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SENIOR DESIGN

Demonstration Day 2024

engineering.uconn.edu

Biomedical Engineering Department Senior Design Teams

Senior Design 2024 – Biomedical Engineering
Team 01

Team 01

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None

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Design of a Microfluidic Device for the Assembly of Nanoparticles

Description

The project focuses on enhancing the assembly of DNA-inspired Janus particles for efficient RNA delivery, a crucial technique for gene editing and tissue engineering. While current methods rely on traditional approaches, this project introduces Janus Base Nano Pieces (JBNps), a novel family of RNA delivery vehicles with DNA-inspired structures. By encapsulating mRNA these particles ensure targeted delivery and protection of therapeutic cargo into cells. This innovative approach facilitates precise genetic editing in target cells and minimizes off-target effects, promising significant advancements in medical treatments. DNA-based JBNps offer unique advantages in drug delivery, including enhanced stability, carrier capacity, and controlled release, leading to more efficient drug targeting and reduced side effects. The surface charge on the JBNps' exterior facilitates mRNA binding and cellular uptake, improving the delivery of functional proteins within targeted tissues. The goal of this project is to ensure the structural integrity of JBNps, determine the ideal flow rate, obtain positive zeta potential values, maintain ideal size during assembly, and compare the microfluidic device method to the conventional sonication method (control group). Currently, Dr. Chen's research lab has only been using sonication to create the JBNps. However, it can be very time-consuming as it requires manual labor from the researchers and is less efficient. The microfluidic device can reduce the time and mass produce the JBNps. Given the ongoing experimentation in Dr. Chen's research lab with the synthesis of JBNps using the conventional method in space, the senior design project can be extended by conducting JBNps synthesis using the Herringbone microfluidic chip in space. By comparing the characteristics of JBNps synthesized on Earth with those synthesized in microgravity, valuable insights into the impact of the space environment on JBNps synthesis can be obtained.

Figure One

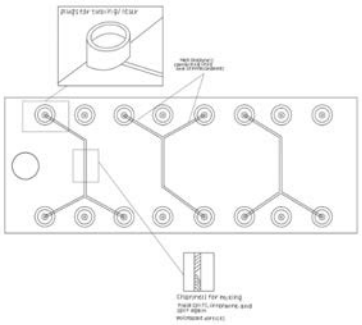
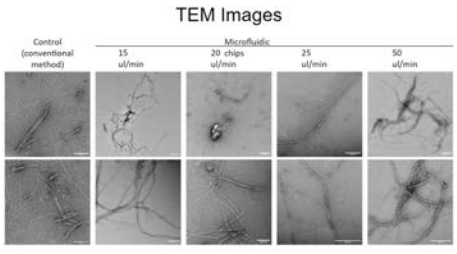


Figure Two



BIOMEDICAL ENGINEERING

Senior Design 2024 – Biomedical Engineering Team 03

Team 3

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BIOMEDICAL ENGINEERING

Circuit and Sensor Design for Smartphone-based Electroretinography

Description

Recent studies have found that electroretinogram (ERG) can be used for diagnosis of neurodevelopmental and neurodegenerative disorders. An inexpensive ERG system that sends data to a smartphone for further processing could help the widespread use of ERG and its application for early detection of neurodevelopmental and neurodegenerative disorders like autism spectrum disorder and attention deficit/hyperactivity disorder on critical patients such as kids. The ERG response is a mass electrical response from the retina, evoked by a brief flash of light. The ERG is composed of electrical potentials contributed by different cell types within the retina, and the stimulus conditions can elicit stronger response from certain components. This light stimulus can be created using a smartphone flashlight , however, the resulting ERG signals are very small and typically are measured in microvolts or nanovolts. This is the reason why the response to a flashlight is needed to be amplified , filtered and processed on a designed PCB circuit board with data storage and communication capabilities.Finally , the data is transmitted to a smartphone for its visualization and enabling real-time smartphone analysis for faster diagnosis and research.

Senior Design 2024 – Biomedical Engineering Team 04

Team 04

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Non-UConn Advisor

None

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In Vitro Model for the Study of Traumatic Brain Injury Mechanisms

Description

Students will create an in vitro model to mimic the brain microenvironment and use a microscope high-speed camera to study injuries

BIOMEDICAL ENGINEERING

Senior Design 2024 – Biomedical Engineering Team 05

Team 5

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Prof. Kazunori Hoshino

Non-UConn Advisor

None

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Hoshino Lab

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Prof. Kazunori Hoshino

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Culture, Imaging, and Characterization of Live 3D Organoids

Description

The research team will conduct an investigation into an in vitro tissue culture model known as "Cancer Organoids," which has been generously supplied by Weill Cornell Medicine, one of the four esteemed Cancer Model Development Centers in the United States. Their primary focus will be on the development of tools and methodologies encompassing microtissue culture, mechanical characterization, high-resolution 3D microscopic imaging, and drug screening.

BIOMEDICAL ENGINEERING

Senior Design 2024 – Biomedical Engineering
Team 07

Team 7

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Beekley Lab for Biosymmetrix

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Singular Part 3D-Printed External Prosthetics for Mastectomy Patients Without Reconstruction

Description

Biosymmetrix is a team focused on producing 3D-printed prosthetics made from a novel lightweight and breathable silicone matrix. However, using this material to produce a customized prosthetic has proven to be both expensive and time-consuming. The current challenge is to design a new singular part 3D-printed breast form that will provide a cost-effective, comfortable, and functional prosthetic for both single and double mastectomy patients to improve their quality of life and restore their confidence. Current customized breast forms are prone to failure, resulting in many failed attempts in addition to wasted time and material. They also require multiple parts of the breast form to be printed and attached together, due to the complex curvatures of each patient's chest wall. Due to this time consuming process, it takes months for a patient to receive their customized form. The newly designed singular breast form should minimize the amount of printing time and the failure rate of printing. Successful development of this product will allow it to be available to a larger population of mastectomy patients, while optimizing the manufacturing process. The newly developed singular part form should cut down on materials use and print time without sacrificing the comfort and quality of the prosthetic. This will be done to maximize scalability of the product for a larger scale production.

BIOMEDICAL ENGINEERING

Senior Design 2024 – Biomedical Engineering Team 08

Team 08

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Windham Dental

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Jawbone Quality Assessment Using Co-registered Ultrasound Imaging and CT Scan

Description

When a patient is given dental implants, the density of the jaw bone must be considered. This information is necessary for the dentist to determine where an implant can be safely placed so that it will be secure and stay secure over time. Clearly identifying the bone density of a pin-point location in the jaw bone can be challenging when using any single traditional imaging modality. To overcome this problem, a new method was proposed. This method would create images that can more easily show bone density by coregistering real-time ultrasound images onto a CT scan. The purpose of this project is to evaluate the feasibility and practicality of this proposed method and come up with a way to execute it. The devised strategy for execution is to use positional data collected from an accelerometer on the hand-held ultrasound probe and relay it to a computer program that will align the two types of images with each other based on this data. Based on the work done and prototypes made, the group came to a conclusion that this method is feasible and may have practical applications in dentistry. However, future work will need to be done to determine this for sure.

BIOMEDICAL ENGINEERING

Senior Design 2024 – Biomedical Engineering Team 09

Team 09

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Antibiotic and Anticancer Drug Screening on a Chip

Description

The goal of this project is to develop a compact device that allows bacteria and cells to grow in different wells on an agar substrate. Different drugs will then be added to different wells and we will monitor their responses using an imaging platform in Dr. Guoan Zheng's lab. This project is a unique opportunity to understand the mechanisms of drug interactions and potentially identify new treatment options.

BIOMEDICAL ENGINEERING

Senior Design 2024 – Biomedical Engineering Team 11

Team 11

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NSEC Lab
Neural Systems Engineering and Control Laboratory

Seizure Forecaster for Epilepsy Management

Description

The objective is to provide a software tool that analyzes non-invasive EEG signals and, at regular intervals, forecasts how likely a seizure will be in the nearest future. To achieve this goal, students must design a deep learning algorithm, e.g., by using convolutional neural networks, to extract EEG spectral features and/or functional connectivity features over time and estimate the seizure likelihood. The project will be conducted in MATLAB using scalp EEG data from a previous study.

BIOMEDICAL ENGINEERING

Senior Design 2024 – Biomedical Engineering Team 12

Team 12

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Wearable EMG-Controlled Tendon-Driven Prosthetic Hand to Restore Grip Function

Description

The objective of this project is to provide a prosthetic hand that can be used by amputees to restore the grip function. To achieve this goal, students will design and print in 3D a tendon-driven gripper with electric actuator. Students will also design a wearable, microcontroller-based system that converts electromyographic signals from the upper arm muscles into a force signal to close the gripper.

BIOMEDICAL ENGINEERING

Senior Design 2024 – Biomedical Engineering Team 14

Team 14

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University of Connecticut

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Lab-on-a-Chip Microfluidic Platform for Studying the Blood Brain Barrier

Description

The Blood Brain Barrier acts as the primary impedance to delivering drugs and other compounds to the brain. Understanding the Blood Brain Barrier's role in molecule prevention is integral to our understanding of neurological diseases. Using 3-D printing methods, these chips can be manufactured at a lower cost and allow for modifications on the chip's materials to improve cell viability and chip durability. Additionally, the integration of sensors and imaging techniques could provide real-time monitoring and analysis of barrier integrity and drug transport. The senior design team working on this project will research and design a lab-on-a-chip device with in-built sensors and imaging systems to model the blood-brain-barrier. The device should ideally allow for multiple drugs/molecules to be tested on a single chip.

BIOMEDICAL ENGINEERING

Senior Design 2024 – Biomedical Engineering Team 16

Team 16

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Medtronic

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Medtronic

Design of Minimally Invasive Surgical Device Burst Simulator System

Description

The Minimally Invasive Surgery Burst Simulator is a system to test various medical devices to define expected performance based on selectable inputs to simulate different surgical situations. Design a burst simulation system that utilizes various profiles of pressure and force to capture device performance. The system will initially focus on requirements of minimally invasive access devices. Trocars are being developed with balloons to keep the device in place during surgery. These balloons endure a large amount of pressure when going into the abdominal cavity so a burst simulator must be able to simulate this tugging motion to ensure that the balloons will not burst during surgery.

BIOMEDICAL ENGINEERING

Senior Design 2024 – Biomedical Engineering Team 17

Team 17

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Dylan Infanti
Charles Lavin
Juliana Rush

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Hartford HealthCare Rehabilitation Network

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Hartford HealthCare
Rehabilitation Network

Mini Motion Lab

Description

Motion tracking technology allows healthcare professionals to assess an individual's movement patterns, risk for injury, and other progressive measures that can enhance their plan of treatment. While some motion capture technologies, especially wearable ones, are designed to operate in limited spaces, others, such as those relying on large-scale camera setups or force platforms, may have spatial requirements that pose challenges in smaller environments like physical therapy clinics. Additionally, such solutions also pose certain limitations including high cost and lengthy setup time. The goal of this project is to design a user-friendly biomeasurement system that is able to operate in a small space and measure functional data such as acceleration, hop distance and jump height.

BIOMEDICAL ENGINEERING

Senior Design 2024 – Biomedical Engineering Team 22

Team 22

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NAVY STEM CREW
est. 2017
The UConn-URI Navy STEM Coalition

Remote Gait Monitoring Device for Navy Personnel at Sea

Description

This project aims to address the issue of fatigue on Navy personnel by remotely monitoring their gait pattern to measure levels of attentiveness. Fatigue diminishes cognitive and physical performance, hindering mission-related tasks. In our project, we propose an insole device integrated into normal footwear to detect changes in cognitive and physical performance using gait patterns. Drawing on studies highlighting the cognitive demands of gait, the group designed a gait monitoring device that analyzes the impact, mid, and active ground reaction forces as well as stride time to determine a sailor's levels of attentiveness. Priorities for this device include accuracy, reliability, cost, and ease of use. Alternative designs explored wearable devices similar to an ankle bracelet or an armband. Each design was evaluated against project objectives and constraints. Our final design involves a ZNX-01 insole sensor to track relevant gait data and an Arduino Nano ESP32 to evaluate the data. The group also began work to develop an algorithm to analyze a subject's gait data to determine their level of attentiveness. This step is still in progress. The algorithm will be uploaded to the Arduino and used to analyze subject data. Additionally, an integrated mobile app has been developed to accompany the device via Bluetooth. This device will be able to monitor a Navy sailor's gait data and provide feedback on their level of attentiveness. Through this project, we aimed to provide a non-invasive, cost-effective solution to enhance Navy personnel performance, and potentially benefit other industries and populations facing similar challenges.

