and simulations will be conducted to further analyze the honeycomb structure's behavior. Leveraging data obtained from shear and compression tests, these models will predict the honeycomb's response under elevated load rates that surpass the physical limitations of the testing equipment. The simulations will be performed using ANSYS, allowing for a detailed and accurate analysis of the material's performance under extreme loading conditions.

MATERIALS SCIENCE ENGINEERING

Senior Design 2025 : Mechanical Engineering Team 29

Team

Delton Wentworth
Hollister Tryon
William Burns

Faculty Advisor(s)

Julian Norato

Non-UConn Advisor

Bill Graves

Sponsor

Pratt & Whitney

Sponsor Logo

Quantification of Non-Linear Aluminum Honeycomb Properties

Description

The overall objective of the project is to perform compression and shear tests on samples of aluminum honeycomb over a range of load rates to be able to characterize the aluminum honeycomb material. The aluminum honeycomb is characterized in terms of its compression and shear properties, anisotropy, load rates, and composite material support.