BIOMEDICAL ENGINEERING

Senior Design 2024 – Biomedical Engineering Team 23

Team 23

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Raja Gudlavalleti

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Biorasis

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Optimizing Continuous Glucose Monitor (CGM) Performance using Improved Sensor Electrode Design

Description

Biorasis's goal is to develop a fully implantable device for continuous glucose monitor (CGM) system primarily for Type I diabetic patients. This system continuously monitors the glucose levels assisting in diabetes management by maintaining glycemic levels and preventing acute hypoglycemia and persistent hyperglycemia. The small size of the implant device minimizes trauma due to implantation and removal. The glucose sensing element is composed of platinum working electrode (WE), coated with glucose oxidase enzyme; an Ag/AgCl reference electrode (RE); and platinum counter electrode (CE). The three-electrode system is based on the breakdown of glucose oxidase enzyme, with hydrogen peroxide as the byproduct and current induced when a voltage is applied between the WE and the RE. The sensor current is readout, processed, and then transmitted through an LED to the external proximity communicator. In this project, we optimized the performance of the sensor by investigating sensor electrode design. The tested sensors improved the sensor output current by around 21%. We used microfluidic device as the sensor testing platform.

BIOMEDICAL ENGINEERING

Senior Design 2024 – Biomedical Engineering Team 24

Team 24

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Joint-on-a-chip Osteoarthritis Disease Modeling for Evaluating Anti-inflammatory Drug Performance

Description

Osteoarthritis is a degenerative musculoskeletal disease that is partly characterized by inflammation of the affected joint. The purpose of this project is to design, prototype, test, and iteratively refine a microfluidic device that can be used to model the osteoarthritic joint in humans and evaluate the efficacy of various anti-inflammatory molecules. We designed and, using soft lithography, fabricated a PDMS chip that includes input and output ports for syringe pump compatibility and individual channels for culturing cells in three-dimensional alginate hydrogel matrices. Our device features channel geometry that allows for addition and mixing of additional molecules within the device itself. A bottom layer for mechanical stimulation of cell cultures is also included in the device. Such features increase ease of use and applicability to a variety of experimental contexts. In parallel, we investigated and developed a method for optical detection and analysis of inflammation using Alcian blue and Safranin O staining. In order to induce inflammatory conditions such as those found in osteoarthritis, lipopolysaccharides were used, while anti-inflammatory metabolite Urolithin A was used in our proof-of-concept for optical detection. This is modeled in vitro using primarily monolayer cultures in a 24-well format. Upon confirmation of staining efficacy, our prototype was further refined. This device and outcomes of this project help to better our understanding of behavior of chondrocytes in inflammatory environments associated with osteoarthritis and the efficacy of various small molecules and therapeutics in treating the inflammatory component of this debilitating disease.

Figure One

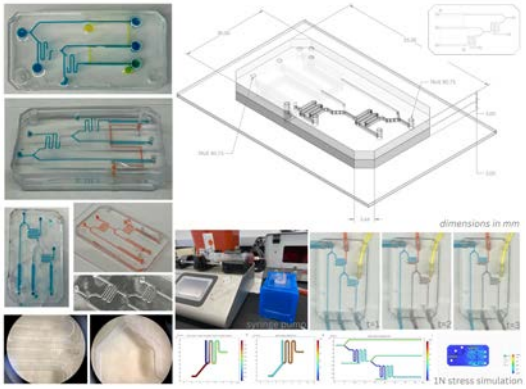
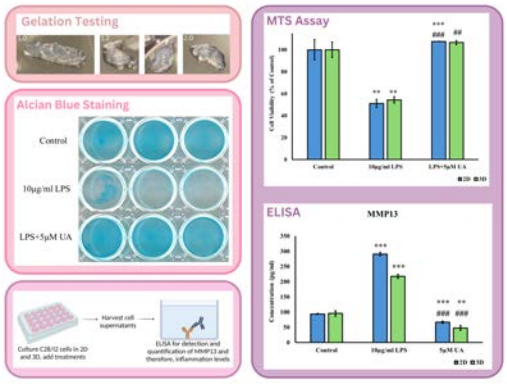


Figure Two



Chemical and Biomolecular Engineering Department Senior Design Teams

Senior Design 2024 – Chemical and Biomolecular Engineering Team 01

Team 1

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Brewing Process Challenges

Description

The UConn Brewing Innovation initiative centers on education, research, and community engagement. UConn Brewing Innovation is an interdisciplinary collaboration among the College of Engineering, the College of Agriculture, Health, and Natural Resources, and the School of Business. Community engagement factors into Connecticut's local craft brewing industry with opportunities directly linked to UConn as a research institute. Reinheitsgebot, the German beer purity law was established in 1516 as a decree that nothing other than barley, hops, and water were to be used as ingredients. However, this has since been modified to include yeast, a once neglected ingredient, earning a generic moniker of brewer's yeast. The goal of our senior design project is to enhance the brewing process by investigating the impact of thiolized yeast and cryogenic hops on efficiency. Volatile thiol precursors in barley and hops are extracted while heated with water. The liquid is separated from the mixture, and is called the wort. Yeast is then added to the wort for fermentation. Yeast cells import the thiol precursors and convert them into 3MH, which imparts tropical aromas and flavors, supporting novel recipe development. Hops is the advertised ingredient that is agriculturally intensive, and finicky. Cryogenic hops enhance the flavor and aroma compared to the same hop strain in its traditional form. Cryogenic hops allow brewers to efficiently dose large quantities of alpha acids and oils without introducing astringent flavors. The potential outcome from these technical solutions may improve efficiency, thus promoting economic growth by reducing cost of production and resources.

Figure One

Figure Two

CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2024 – Chemical and Biomolecular Engineering Team 02

Team 002

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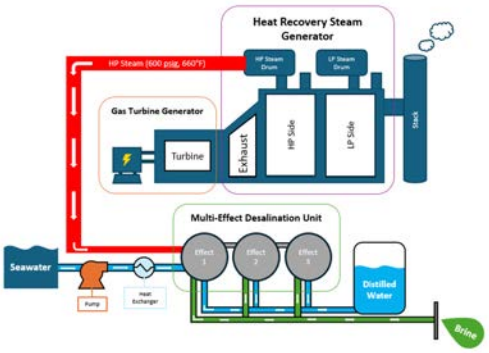
Design and Optimization of a Multi-effect Desalination Unit Integrated with a Gas Turbine Plant

Description

In 2022, the United Nations reported that 2 billion people don't have access to safe drinking water, and about half of the world experiences water scarcity. To combat this, a desalination process is used in dry regions where rainfall or underground water is limited. Desalination is a process that separates salt from sea water to produce freshwater, but it requires a large energy source. Our goal for this project is to simulate a desalination unit and power it using wasted heat from a gas turbine power plant. A combined cycle gas turbine power plant combusts natural gas and air to create enough heat to make steam. Our team modeled a desalination unit and gas turbine power plant using a software called Aspen Plus. We based our models off data from the University of Connecticut's Cogeneration Power Plant and existing papers on desalination. Aspen Plus makes it easier to analyze and manipulate large-scale projects in a smaller and controlled environment. After electric and heat demands are met, leftover steam is sent to power the desalination unit. We are performing analyses on the efficiency, economics, and environmental impact on the combined systems. Additionally, we're analyzing how we can power the system during the winter, as there may not be as much leftover steam. This allows us to create the best process that can be applied to current gas turbine power plants located in areas affected by water scarcity.

Figure One



CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2024 – Chemical and Biomolecular Engineering Team 03

Team 3

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Mu-Ping Nieh

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AI-assisted design of copolypeptide hydrogels

Description

Hydrogels are a cross-linking network of amino acid chains that form to create a porous and elastic solid. Their tunable properties, which influence mechanical strength and biodegradability, make them applicable in various fields such as contact lenses, cosmetics, and drug delivery. In the current market, testing the hydrogelation of a hydrogel, also known as its ability to hold water, is a complex and time-consuming process due to the multitude of potential combinations and the diverse range of characteristics they exhibit. Our project objective is to produce an artificial intelligence model that predicts the hydrogelation of a hydrogel based on its amino-acid composition. We wrote an optimization program to analyze circular dichroism spectroscopy (CD-spectra) data to determine the secondary structure composition of an amino acid chain. Secondary structures arise from the formation of cross-links between amino acids. One of these secondary structures, beta sheets, signifies hydrogel formation due to internal cross-linking. Kinetic profiles tracking the cross-linking polypeptide formation validate this data on hydrogelation. Our machine-learning model learned patterns from kinetic profiles and secondary structure compositions to create a hydrogelation prediction boundary. The prediction boundary tells us if a hydrogel is likely to hydrogelate. This prediction boundary can be improved with a more diverse data set with a wider range of pH and temperatures. The efforts put into this project will work to reduce the amount of research and experimentation necessary to predict hydrogelation.

Figure One

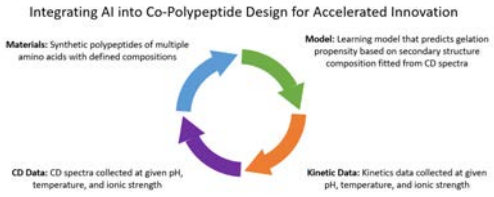
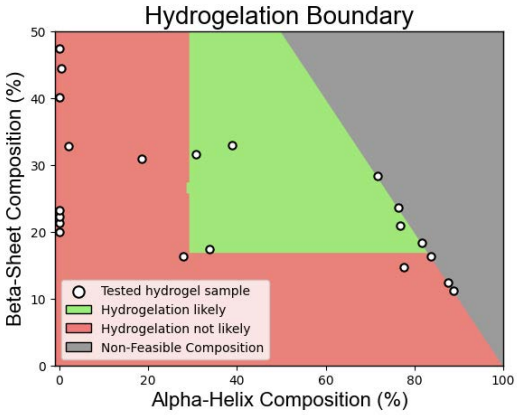


Figure Two



CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2024 – Chemical and Biomolecular Engineering Team 04

Team 04

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Spirit of Sobriety: Engineering the Essence of Non-Alcoholic Brews

Description

Non-alcoholic beverages promote health and wellness, foster inclusivity, and contribute to an innovative craft beverage market, allowing them to be catered to a diverse range of consumers. As societal attitudes continue to evolve, the gravitas of non-alcoholic beverages increases, cultivating a substantial surge in demand for non-alcoholic alternatives. In the United States alone, non-alcoholic beer sales increased by 32% from October, 2022, to September, 2023, indicating the growing popularity of non-alcoholic beverages. Controlling operation and production variables is critical during the brewing of non-alcoholic beverages to yield a high-quality product, maintain repeatable production procedures, and achieve a comparable flavor profile to an alcoholic counterpart. Our project aims to develop and study a non-alcoholic brewing process which yields a comparable alternative to an alcoholic beverage. To solve this problem, we introduced specific yeast strains and monitored various parameters to create a kinetic model. This kinetic model can be used by small, craft-breweries to allow for the controlled brewing of non-alcoholic beer. Additionally, we implemented pasteurization process on a home-brewing scale to ensure the safe drinkability of the non-alcoholic beer. We then explored pervaporation for flavor and aroma compound recovery through the creation of a computational model. Based on the results of the experiments and computational model, we designed a general process that implemented non-alcoholic brewing practices which resulted in a stable non-alcoholic product. This guide will ensure consistent product quality by killing off any spoilage microorganisms, yield a non-alcoholic beverage, and aid in a more repeatable scale-up process from the laboratory scale to the craft brewery setting. Likewise, it serves as a paradigm for small craft breweries who seek to join a budding industry.

Figure One

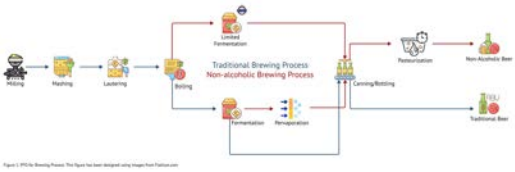
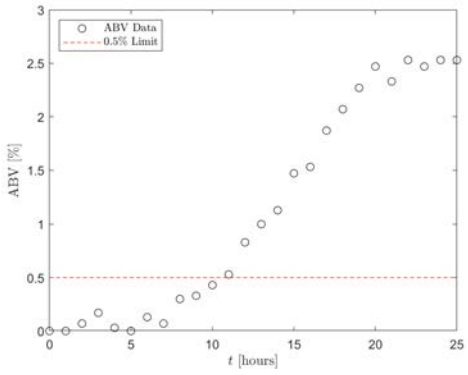


Figure Two



Senior Design 2024 – Chemical and Biomolecular Engineering Team 05

Team 5

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Unilever

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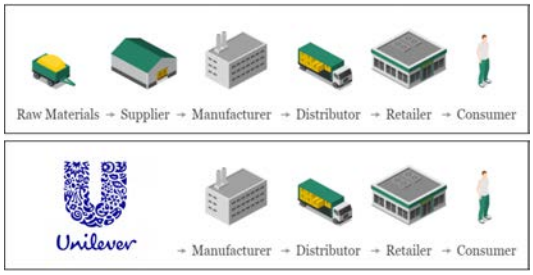
Redefining How to Process Body Wash: Creating a More Efficient and Agile Supply Chain

Description

As one of the world's largest producers of consumer goods, Unilever is constantly seeking solutions to improve their manufacturing processes. Our project aims to develop a standardized protocol for a concentrated body wash that can be diluted internally or by third-party manufacturers. Currently, Unilever makes and ships full formulations to their customers, resulting in a supply chain with limited agility or flexibility. With a concentrate-dilute protocol, the supply chain can streamline their cost structure and manufacture products more efficiently. Beginning at the laboratory scale, our team explored various ratios of surfactants that determine the soaping and cleansing properties of a base Axe body wash formula, and how certain additives modified the fluid flow properties of the developed concentrate. These fluid flow properties, mainly viscosity, were assessed through the use of a rheometer. After determining an optimal concentrate formulation, our team replicated the production process in a pilot manufacturing plant to assess the feasibility of scaling up the formulation. Once the scaled-up product is assessed, a singular protocol will be proposed, detailing how to determine an optimal surfactant ratio and appropriately scale production up. In theory, it will also be applicable to a broad range of product formulations beyond our initial case study. A successful protocol will decrease conversion costs and reduce wasted material while maintaining the product's desired physical properties and consumer experience. If Unilever can implement this protocol to Axe body washes and other products in their portfolio, they can reinvent their supply chain process and save an estimated $3 million annually.

Figure One

Figure Two



CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2024 – Chemical and Biomolecular Engineering Team 06

Team 06

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Sponsor (Text)

Unilever

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

Protocol Development to Achieve Revolutionary Skin Benefits from a Cleanser

Description

Choosing the perfect body wash has become a routine for many consumers. Over the years, consumer preferences have shifted from normal, day-to-day cleansers to products that deliver a luxurious end-to-end experience. In a growing market, companies aim to deliver cleansing properties in their body wash products while differentiating themselves from their competitors. Unilever, one of the world's largest consumer goods companies, achieves this goal through breakthrough emulsion technology. This technology improves oil deposition by creating smaller oil droplets, improving moisturization efficiency. Today, Unilever is only able to deliver 24 hours of micromoisture to North American consumers. With ambitions to bring the technology to other parts of the globe, factors such as cost and regional regulations need to be considered. As such, a new global protocol to quickly prototype and scale emulsion formulations within these constraints is needed. Our project focused on developing this protocol and as a result we've generated a potential prototype formulation for Unilever to use globally. With Unilever's assistance, our team generated a design of experiments where various formulations with different inclusion percentages were tested and several stable prototypes were identified by analyzing their viscosities. We then chose one prototype to scale up in Unilever's pilot plant, effectively producing multiple emulsion batches. From our testing, a model was developed to predict the necessary parameters to achieve the desired droplet size distributions. While this is only the beginning of developing a global protocol, the information the team has gathered will be substantial to evolving the formulation experiments further.

Figure One

Figure Two

Senior Design 2024 – Chemical and Biomolecular Engineering Team 07

Team 007

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Non-UConn Advisor

None

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University of Connecticut

Other Sponsor (Text)

N/A

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Optimal Design of Controlled Environment Agriculture System

Description

As the world population rapidly grows, it has outpaced growth in food production and, therefore, the ability to meet future nutritional needs of the planet. By 2050, researchers predict the world food production needs to increase by 70% to meet the demands of the growing global population. Our project presents a sustainable agricultural system that meets the nutritional demands of a subset of the US population while also being profitable. Controlled environment agriculture (CEA) systems are a promising solution to this dilemma. The CEA system utilizes hydroponic techniques, which grow crops in nutrient-rich water instead of soil. The hydroponic techniques are coupled with a recycling system to facilitate water reuse for a more sustainable process. Further, the entire CEA system will be encapsulated in recycled shipping containers and placed directly behind big brand stores such as Whole Foods. The proposed “farm-to-table” business model will be able to generate fresh local produce in a myriad of ecosystems. This method of growing crops can be modeled using mathematical optimization to maximize net-present value of the technology by determining what to grow and how much, while meeting nutritional demands of the population. Ultimately, our team aims to provide a flexible and robust technology that can produce food across disparate regions of the world.

Figure One

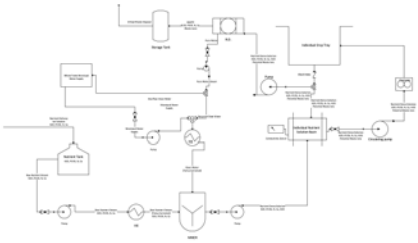
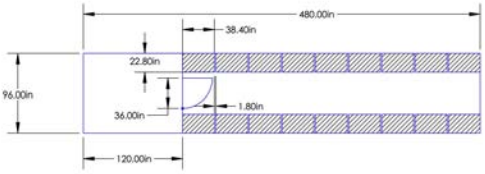


Figure Two



CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2024 – Chemical and Biomolecular Engineering Team 08

Team 08

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Nel Hydrogen

Other Sponsor (Text)

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Optimizing Water and Oxygen Phase Separation in Electrolyzers with T-Junction Technology

Description

As we shift away from a carbon economy, hydrogen energy is emerging as a viable alternative energy form. Nel Hydrogen creates electrolyzers that produce hydrogen by splitting H2O into hydrogen and oxygen molecules through a process known as electrolysis. It yields a stream with liquid water and gaseous oxygen, and a separate stream of pure hydrogen. The liquid water enters an outlet stream because not 100% of the water splits into hydrogen and oxygen. The hydrogen stream can then be used, transported, or stored as a potential energy source. Pump cavitation is an undesired condition where gaseous bubbles enter pumps and potentially collapse or implode when they encounter regions of higher pressure. Pump cavitation causes intense localized forces on pump components, resulting in erosion, pitting, and structural damage to the pump. To prevent pump cavitation, we are simulating T-junction designs to separate the oxygen and water into different outlet streams using ANSYS Fluent software. By adjusting factors like velocity, tank length, and inlet and outlet diameters, we can conduct a sensitivity analysis. By manipulating variables, we can optimize the performance of the separator. By improving the separation efficiency, we can reduce the necessary inlet deionized water, reducing electrolyzer operating costs. This optimization will also improve the longevity and compactness of the electrolyzers. This project contributes to the ever-advancing landscape of green hydrogen energy as a step towards reducing our global carbon footprint.

Figure One

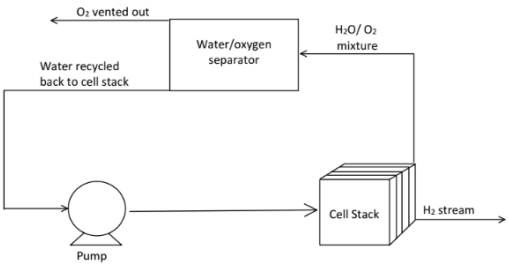
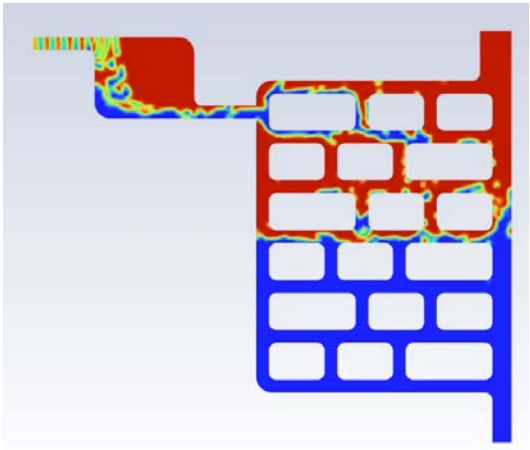


Figure Two



CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2024 – Chemical and Biomolecular Engineering Team 09

Team 9

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UConn College of Engineering

Other Sponsor (Text)

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Energy from Sustainable Waste Management

Description

At UConn, food waste is a prevalent issue caused by overproduction in meeting the demand of its large student population. UConn wastes over 107 tons of food in its dining halls each year. Currently, that food waste is trucked to Quantum Biopower, located in Southington, CT, and makes up about 5% of the supply in their anaerobic digestion process. Anaerobic digestion turns food waste into biogas which is then burned to create electricity. Quantum Biopower's process takes organic compounds that would otherwise be emitted into the atmosphere and turns them into a useful product. Our team's goal was to design a sustainable solution to address UConn's waste on campus. We proposed an anaerobic co-digestion facility, built on Horsebarn Hill, that uses campus food waste and the 800 tons per year of animal waste from campus farms. Combining the two feedstocks leads to more biogas production, and more electricity generation. The team performed engineering calculations to acquire the theoretical electrical production yields. This design included evaluating solutions for handling digestate, the solid byproduct of anaerobic digestion. Our team explored multiple digestate handling scenarios including pyrolysis to create biochar, fertilizer, and additional energy production using microbial fuel cells. Our project explored the economic and environmental viability of the anaerobic co-digestion process and each of these digestate management methods. The proposed design could help UConn meet its environmental goals and become a leading example for waste management across the country.

Figure One

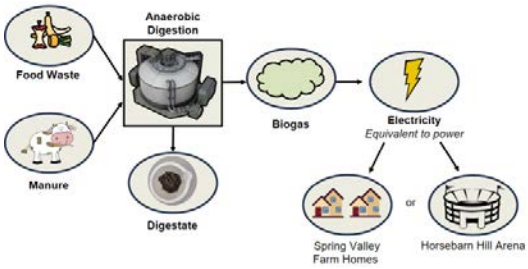

Figure Two

Digestate Management Method	Outcome
Pyrolyze digestate	• The mixed feedstock quality of the digestate leads to a high ash content biochar • The biochar is not structurally sound enough to activate to create a valuable product
Use digestate as fertilizer (as is) at UConn	• The fertilizer would add phosphorus to an already high phosphorus soil in this area • Typically, this is how small farm anaerobic digesters handle their digestate
Truck digestate to be used as fertilizer elsewhere	• An area in need of phosphorus in their soil could benefit • Added cost of transporting a waste product
Use Microbial Fuel Cells to treat digestate and then use as fertilizer at UConn	• Shown to reduce the level of phosphorus in digestate • Harvests additional energy from the feedstock • Only done on a lab scale thus far

CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2024 – Chemical and Biomolecular Engineering Team 10

Team 10

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Non-UConn Advisor

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Center for Clean Energy Engineering (C2E2)

Other Sponsor (Text)

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Optimizing the Cost and Performance of Proton Exchange Membrane Water Electrolysis

Description

The current carbon economy is an unsustainable method of providing power, transportation, and resources for the modern world. The current leading alternative is the hydrogen economy. The United States Department of Energy aims to reduce the price of hydrogen to at least $1/kg by 2031 to make this path viable. An important aspect of creating a viable hydrogen economy is the process of water electrolysis. Water electrolysis is the process of splitting water molecules into their component parts of hydrogen and oxygen gas. Water electrolysers consist of backing plates, current collectors, flowfields, and a membrane electrode assembly (MEA). The MEA is made of diffusion layers, catalyst layers, and a solid electrolyte membrane. Through modification of the anode and cathode catalysts layers, the electrolyte membrane, and the flow fields, we made improvements to the water electrolysis cell. We modified anode and cathode catalyst through reactive spray deposition technology and shaped catalyst layers to reduce the amount of catalyst required for optimal performance. We improved membrane durability and performance through the addition of reinforcement and additives. Finally, we designed and tested multiple different flow field geometries to determine the best performing candidate for a cell. Through these modifications we intend to improve the performance of the cell enough to reach the 2026 Department of energy targets and get one step closer to achieving the final 2031 goals, and a sustainable hydrogen economy.

Figure One

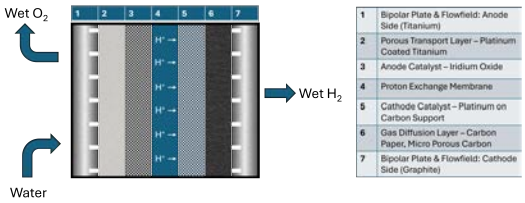
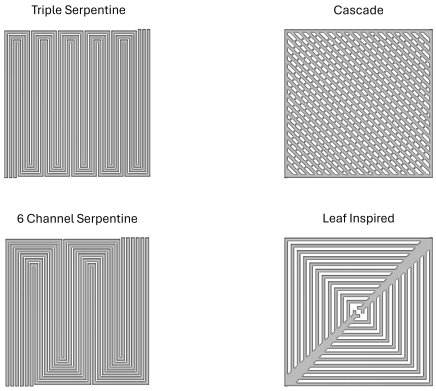


Figure Two



CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2024 – Chemical and Biomolecular Engineering Team 11

Team 11

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Non-UConn Advisor

None

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University of Connecticut

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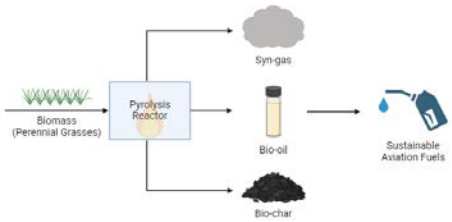
Sustainable Aviation Fuels: A Holistic Analysis of the Pyrolysis Pathway

Description

According to the National Oceanic and Atmospheric Administration, aviation is responsible for 3.5% of climate change because it uses petroleum-based fuel. The aviation sector must adopt more sustainable practices to decrease their carbon footprint without sacrificing the current infrastructure of airplanes. In 2022, the U.S. Department of Energy proposed the use of biofuels, fuels made from organic matter, to replace traditional aviation fuel by using bio-oil as the precursor. The pyrolysis process, which is the thermal degradation of biomass, is one of the pathways mentioned to create bio-oil. This project's objective is to investigate pyrolysis as a viable pathway for creating sustainable aviation fuels using the current infrastructure of refineries. Our group proposes a four-fold approach to the analysis: energy and mass balances, a process simulation using ASPEN, a life cycle assessment, and ethical considerations. Energy and mass balances demonstrate whether the fundamental process is favorable, especially when integrated into an existing refinery. The ASPEN simulation predicts the bio-oil composition of different feedstocks, which is vital for compatibility with airplane engines. The life cycle assessment explains the environmental impact of the process and its profitability. Likewise, considering ethics ensures accountability for the intended and unintended consequences of the pyrolysis pathway. The results of the holistic analysis will allow the team to make a recommendation on the viability of pyrolysis in the creation of bio-oil and sustainable aviation fuels.

Figure One

Figure Two



CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2024 – Chemical and Biomolecular Engineering Team 12

Team 12

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None

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University of Connecticut

Other Sponsor (Text)

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UConn's Green Energy Transition

Description

UConn wants to reach carbon neutrality by 2030 to properly address and combat the university's current release of over 100,000 tons of carbon emissions a year. Carbon neutrality is achieved by removing the same amount of carbon from the atmosphere that is released. To accomplish this, carbon emissions must be offset by the use of clean energy sources. The team will create a plan for how the campus can use renewable energy to reach this goal and evaluate if there is enough land and local resources to support a possible solution. The team will also create an energy balance to properly account for UConn's needs (commodities that include electricity and heat). The team would like to combine a solar panel field, wind turbines, hydrogen fuel cells, and an anaerobic digester to provide a sufficient amount of energy to campus. In addition, the group will propose conservation policies by which students, faculty, and the surrounding community can all help their campus reach carbon neutrality.

Figure One

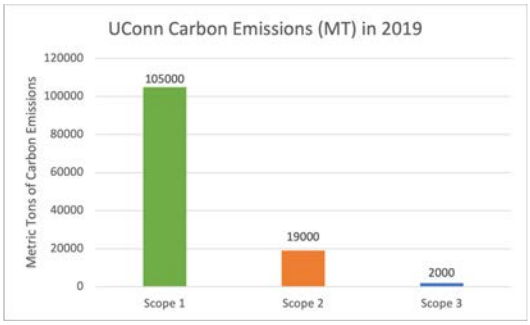
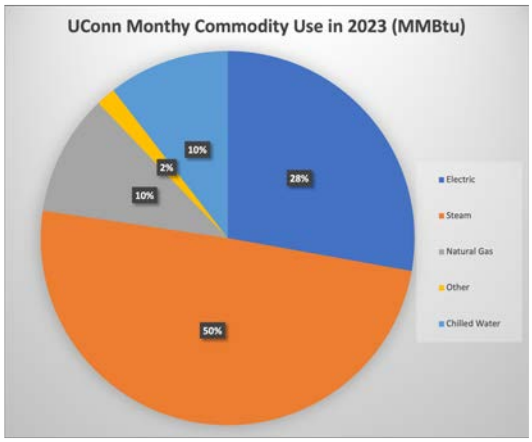


Figure Two



CHEMICAL AND BIOMOLECULAR ENGINEERING

Senior Design 2024 – Chemical and Biomolecular Engineering Team 13

Team 13

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UConn College of Engineering

Other Sponsor (Text)

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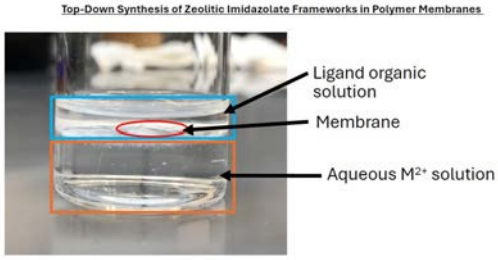
UCONN
COLLEGE OF ENGINEERING

Porous Membranes for Energy Efficient Gas Separation

Description

Traditional methods for separating gases, such as cryogenic distillation, require a considerable amount of energy. These energy-intensive processes result in higher energy costs and greater carbon emissions. Despite the costs and emissions, gas separation is an important process because it creates the precursor gases for several products that we use. Propylene is an example of a precursor gas that creates common polymeric materials such as clothing, packaging, and furniture. Using membranes for gas separations is an alternative method that reduces energy costs and emissions. Our team's objective is to optimize the porous membrane synthesis process to separate gases such as propane and propylene. We grew metal organic frameworks (MOFs) inside the pores of polycarbonate track-etched (PCTE) membranes. MOFs are porous polymers that use metal ions coordinated by organic ligands to create structures with a certain pore size. Specifically, we created a subclass of MOFs called zeolitic imidazolate frameworks (ZIFs), which use imidazolate ligands. For the metal ions in our ZIF structures, we used zinc and cobalt. Our membranes separate gases with a process called molecular sieving, which is when the pore sizes of membranes only allow the smaller molecules to pass through. Additives such as silver and polyvinyl alcohol were included in our syntheses to improve gas separation. We tested the membranes using gas chromatography to see the amount of propylene going through the membrane compared to propane. As climate change becomes an increasing threat, our team believes that porous membranes are the next step for energy-efficient gas separation processes.

Figure One



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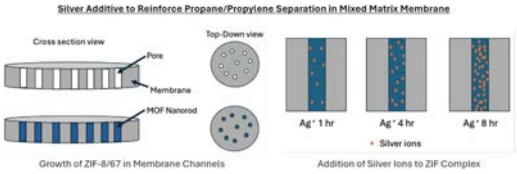

Civil Engineering Department Senior Design Teams

Senior Design 2024 – Civil Engineering Team 01

Team 1

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Dr. Nicholas Lownes

Non-UConn Advisor

None

Sponsor (Text)

Connecticut Department of Transportation (CTDOT)

Other Sponsor (Text)

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Operational and Safety Improvements - Route 15 & Route 175

Description

With large amounts of traffic build-up and accidents occurring on Route 175 Eastbound, this project aims to redesign the intersection of the Berlin Turnpike (Route 15) and Route 175 in Newington, Connecticut.

CIVIL ENGINEERING

Senior Design 2024 – Civil Engineering Team 03

Team 3

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Non-UConn Advisor

None

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Town of Stamford, CT

Other Sponsor (Text)

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Hope Street Quick-hit Complete Streets Project

Description

Hope Street in Stamford, CT is a high crash section of roadway that lacks well defined travel lanes, cross walks and currently has no bike infrastructure in place. The objective of the project is to develop a multi-modal Complete Street on Hope Street between Viaduct road and Northill Street through a pavement marking plan and plan a plan for the use additional speed control measures. The plans are to include pavement markings for travel lanes, cross walks, bike lanes, on street parking, and bus stops.

CIVIL ENGINEERING

Senior Design 2024 – Civil Engineering Team 04

Team 04

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Leonardo Gamez

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Non-UConn Advisor

None

Sponsor (Text)

Jacobs Vehicle Systems

Other Sponsor (Text)

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Jacobs

Roadway Capacity Improvement Project - Route 113 (Main Street) in Stratford

Description

"The Connecticut Department of Transportation (CTDOT) has implemented a project to decrease the travel time along the Metro North Railroad (MNRR) line from New Haven to New York named, “Track Improvement Mobility Enhancement (TIME-1)”. This project will increase the Maximum Authorized Speed (MAS) of a three-mile section of MNRR from 70 mph to 90 mph in the cities of Bridgeport and Stratford. The project will include reconstruction of track to improve track geometry, reconstruction of six railroad and one vehicular bridge and replacement of overhead catenary lines and structures. Reconstruction of the seven bridges presents an opportunity to investigate improvements to the roadways at these railroad bridge crossings. The scope of this Senior Design project is to determine roadway capacity improvements at one of these bridge crossings, Route 113 (Main Street) crossing in Stratford. The proposed design shall include: • Revisions to the Main Street roadway cross-section and lane arrangements based on given traffic volumes. • Capacity improvements needed at two (2) adjacent traffic signals along Main Street. • Incorporating complete streets elements".

CIVIL ENGINEERING

Senior Design 2024 – Civil Engineering Team 05

Team 05

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Christian Maignan
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Ryan Baj
Darren Lin

Faculty Advisor(s)

Shinae Jang

Non-UConn Advisor

None

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Slam Collaborative

Other Sponsor (Text)

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SLAM

Proposed College of Engineering Building at The University of Connecticut

Description

In collaboration with SLAM Collaborative, our team at Senior Project Inc. was assigned a project at the University of Connecticut, addressing the pressing need for a modernized space to accommodate the expanding engineering programs within the newly designated College of Engineering. Our senior design project aimed to replace the aging engineering facilities within the College of Engineering. We designed a fictitious multi-story steel-framed building with composite concrete floors and metal roof deck, envisioning the new UConn College of Engineering building on the Storrs campus. We obtained geotechnical data from past construction projects and, with assistance from professors and our sponsor, identified a strategic and optimal new location for this project on campus. Architectural and grid layouts guided the placement of beams, columns, lateral systems, and footings to support the building. Close coordination with our sponsor ensured the integration of the lateral system into the design. Adherence to the current Connecticut Building Code determined required gravity and lateral loads, with Tekla Structural Designer employed to analyze the steel frame and foundations. The design incorporated composite and non-composite beams, along with a combination of lateral systems including steel moment frames and braced frames. Hand calculations verified the output from analytical software for beam, column, and foundation designs, as well as the computation of seismic and wind forces. Integration of the analytical model into Revit was pursued where feasible. Through this comprehensive approach, we delivered a cutting-edge College of Engineering building that exceeded the University of Connecticut's standards of academic excellence and innovation.

Figure One

Figure Two

CIVIL ENGINEERING

Senior Design 2024 – Civil Engineering Team 07

Team 7

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Nathan Comment

Faculty Advisor(s)

Shinae Jang

Non-UConn Advisor

George Gerard

Sponsor (Text)

WSP

Other Sponsor (Text)

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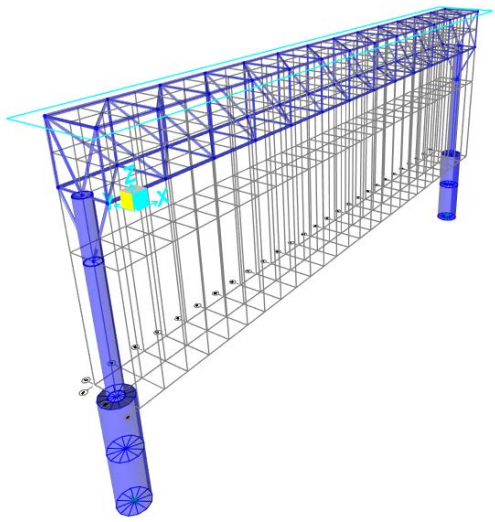
All-Electronic Tolling Gantry

Description

A RITBA tolling plaza in Jamestown, Rhode Island has been determined to require a design update after an increase in traffic accidents in recent years. The addition of the new electronic tolling gantry has caused increasing speeds of vehicles traveling through the area with no toll booths to stop at. In order to solve this issue, the project requires the design of a new electronic gantry as well as necessary roadway updates to this section of RT-138. Our project involves a preliminary design dedicated to addressing a broken back curve and cross slope in the roadway. There also will be a new All Electronic Tolling Gantry constructed spanning the highway that requires a structural and foundation design. Supplemental deliverables to the project include a maintenance and protection of traffic plan and a virtual reality model of the highway area. All of this will lead to a successful construction project that will make Jamestown, Rhode Island a safer place to drive.

Figure One

Figure Two



CIVIL ENGINEERING

Senior Design 2024 – Civil Engineering Team 08

Team 8

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Non-UConn Advisor

None

Sponsor (Text)

Manafort Brothers

Other Sponsor (Text)

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UConn Southwest Campus Infrastructure Upgrades

Description

The purpose of this project is to complete quantity takeoffs of the utility work for the UConn Southwest Campus Infrastructure Upgrades to develop the lowest bid that will allow the project to be awarded to our senior design team. The project consists of replacing the utilities in the areas of Alumni Drive, Jim Calhoun Way, Husky Circle Lot and Nathan Hale Hall. Included in this project is the Uconn Stadia project which will replace the existing facilities with new stadia for baseball, soccer, and softball. The utilities that are involved in this project include sanitary sewers, storm drainage, domestic water and fire piping. Other renovations for this project include new lighting, sidewalks and paving. After the bid is created it will then be used to create a resource loaded project schedule and work plan that describes how the project will be completed. Another part of this project is creating a submittal log and preparing the submittals required by Manafort Brothers Incorporated. The upfront submittals include a resource-loaded schedule, project materials submittals, work plan, water main flushing and disinfection plan, and key personnel.

CIVIL ENGINEERING

Senior Design 2024 – Civil Engineering Team 09

Team 09

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Benjamin Ragozzine

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Dr. Wei Zhang

Non-UConn Advisor

Mr. John Bernick and
Mr. Garrett Collins

Sponsor (Text)

HDR, Inc.

Other Sponsor (Text)

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Worcester Union Station Center Island Platform Project

Description

Worcester Union Station is a rail and bus transportation hub in Worcester, MA. The existing 370' concrete side high-level rail platform is inadequate to support increasing passenger rail ridership and has degraded due to years of salt corrosion. The project involves a preliminary design of an 800' center island platform for the station that is capable of accommodating two 9-car trains, significantly upgrading the passenger rail capacity of the station and improving overall service in the MBTA rail system. The project explores the use of Fiber-Reinforced Polymer (FRP) platform sections, as opposed to conventional concrete, in order to maximize the lifespan of the platform and accelerate construction.

CIVIL ENGINEERING

Senior Design 2024 – Civil Engineering Team 10

Team 10

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Helen Pruchniak
Nicholas Vestergaard

Faculty Advisor(s)

Wei Zhang

Non-UConn Advisor

David Jacobs, Randall States, and Jake Corbett

Sponsor (Text)

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

Other Sponsor (Text)

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

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Blue Line Extension

Description

The focus of our project is the design of a new Blue Line subway station at Government Center. The main challenge in this station's design and construction is the location. Government center is a highly congested area at the surface and below the surface.

CIVIL ENGINEERING

Senior Design 2024 – Civil Engineering Team 11

Team 11

Matthew Bagdasarian
Brandi Lyons
John McLaughlin
Antonio Rosado

Faculty Advisor(s)

Wei Zhang

Non-UConn Advisor

Alex Freeman, Angelika Zygo

Sponsor (Text)

Lochner

Other Sponsor (Text)

Lochner

Sponsor Image

LOCHNER

I-95 Interchange Improvements at Route 161 and Replacement of Bridge No. 00250

Description

The primary purpose of this project is to improve vehicular safety on I-95 at Interchange 74 and address traffic operational concerns between interchanges 74 and 75 in the Town of East Lyme, CT. This includes the full replacement of Bridge No. 00250, I-95 over Route 161 for the purpose of addressing existing capacity and condition deficiencies.

CIVIL ENGINEERING

Senior Design 2024 – Civil Engineering Team 12

Team 12

James Missell
Haseeb Qureshi
Chrystel Acosta
Julie Sierra
Diego Barajas

Faculty Advisor(s)

Wei Zhang

Non-UConn Advisor

None

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National Guard

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

TASM-G Flood Mitigation Plan, Groton, CT

Description

Our team's objective is to design a solution to alter the 1% annual floodplain in order to allow for the expansion a facility without any of its footprint falling within the 100 year floodplain plus two feet of elevation. Our focus has been directed towards the strategies that can be employed through sitework, water retention, grading, site elevation, water redirection, or any other mitigation techniques. Communications with our sponsor have helped us narrow our scope to finding where construction is feasible on the site, what work will be done to mitigate the flood levels, and the cost of this work.

CIVIL ENGINEERING

Senior Design 2024 – Civil Engineering Team 13

Team 13

Shaun McGuire
Kayla Turner
Steven Anderson
Juan Javier Mejia

Faculty Advisor(s)

Dr. Manish Roy

Non-UConn Advisor

Tyler Brett

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HNTB Corporation

Other Sponsor (Text)

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HNTB

Design of Pedestrian Walkway for the Gold Star Memorial

Description

The Gold Star Memorial Bridge, a pair of twin-span bridges carrying I-95, is the largest in Connecticut and serves as a critical transit point between Groton and New London over the Thames River. Pedestrians are currently forced to cross on the southbound span via a narrow sidewalk immediately adjacent to traffic while guarded only by a low concrete barrier. This not only presents a major safety concern but deters users from sustainable transport options such as walking or biking which are increasingly in demand. The central objective of this project is to integrate an accessible pedestrian walkway into the existing bridge's superstructure considering both current repairs due to the recent oil tanker accident and planned rehabilitation. In addition, the walkway design should account for the aesthetics and history of the existing bridge. Finally, the connection of the walkway into the community's transit system must avoid any issues with zoning or clearance that might arise due to neighboring railway tracks and a historic mill on one bank of the river.

CIVIL ENGINEERING

Senior Design 2024 – Civil Engineering Team 15

Team 15

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Daniel Ottowitz

Faculty Advisor(s)

Dr. Manish Roy

Non-UConn Advisor

Mr. Cory Knick

Sponsor (Text)

US Air National Guard

Other Sponsor (Text)

United States Air National Guard

Sponsor Image

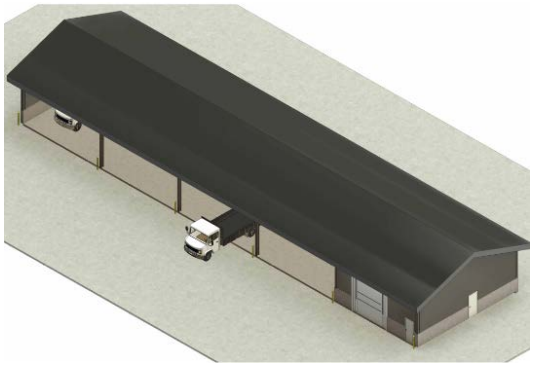
Design of Covered Storage Facility for Bradley Air National Guard Base

Description

This Senior Design project concerns the development of a 35% design for a covered storage facility for the U.S. Air National Guard base located in East Granby, Connecticut. A partially enclosed facility is required to mitigate the effects of weather and temperature fluctuations on various emergency vehicles and equipment which are currently experiencing wear due to their exposure to the elements. In particular, the Air National Guard requires a section of fully enclosed and heated storage to prevent damage to electrical components within the Mobile Emergency Operations Center vehicle. As per the U.S. Air National Guard's square footage authorization, the facility will have 4,000 square feet of storage space with another 1,000 square feet of fully enclosed heated parking. The scope of the project calls for the design and load rating of a steel frame structure as well as the development of a cost estimate and a construction schedule. The details of the 35% design are packaged in a set of design drawings laying out the chosen dimensions and sections of the facility. Three alternative steel frame designs have been developed to address the problem. One of these designs was ultimately selected based on criteria such as the impact of construction cost, expected maintenance, and the input of the project's end users.

Figure One

Figure Two



Computer Science and Engineerign Department Senior Design Teams

Senior Design 2024 – Computer Science and Engineering Team 01

Team 1

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Zachary Varnum
Ian Connolly
Geoffrey Takacs
Luke Sansonetti
Daniel Gove

Faculty Advisor(s)

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Non-UConn Advisor

None

Sponsor (Text)

Prof. Caiwen Ding

Other Sponsor (Text)

Professor Caiwen Ding

Sponsor Image

Ding AI-Based Video Analytics for Intersection Safety

Description

The major goal of this research is to investigate and develop computing algorithms to analyze camera and video data for intersections in CTDOT, using modern AI and computer vision technologies. The algorithms will focus on analyzing not only traffic operation information, including but not limited to vehicle/pedestrian/bicycle counts, vehicle turning movements and vehicle traveling speed, but also traffic safety metrics, including but not limited to vehicle-vehicle conflicts, vehicle-pedestrian/bicycle conflicts and unsafe intersection crossing behaviors made by pedestrians. To further extend the capabilities of investigating intersection operations and safety in more detail, these metrics will be generated by different intersection approaches, traveling directions and time periods. The team envisions that the more granular analysis can help CTDOT better optimize the signal phasing to maximize capacity and minimize delay, and identify driver behavior issues and improve safety for intersections.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2024 – Computer Science and Engineering Team 02

Team 2

Noah Hanka
William Silva
Noor Majid
Nemat Shaikh
Dominic Rendero

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Jake Scoggin

Non-UConn Advisor

Seth Matrocola

Sponsor (Text)

CTNG

Other Sponsor (Text)

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CTNG PHA App

Description

The Connecticut National Guard, consisting of over 5,000 soldiers and airmen, is required by the Department of Defense (DOD) to conduct annual comprehensive Periodic Health Assessments (PHA) for each of the people in service. These health assessments are conducted on a monthly basis, and consist of numerous different health stations for conducting assessments on the soldiers. These stations include: Records Sign-out and Sign-in Vision Screening Vitals Check and Ht/Wt Hearing/Audiology testing Dental examination Behavioral Health Labs, bloodwork EKG Provider Close-Out QA/QC During each monthly assessment, there are often 150 - 300 soldiers scheduled to go through all of the stations. The goal of this project is to provide an application that allows for the tracking of individual soldiers and their progress in completion of their health assessment, as well as the overall status of all the stations. (i.e. how many people are waiting in line, how long each station is taking on average from check-in to check-out, etc. The completed application provides capabilities to check in and check out soldiers into the varying medical stations, provide soldier lookup to view their progress, as well as see an overview of the status of each station. The application also comes with full functionality for data backups and integrity, visit listing upload to prepare for a new days visits, and is built upon a sophisticated and modern infrastructure designed to run on any machine or setup.

Figure One

Figure Two

Senior Design 2024 – Computer Science and Engineering Team 03

Team 3

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Ahmad Wajid
William Bartholomay
Tony Lin
Nicholas Hoyecki
Anthony Verrillo

Faculty Advisor(s)

Suining He

Non-UConn Advisor

Jeremiah Lee

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Pratt & Whitney

Other Sponsor (Text)

Sponsor Not Avaiable

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Optical Tactile Sensor for Detecting Jet Engine Fan Blade Damage

Description

An array of bearing balls is attached to the gel of an optical tactile sensor, which captures the image of the gel from the opposite side. The sensor is pressed into a surface, pushing the bearing balls into the gel. An image is taken of the gel in this state, and is then processed to find the size of the circular imprints created by the bearing balls pressing into the gel. This size is compared to an expected value given the amount of force applied, and deviations from this value are noted as damage to the blade (protrusions or dents).

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2024 – Computer Science and Engineering Team 04

Team 4

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Harrison Hua
Nicholas Pang
Ameya Arun
Joshua Charleston
Bryce Yamamoto

Faculty Advisor(s)

Mohammad Khan

Non-UConn Advisor

None

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UConn Kinesiology

Other Sponsor (Text)

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Modular Data Transfer - Bridging the Gap Between Researchers and Networking

Description

Professor Steven Harrison of the Department of Kinesiology is deeply interested in using external biofeedback systems to expand the range of human sensation. One such use-case is the improvement of human navigation around an environment using a vibrating belt. The belt can vibrate in all directions, and may provide additional input to help guide users around a space. This can be especially useful for situations where normal human sensory organs can be overwhelmed, such as navigating the chaos of a burning building. Simulating such situations can be rather meticulous, as multiple different hardware components and software services have to come together in order to transfer and process data. We aim to alleviate the complexity of building these systems by providing a simple server solution for communicating between any hardware and software using sockets. Our solution can manage the data transfer using user-created data templates, as well as save the data for further examination post-experiment. We also provide a simulation using our solution that mimics navigating a maze using the aforementioned vibrating belt.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2024 – Computer Science and Engineering Team 05

Team 5

Jake Forte
Ahmed Abdelhady
Jack Psaras
Paris Machado
Zayn Khan
Youssef Amer

Faculty Advisor(s)

Professor Bing Wang

Non-UConn Advisor

None

Sponsor (Text)

Captured Sun

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Parchment

Description

Working with Captured Sun to help produce ‘Parchment’ which is a browser specific file system to make your file system easier to navigate and use.

Senior Design 2024 – Computer Science and Engineering Team 06

Team 6

Alex Manasoiu
Jonathan Ameri
Thomas Bergendahl
Dylan Catapano
Eddie Kruah
Jackson Difloures

Faculty Advisor(s)

Swapna Gokhale

Non-UConn Advisor

None

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UConn College of Engineering

Other Sponsor (Text)

none

Sponsor Image

UConn Marketplace

Description

As students at UCONN go through the college experience, each year can look and be completely different from the rest. Whether it's where you live or classes you take, the necessary supplies for a student can rapidly change from year to year and can be quite costly for the "broke college student". Buying new supplies each semester can be expensive, feel overwhelming and unnecessary especially when many items are only used for a single year. Our idea is to create a marketplace for the UCONN community where students can buy and sell things at a cheaper rate than what they could find elsewhere. Such items could be textbooks, furniture, clothes, or even essential dorm supplies that a student moving off campus no longer needs. This is a way for the UCONN community to support each other and also diminish waste from perfectly good items being thrown away just because they're no longer needed for that particular student.

Senior Design 2024 – Computer Science and Engineering Team 07

Team 7

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Marianella Salinas
Alexandra Dolloff
Maksym Haydamakha
Dylan Yoder

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Yufeng Wu

Non-UConn Advisor

Jessica Chavez Gutierrez

Sponsor (Text)

TRUMPF

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

Trumpf Virtual Reality Training Center

Description

This virtual reality project, sponsored by TRUMPF, uses Unity to improve training for customers and service engineers through a VR pilot module. This module focuses on maintenance tasks like cleaning and changing protective glass on TRUMPF's TruLaser 2030. Prior to its development, the team conducted research on virtual reality's various applications in manufacturing. The research also included studying the history and design of TRUMPF machines and their training methods, as well as exploring VR hardware and hand tracking systems. The VR environment, accessible via Oculus headset, provides an interactive and sequential hands-on learning experience.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2024 – Computer Science and Engineering Team 12

Team 12

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Rashmi Pai
Connor Marry
Kyle Voelker

Faculty Advisor(s)

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None

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Pratt & Whitney

Other Sponsor (Text)

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Causality Interrogation Using a Physics Infused Data Analytics Approach

Description

The challenge of a purely data driven approach is partly the extreme bias of the dataset. By design, failure of a component is a rare occurrence. Added to this is a high noise-to-signal characteristic of the sensor signals that make a purely data driven approach unreliable. Also, the sensor which reports a problem can be a consequence of a long cascade of events starting from the root of the problem to where the sensor is located. Data analytics is not aware of such connection and may not be able to infer such a connection. Also, the root cause to failure detection is a many-to-one and one-to-many type of connections with each being probabilistic in nature. A great way to make analytics more reliable and to circumvent the biased dataset is to combine physics and data analytics. There are many ways to do this. This can be straightforward such as deriving a feature using physical laws for tracking the likelihood of a failure occurring (mean time to failure) or to build an elaborate model that describes the operation of a component and its associated failure modes with system parameters inferred from data. A more general method would be to use inductive logic in the context of a reasoning or belief network to find with data the most likely physical pathway leading to a detected failure, i.e., the cause and thus, the best feature for tracking, which is the focus of this project.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2024 – Computer Science and Engineering Team 13

Team 13

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Huubang Quach
Qendrim Veseli
Nityasriya Patturi

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Jake Scoggin

Non-UConn Advisor

None

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CMS

Other Sponsor (Text)

Communications Management Services

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CMS Panic Button Web Application

Description

The Soteria Shield Web Application will deliver a panic button solution for employees who need to notify coworkers and authorities of threats, violence, and emergencies quickly and easily while at work or outside the office. CMS's staff protection solution will provide peace of mind for employees. Also, it will provide accurate positioning information for first responders. Should anything happen, push the panic button and a coordinated response will be initiated. Panic and Non-emergency alarms can be raised directly from the smartphone app. Also, the physical Bluetooth Panic Button will be able to communicate with the smartphone. Should an emergency incident take place the Bluetooth panic button is the fastest way to get help.

Senior Design 2024 – Computer Science and Engineering Team 14

Team 14

Ross Relator
Shahood Khan
Samuel Cordone
Sakeena Aimandi
Ethan Funk
Peyton Lao

Faculty Advisor(s)

Bing Wang

Non-UConn Advisor

Maria C Kirejczyk

Sponsor (Text)

Pratt & Whitney

Other Sponsor (Text)

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Automated Inspection Framework

Description

The objective of this project is to develop a process for the overlaying of multi format inspection data onto as designed CAD models for purposes of creating part specific analysis (FEA) models.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2024 – Computer Science and Engineering Team 15

Team 15

John Matura
Isaiah Haynes
Megan Sidmore
Joan Tejera
Nandan Suresh Kumar
Ayyan Mumtaz

Faculty Advisor(s)

Mohammad Khan

Non-UConn Advisor

Mark Gosink and Jon Hill

Sponsor (Text)

Boehringer Ingelheim

Other Sponsor (Text)

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Boehringer Ingelheim

MeSH Mining

Description

Boehringer Ingelheim (BI), a pharmaceutical company with an emphasis on targeted disease treatment, heavily relies on specific gene research to improve treatment and prevention therapies for patients. In a continuously expanding scientific library with rapidly growing and updating gene research, the present challenge is developing a solution toward streamlining the ability to locate research on a specific gene. With a pre-existing database of important genes, the MeSH Mining challenge is aims to parse through a large database to obtain published information for any requested gene through a set of scientific literature. The library of literature is obtained through Medical Subject Headings (MeSH), a controlled ontology that annotates published PubMed and Medline articles. The goal of the MeSH Mining software is to allow end users to perform queries on a significant dataset of Gene IDs and MeSH terms. In doing so, searches will redirect end users to a shortlisted selection of Gene IDs, MeSH terms, and relevant references linked to PubMed articles based on the query criteria. The MeSH Mining software is intended for employees at BI to locate information about genes and MeSH terms by streamlining the search in an existing database which originally had no such functionality. This both optimizes gene search methodologies for end users and promotes the necessary efficiency toward finding targeted solutions for existing healthcare concerns.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2024 – Computer Science and Engineering Team 16

Team 16

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Mason Ritchotte
David LaCava
Andy Garcia
Angeline Mclean

Faculty Advisor(s)

Maifi Khan

Non-UConn Advisor

None

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Lockheed Martin

Other Sponsor (Text)

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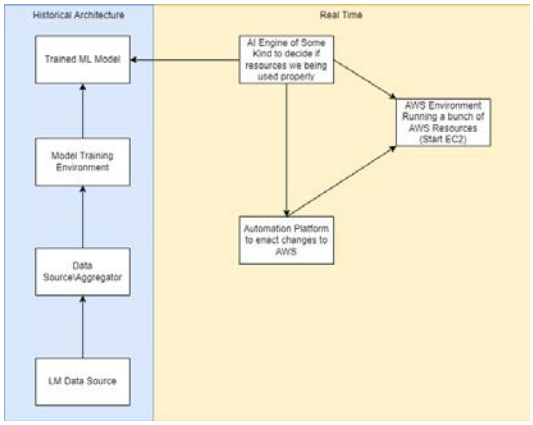
AI/ML Optimization of AWS Compute Resources

Description

As industry digitally transforms, there is an exponential increase in the demand for IT infrastructure, and coupled with that an exponential increase in the overall IT costs. In cloud computing platforms, consumers only pay for the compute resources they use and only when they use it. If a large enterprise IT operation can power off compute resources when not in use, this can save millions of dollars or more. The challenge here is developing the ability accurately predict, in a repeatable fashion, when a compute resource is not being used, turning it off and Eliminating the need to pay for it.

Figure One



Senior Design 2024 – Computer Science and Engineering Team 18

Team 18

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Abraham Taracena
Giovanni Romano
Nick Brzoska
Ashwin Sivamohan

Faculty Advisor(s)

Qian Yang

Non-UConn Advisor

None

Sponsor (Text)

NUWC

Other Sponsor (Text)

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NUWC Signal Collection Device

Description

This project entails the creation of a “black box” digital data recorder system utilizing embedded computing technology to capture data traffic and signals on the payload interface. The “black box” is intended to sample and record both serial data and discrete signal levels (both analog and digital values for a given signal) to nonvolatile memory so that this data may be sent off-site for analysis once the system has powered down. This will also include the implementation of an accompanying data analysis desktop application.

Senior Design 2024 – Computer Science and Engineering Team 19

Team 19

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Avaneesh Sathish
Zakarya Zahhal

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Qian Yang

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None

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UConn Computer Science & Engineering Department

Other Sponsor (Text)

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Light Scattering Automation

Description

Automating the light scattering lab operated by Justin Amengual and Professor Nieh

Senior Design 2024 – Computer Science and Engineering Team 20

Team 20

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Justin Fuentes
Sarah Bennett
Tyler Hinrichs
John Broadbin
Kevin Han

Faculty Advisor(s)

Yufeng Wu

Non-UConn Advisor

None

Sponsor (Text)

Logicbroker

Other Sponsor (Text)

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Logicbroker BOPIS

Description

Logicbroker BOPIS is an embeddable, fullstack solution for ecommerce sites, allowing customers to Buy Online, Pickup In-Store. Customers can complete either a geospatial search using a zipcode or address to find local vendors and product availabilities there. Companies that are online-only or have a wide variety of vendors can use our tool to connect their customers with their products across the country. We use a modern stack comprised of Mapbox, Next.js, and MongoDB to provide a seamless user experience.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2024 – Computer Science and Engineering Team 21

Team 21

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James Frederick
Betul Agirman
Cameron Ky
Quincy Miller
Mir Zaman

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Suining He

Non-UConn Advisor

Amin Moradi

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University of Connecticut

Other Sponsor (Text)

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bastion

Responsive Multimodal Care Coordinator (MCC) Development

Description

Bastion Health is the US's first specialty digital clinic for male health, offering a comprehensive end-to-end healthcare experience. From at-home diagnostics and virtual consultations to personalized treatments and care navigation, they provide a seamless and integrated healthcare solution designed specifically for men. They are becoming the go-to platform for men's health, making quality care more accessible and convenient. In pursuit of optimizing their digital healthcare solution, we intend to develop a responsive Multimodal Care Coordinator (MCC) that onboards patients to our platform. MMC will initiate essential conversations with our clients by asking critical questions and providing a list of answer options to choose from. Generally, the onboarding process comprises 15-20 questions. It goes above and beyond to include the provision of article cards, a doctor promotion card, and tip cards. MMC should demonstrate complete independence and facilitate accurate transmission of data to the client side in a format they can engage with without resistance. Moreover, MMC will facilitate an interactive presentation of communications from care coordinators and doctors in the chatfeed, such as visit summaries, prescription notifications, upcoming appointments, and other important messages. Ideally, if a patient inquires about their last visit summary, MMC should comprehend the request, create an appropriate payload, and communicate it to the back-end API to retrieve the relevant data.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2024 – Computer Science and Engineering Team 22

Team 22

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Jianhua Zhu
Walson Li
Peter Filip

Faculty Advisor(s)

Qian Yang

Non-UConn Advisor

None

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Boehringer Ingelheim

Other Sponsor (Text)

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Boehringer Ingelheim

Solubility Data Management

Description

Solubility data management is an internal tool designed for scientists at Boehringer Ingelheim to assist them in accessing quick and reliable solubility data. Solubility plays a crucial role in drug development, influencing factors such as drug release in the gastrointestinal tract and the design of isolation processes for drug molecules. Our system aims to provide scientists with an efficient platform to access, organize, and analyze solubility data, accelerating the drug development process. Our system is composed of three main components: the frontend, backend, and relational database, it is engineered for seamless data flow and user-friendly interaction. The frontend component, built with Angular, offers a user-friendly interface for users to easily upload Excel files, retrieve and visualize data points from the database with their desired units, and finally, export the retrieved data points back to Excel for further analysis. The backend component, powered by Flask, ensures secure data storage and efficient data processing for quick access to information. Flask serves as a backbone in our system, orchestrating communication between the frontend and the database. The PostgreSQL database acts as the centralized repository for all solubility and user data. Moreover, our team has built a robust server to accommodate diverse global traffic. By integrating these components, our system provides a robust platform for scientists to effortlessly input, query, and visualize solubility data while also gaining access to insights derived from their peers' contributions. By centralizing solubility data management, our tool aims to transcend the limitations of manual data handling, offering a unified repository where scientists can collaborate, glean insights, and drive innovation forward in the field of pharmaceutical science.

Figure One

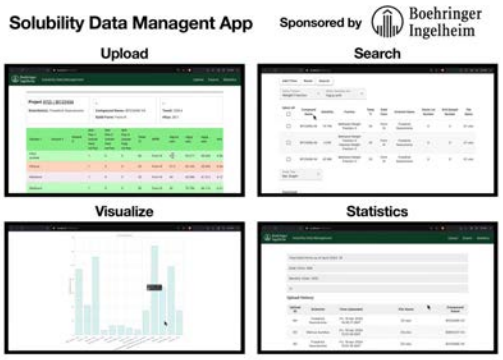
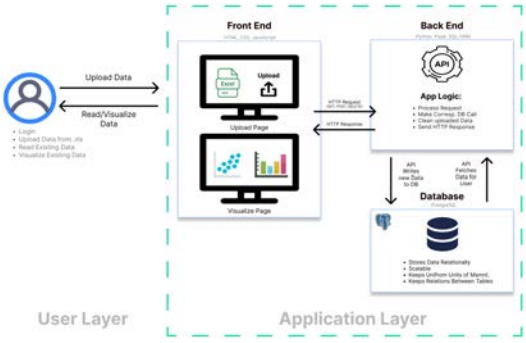


Figure Two



COMPUTER SCIENCE AND ENGINEERING

Senior Design 2024 – Computer Science and Engineering Team 23

Team 23

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Nicholas Donegan
Shabit Bhatt
Jonathan Christie
Daniel Baker
David Hart

Faculty Advisor(s)

Swapna Gokhale

Non-UConn Advisor

None

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ABB

Other Sponsor (Text)

Spring Valley Student Farm

Sponsor Image

Precision Agriculture at the Spring Valley Student Farm

Description

Agricultural systems are incredibly complex and important systems, responsible for providing the world with food. The output of agricultural systems are made up of a large number of variables which contribute to the final yield of the system. These variables such as air temperature, rainfall, air pressure, and wind speed all have significant influences on soil temperature which is vital for understanding when to harvest produce and when to plant produce. We aim to use machine learning and statistical models to predict and forecast soil temperature based on weather data.

Senior Design 2024 – Computer Science and Engineering Team 24

Team 24

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William Brodhead
Emily Kaitlyn
Mahad Khan
Nithila Annadurai

Faculty Advisor(s)

Bing Wang

Non-UConn Advisor

Consumer Financial Protection Bureau (CFPB)

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UConn School of Engineering

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Credit Card Comparison Tool

Description

We sought out to build a platform that will allow people to fill in their information and get matched with their "optimal" credit card.

Senior Design 2024 – Computer Science and Engineering Team 25

Team 25

Tyler Lindberg
Akhil Saini
Peter Alonzo
Krishna Chilakapati
Matthew Frias
Zachary Kollar

Faculty Advisor(s)

Yufeng Wu

Non-UConn Advisor

Matthew Ferrier

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Sonalysts, Inc.

Other Sponsor (Text)

Sonalysts, Inc.

Sponsor Image

Kubernetes Cloud Orchestration Simulation

Description

Our senior design project is a locally-executed simulation of a Kubernetes' application scheduler that was created with our chosen simulation tool: KWOK. This project, sponsored by Sonalysts, Inc., was required to demonstrate several aspects of the scheduling process, including pod priority, pod failures, and the ability to show computing resource consumption. Before picking our final cloud technology, we conducted hands-on research on a number of other platforms like K3D/K3S, Alibaba, and Rancher. To rule out other options, we also considered evaluation criteria such as licensing/pricing, deployment time, and access to documentation. We completed this project by setting up a local instance of KWOK in a virtual machine so we could run commands, create nodes and pods, and showcase the behavior of the application scheduler. Through this, we found a variety of commands and pod test sets that allowed us to show various behaviors regarding how Kubernetes handles conflicting priorities and resource needs. We also streamlined the programming process by developing a Python script to simplify commands and test sets for easy use. Alongside our software deliverable, we also created a poster board, video, and documentation to compile all of our findings and research for this design project.

Senior Design 2024 – Computer Science and Engineering Team 26

Team 26

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Alexey Pozdnyakov
Gordon Yang
Paul Hernandez
Justin Lin
Shaheer Siddique

Faculty Advisor(s)

Caiwen Ding

Non-UConn Advisor

None

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UConn Computer Science & Engineering Department

Other Sponsor (Text)

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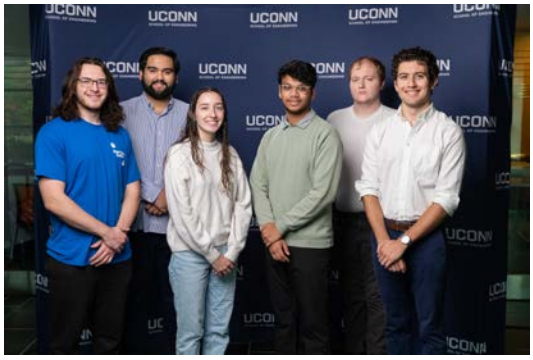
PartsFinder

Description

PartsFinder is a mobile application developed to make the finding of purchasable car parts easier. The app utilizes a machine learning model to predict uploaded images of car parts to make identification simpler for the user. We have designed a search that will remove redundancies and prioritize lower prices to make sure the user is getting the best deal possible. The frontend is built with React Native, a javascript framework designed for mobile application development. The backend is built with Python utilizing the Flask library and is being hosted on an Amazon Web Service (AWS) hosted service called Amazon Elastic Compute Cloud (EC2).

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2024 – Computer Science and Engineering Team 27



Team 27

Nicholas Joshua Scaglione
Momin Nadeem
Melanie Jeannette Mouser
Hari Krishna Patchigolla
Charles William Gordon
Thomas Pennie

Faculty Advisor(s)

Caiwen Ding

Non-UConn Advisor

None

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The Hartford

Other Sponsor (Text)

The Hartford

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Applying Fully Homomorphic Encryption To Insurance

Description

Data security is a major concern for companies like The Hartford that are entrusted with sensitive client data. Traditionally, to run analytics on encrypted client data, it would first have to be decrypted, thus increasing the risk of exposing client information. This project utilizes an encryption methodology named Fully Homomorphic Encryption (FHE) to address this issue. FHE computations can be performed on ciphertext, without the need to decrypt values. We implemented a full stack application with a React.js frontend and a Flask backend that uses the OpenFHE C++ library to estimate a customer's monthly car insurance price using personal client data. Through this, we are able to guarantee that only the client has access to their own data!

Senior Design 2024 – Computer Science and Engineering Team 29

Team 29

Maxwell Schleicher
Jace Scaramella
Andrew Curry
Antonio James Butler
Xiayang Wang
Crina Gutu

Faculty Advisor(s)

Dongjin Song

Non-UConn Advisor

Paul Adamski

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Pratt & Whitney

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PW Secure Embedded Architecture with Cyber Monitoring and Optional Bug Bounty

Description

Embedded systems are now exposed to evolving cyber security concerns that threaten even the simplest of attack surfaces. These systems must employ various secure boot and anti-tamper methodologies to protect against malicious code modification and loss of intellectual property/technology. Safety critical systems are typically deployed as field loadable via robust proprietary methodologies which implement fundamental artifact integrity checks. Ensuring authenticity and integrity in environments where cyber security risks exist is mandatory. Also, confidentiality of all artifacts should be maintained. For this project, consider an embedded system that has a hardware backed secure boot with both digital signatures and confidentiality, an ethernet connection with a simple memory peek/poke protocol implemented, and with an FPGA firmware-controlled lock box. 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, 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 direct the FPGA firmware to open the lock box to reward the attacker. Students evaluated 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 was extended.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2024 – Computer Science and Engineering Team 30

Team 30

Gary Zhu
Jack Crocamo
Ryka ChandraRaj
Alicia Chiu
Ryan Mercier
Donny Sauer III

Faculty Advisor(s)

Bing Wang

Non-UConn Advisor

None

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Pratt & Whitney

Other Sponsor (Text)

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Data Collection and Analysis for an Autonomous Electric Vehicle System

Description

An autonomous land rover is a sophisticated vehicle that exhibits complex behavior given various environmental conditions that may occur along a given path. The objective of this project is to develop and execute a data analysis framework capable of precisely predicting the self-driving vehicle's reactions to input directives. This framework aims to diminish fluctuations in responses within both Software-in- the-Loop (SITL) simulations and Hardware-in-the-Loop scenarios. The foundation of this initiative rests upon a data-driven control system tailored for electric vehicles, harnessing the power of machine learning algorithms. These algorithms are designed to acquire insights into the vehicle's behavior through data assimilation and subsequently fine-tune control parameters accordingly.

Senior Design 2024 – Computer Science and Engineering Team 31

Team 31

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Colin Zhang
Nicolas Rossiter
Kenneth Wu
Shreya Seshadri
Johnathan Shui(Not pictured)

Faculty Advisor(s)

Seung-Hyun Hong

Non-UConn Advisor

Michael Denton

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Pratt & Whitney

Other Sponsor (Text)

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LLMs for Pratt and Whitney Engine Health Monitoring

Description

UConn Team to investigate the performance of open-source, local, large language models (LLMs) on Pratt and Whitney's analytics and engine health monitoring platform. Ideally with ability to do the following: 1) Q/A over documents (such as pdf, csv, etc.) 2) Q/A over SQL databases 3) Performing data science and machine learning tasks

Senior Design 2024 – Computer Science and Engineering Team 32

Team 32

Arvind Kasiliya
James Henriquez
Michael Ray Sawan
Jason Ky
Bryan Lecza
Jackie Zhang

Faculty Advisor(s)

Jacob Scoggin

Non-UConn Advisor

Jonathan Clark

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Cigna

Other Sponsor (Text)

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Cigna Telehealth Sentiment Analysis Webapp

Description

A cutting-edge telehealth solution designed to bring a new dimension of care to virtual healthcare services. As a team of dedicated students, we are creating a web-based application that integrates real-time sentiment analysis into telehealth consultations. The core functionality of our webapp lies in its ability to analyze and interpret the emotional tone from patient-provider interactions during a telehealth session. This analysis provides valuable insights to healthcare providers, enabling them to respond more effectively to the patient's emotional and psychological needs.

Senior Design 2024 – Computer Science and Engineering Team 34

Team 34

Selena Bishara
Wassay Qureshi
Vishnu Ramesh
Brett Melchionno
Adam Akbarzai
Alex Abriola

Faculty Advisor(s)

Dongjin Song

Non-UConn Advisor

Haoyu Wang

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NEC Labs America

Other Sponsor (Text)

NEC Labs America

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Interactive Disaster Simulation

Description

Our work seeks to model and understand the dynamics of natural disasters. Users can witness the impacts of attributes such as wind speed or mortality rate on the overall trajectories and severities of disasters from tornadoes to virus outbreaks. This allows for not only future disaster emulation but also for insights into previous disasters. Our current work is focused on simulating these occurrences in New York City, however, the trends found can be used to understand broad disaster behavior. The value of this project lies in its ability to deepen our understanding of disasters and their consequences in an intuitive and interesting format. To understand the behaviors of virus spreading, many people generally understand how a disease spreads to people close to you, but not how fast a disease can spread to 100 people from 3 infected people within a set radius. Much logic in our current tornado and virus simulations can be expanded to other disastrous events such as typhoons or flooding for potential future work.

COMPUTER SCIENCE AND ENGINEERING

Senior Design 2024 – Computer Science and Engineering Team 36

Team 36

Emilio Montejo
Sashank Venugopal
Conner Byrne
Hemil Patel
Edward Querzoli
Alex Nguyen

Faculty Advisor(s)

Yufeng Wu

Non-UConn Advisor

None

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University of Connecticut

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Application of Program Analysis in C/C++ Programming Courses

Description

Applying program analysis to student code in order to provide students with meaningful feedback and clear instruction on how to better their program.

Senior Design 2024 – Computer Science and Engineering Team 38

Team 38

Ishan Tyagi
Long Do
Chenghe Feng
Aayush Gupta
Sunwang Luo
Ron Zatkovsky

Faculty Advisor(s)

Seung-Hyun Hong

Non-UConn Advisor

None

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UConn School of Engineering

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Algorithmic Trading Strategy Simulator

Description

Develop an algorithmic trading simulator that allows users to trade and learn through trading strategies using historical market data packaged onto a website. This project showcases our team's quantitative and technical skills, as well as our ability to apply advanced concepts in finance and programming. Sections of our project: Market Data Integration, Strategy Design and Backtesting, Statistical Analysis and Optimization, Real-time Simulation and Paper Trading, Risk Management and Portfolio Allocation, & Data Visualization and Reporting.

Senior Design 2024 – Computer Science and Engineering Team 39

Team 39

Nyamdemberel Munkhbat
Abdulmalik Suleiman
Nidhish Yarlagadda
Fernanda Hanashiro
Dacheng Shen
Haoyu Zhang

Faculty Advisor(s)

Caiwen Ding

Non-UConn Advisor

None

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OEM Controls

Other Sponsor (Text)

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OEM Controls Automated Angle Sensor Testing

Description

OEM Controls is a design and manufacturing company based in CT focused on customizing rugged joysticks and electronics for mobile equipment. They have developed the AS5, an Angle Sensor whose purpose is to provide accurate angle degrees and give feedback on the positions of a machine and its components. As it was recently manufactured, it must undergo testing on each angle degree in order to evaluate its accuracy – our team is assisting in the automation to facilitate this process. Our project's purpose is to fully automate this process using a robotic arm for an efficient and accurate product delivery.

Senior Design 2024 – Computer Science and Engineering Team 40

Team 40

Damian Miskow
Gautam Pirthiani
Amogh Garudadwajan
Liyang Wan
Yingzheng Li
Ziheng Huang

Faculty Advisor(s)

Mohammad Maifi Hasan Khan

Non-UConn Advisor

None

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Synchrony Financial

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Synchrony Interview Process

Description

The “Synchrony Interview Process” is a project conducted by University of Connecticut's Senior Design Project Group 40 from Fall 2023 semester to Spring 2024 Semester. The project is dedicated to develop an automated and streamlined application for Synchrony Financial, aimed at replacing the company's existing Excel-based interview processes to enhance the efficiency and quality of interviews. The team proposed to develop a web-based application that incorporates advanced features including: a user-friendly interface, dynamic form creation, comprehensive candidate information management, scoring and evaluation capabilities, real-time collaboration via email notifications, and robust data analytics/reporting functionalities. The development approach of the project adheres to agile development methodology, prioritizing collaboration with end-users and emphasizing on the adaptability to changing requirements, iterative delivery of valuable solutions, and attention to team dynamics. The frontend of the web-based application is developed using React.js, as an open source library in JavaScript. The backend is implemented on Amazon Web Service by utilizing features including API, lambda, DynamoDB, Amazon Simple Email Service, ensuring adherence to engineering standards within the project timeline.

Electrical and Computer Engineering Department Senior Design Teams

Senior Design 2024 – Electrical and Computer Engineering Team 01

Team 01

Ahmad Bari
Nicholas Pappas
Maxime Pindrys

Faculty Advisor(s)

Ali Gokirmak

Non-UConn Advisor

None

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UConn Electrical & Computer Engineering Department

Other Sponsor (Text)

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Optical thin film characterization system

Description

The objective of this project is to design and build an automated optical characterization setup that integrates broad spectrum light sources with an optical spectrum analyzer to calculate the film thickness, absorption coefficient and optical bandgap of thin films. The designed system is to be entirely automated and contain a temperature control mount that allows for measurements at various angles and temperatures. This device should be able to handle glass sides up to 2cm x 5cm and wafers up to 125mm in diameter.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2024 – Electrical and Computer Engineering Team 02

Team 2

Matthew Silverman
Nicholas Wycoff
Spencer Albano

Faculty Advisor(s)

Shengli Zhou

Non-UConn Advisor

None

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UConn Electrical & Computer Engineering Department

Other Sponsor (Text)

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AFRL SDR University Challenge: Physical Layer Network Slicing

Description

Throughout the course of our senior design project we have participated in a Software Defined Radio (SDR) university challenge hosted by the Wright Brothers Institute (WBI) and partnered with the Air Force Research Laboratory (AFRL). A total of 17 universities have participated with the key goals of the competition being to encourage hands-on skill building and explore experimentation through SDR hardware. Team UConn was one of the top 8 finalists to demonstrate and compete in person at WBI in Dayton, Ohio and received the award of most outstanding project. Judges of the competition were members of the AFRL, National Instruments, and other industries including Northrop Grumman and Collins Aerospace. For our project we plan on implementing network slicing with SDRs in context of local area networks. Our vision is to create an access point that can establish a network and communicate across both Wi-Fi (802.11) and Zigbee (802.15.4) devices. The LAN can be partitioned on both networking standards to separate communications between devices. An example of this would be a business that limits sensitive information and communications between departments. Network slicing typically occurs in layer 3 or higher of the OSI model but in our application, we incorporate network slicing on the physical layer (layer 1). Physical layer network slicing will be accomplished by using custom preambles that will be appended to the beginning of the Wi-Fi and Zigbee packets. The characteristics we strive for are high autocorrelation for detectability, and low cross-correlation so that each preamble is uniquely different from one another. There are some routers that can communicate over both Wi-Fi and Zigbee but are typically two separate devices bundled in the same enclosure. Having one device that communicates across both standards provides ease to a network administrator that can manage devices in both standards. Benefits include efficiency, flexibility, and security.

Figure One

Senior Design 2024 – Electrical and Computer Engineering Team 16

Team 16

Andre Jin
Kristen Schadtle Morse

Faculty Advisor(s)

Liang Zhang

Non-UConn Advisor

None

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Pfizer

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Energy Consumption And Efficiency Initiatives For Building 257

Description

The objective of this project is to assess energy consumption of Building 257 (laboratory and office space) to understand electricity, steam and chilled water use and identify opportunities for improvement that translate into energy reduction. Pfizer desires to receive a comprehensive report that identifies energy consumption and opportunities for energy efficiency initiatives within Building 257 that allow Pfizer to reduce the consumption of steam, chilled water and electricity while maintaining a safe and effective workplace that complies with regulatory requirements.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2024 – Electrical and Computer Engineering Team 24

Team 24

Rajvir Singh
Juan Stevens
Daniel Heiden

Faculty Advisor(s)

Abhishek Dutta

Non-UConn Advisor

None

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American Society of Naval Engineers

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Electric Powered Boat

Description

Promoting Electric Propulsion (PEP) is an annual run electric boating competition from April 15-16, 2024. This is the fourth year of the competition sponsored by the American Society of Naval Engineers and the Office of Naval Research. Our senior design team in combination with the newly formed Uconn PEP club will be participating in the event under the Unmanned category. The race consists of five one-mile laps in Broad Bay, located in Virginia Beach with the top three placing teams earning a cash prize. In order to complete this task we must design the boat from scratch while abiding by the PEP rules and regulations. Completing this task will involve researching and understanding the rules and guidelines for boat construction and competition, conducting necessary tests to evaluate each component, and fabricating of the boat based on our design choices.

Senior Design 2024 – Electrical and Computer Engineering Team 04

Team 2404

Omar Partida
Kevin Medeiros

Faculty Advisor(s)

Necmi Biyikli

Non-UConn Advisor

None

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Center for Clean Energy Engineering (C2E2)

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ECE 4901: PROJECT 2402 – HYBRID FUEL CELL POWERED AIRCRAFT

Description

In this project we aim to help the environment, specifically by trying to reduce pollution caused by aviation. We aim to integrate a hydrogen fuel cell into a battery powered aircraft, making a hybrid system to power the aircraft. this will allow us to reduce emission while increasing efficiency of the aircraft and will we be of great help iin fighting climate change and helping our environment.

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2024 – Electrical and Computer Engineering Team 09

Team 2409

Jan Ramirez
Devon Rojas
Ilya Klimoshenko
Syed Ahmad

Faculty Advisor(s)

Abhishek Dutta

Non-UConn Advisor

None

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Lockheed Martin

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Radar Altitude Hold for Helicopter Flight Controls

Description

We are adding a mode to an existing controller for a quadcopter. The mode we are adding is RadAlt hold, utilizing two radar altimeters in conjunction with the existing sensors aboard the quadcopter. This mode will allow for accurate height control for the quadcopter depending on what the user input is.

Senior Design 2024 – Electrical and Computer Engineering Team 14

Team 2414

Andrew Feliciano
Colby Powers

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Ashwin Dani

Non-UConn Advisor

Dr. Robert LaFreniere

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United States Navy

Other Sponsor (Text)

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Deblurring of Digital Images

Description

Blur reduction or removal has become a common feature on digital imagers, including popular cellular telephones. This senior design project aims to evaluate blur reduction or removal algorithms that could be implemented on imaging systems found on United States Coast Guard ships, naval vessels, and Unmanned Aerial Vehicles (UAVs). It is also required to know what the maximum rotational speed at which the algorithm chosen will successfully produce deblurred images.

Senior Design 2024 – Electrical and Computer Engineering Team 15

Team 2415

Hritish Bhargava
Samuel Gresh

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Shan Zuo

Non-UConn Advisor

Brian Sheehan

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Draper Laboratory

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Robotic Perception Sensor Characterization Platform

Description

Drone

ELECTRICAL AND COMPUTER ENGINEERING

Senior Design 2024 – Electrical and Computer Engineering Team 20

Team 2420

Alexander ReCouper
Mitchell Bronson

Faculty Advisor(s)

Liang Zhang

Non-UConn Advisor

None

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OEM Controls

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OEM Controls

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Automated Angle Table for AS5

Description

The AS5 Angle Sensor is product at OEM Controls that must be calibrated and tested for quality assurance. This is done by taking measurements at multiple angles and comparing them to a testbench. At the moment, this process is done manually, using an angle table and a mounting apparatus. This process requires an engineer to take 32 measurements on 6 different planes. We aim to use a collaborative robot arm, or a cobot, to automate the testing process, thus freeing up an engineer from a tedious task as well as improving the efficiency of the process. We need to choose a model of robot arm to work with, as well as create a Python program that handles both communications between the robot and the board, as well as the interface in which an engineer can use to calibrate and run the quality assurance process.

Environmental Engineering Program Senior Design Teams

Senior Design 2024 – Environmental Engineering Team 01

Team 1

Kristopher Dow
Ellie Fiorentino
Tessa Cannon
Baasim Zafar

Faculty Advisor(s)

Alexander Agrios

Non-UConn Advisor

Elizabeth Doerfler, Sarah Simoni and Maruisz Jedrychowski

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Wright-Pierce

Other Sponsor (Text)

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PFAS Treatment for Bethel Drinking Water

Description

The Bethel Water Department (BWD) in Connecticut currently operates one groundwater source and two surface water sources to supply drinking water to their community. They are currently installing a new wellfield as an additional groundwater source, and to phase out the surface water sources. PFAS have been detected in both groundwater sources although PFAS concentrations at one of the groundwater sources exceeds proposed regulatory limits. The BWD is seeking to understand alternative treatment options and develop a conceptual design to remove PFAS from their drinking water.

Senior Design 2024 – Environmental Engineering Team 02

Team 2

Joshua Stone
Emily Cowan
Zoe Alber
Marie Hennawi

Faculty Advisor(s)

Alexander Agrios

Non-UConn Advisor

None

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ABB

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Haley Ward

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HALEY WARD
AN EMPLOYEE-OWNED COMPANY

Public Water System Replacement Study

Description

The Town of East Lyme has a current public water system that serves most of the developed areas in town. The town uses wells and an interconnection with New London as its sources. The scope of this project revolves around designing a new water treatment plant for the town that would address possible contaminants in the water such as iron, manganese, and PFAS. The scope of the work also includes designing a water storage system to meet both peak demands and fire protection that comply with town regulations. Another important factor is laying out the distribution system, sizing pipes, and evaluating hydraulics.

ENVIRONMENTAL ENGINEERING

Senior Design 2024 – Environmental Engineering Team 03

Team 3

Rory Cavicke
Kelsey DiCesare
Alexander Brita

Faculty Advisor(s)

Alexander Agrios

Non-UConn Advisor

None

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CHA Consulting, Inc.

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Stormwater/Septic Design

Description

Working with CHA Consulting, our team will be designing the septic system and stormwater infrastructure for a tractor trailer rest stop in Madison, CT. The CT Department of Transportation has requested more rest stops to be developed along I-95. Our site is an existing commuter Park and Ride lot, which will be expanded to twice its size to accommodate 25 tractor trailers and include restroom facilities. Our designs were developed in accordance with the CT Public Health Code 2023 Technical Standards and the CT Stormwater Quality Manual.

ENVIRONMENTAL ENGINEERING

Senior Design 2024 – Environmental Engineering Team 04

Team 4

Julia Olchowski
Jasmine Rawls

Faculty Advisor(s)

Alexander Agrios

Non-UConn Advisor

None

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Hamilton College

Other Sponsor (Text)

Hamilton College

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Design of Water Quality Sensors for Wetland Treatment System

Description

The objective of this project is to design and fabricate a system to monitor various water quality parameters within a land-based wetland treatment system (LBWTS) capable of removing nitrogen pollution from small to medium-sized bodies of water. Nitrogen pollution, also known as eutrophication, causes the rapid growth of algae in these bodies of water. These algal blooms strip resources from other lifeforms in the water, destroying the natural ecosystem. By developing sensors to monitor the nitrate (NO_3^-), ammonium (NH_4^+), pH, and temperature levels in the water, the effectiveness of the LBWTS can be tracked.

ENVIRONMENTAL ENGINEERING

Senior Design 2024 – Environmental Engineering Team 05

Team 5

Samuel Rothfarb
Nathan Davis
Malachi Denton

Faculty Advisor(s)

Alexander Agrios

Non-UConn Advisor

None

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Michael Curtis

Other Sponsor (Text)

Michael Curtis

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Campus Anaerobic Digester

Description

Anaerobic digestion is a biological process that breaks down organic materials in the absence of oxygen and produces a renewable energy source in the form of a methane-based biogas. Our team developed two optimal designs for an anaerobic digestion (AD) system at the University of Connecticut's Storrs Campus, which breaks down university-created waste into a renewable biogas and nutrient-rich fertilizer. This project focused on implementing an on-campus AD system that could divert organic waste streams from traditional disposal methods into valuable resources. A goal that directly aligns with UConn's approach to sustainability through reducing greenhouse gas emissions, providing a source of renewable energy, and offering a sustainable fertilizer alternative. The AD facility also presents a unique research platform for faculty and students across various disciples, fostering interdisciplinary collaboration and hands-on learning opportunities. In total, our recommended design will process 3,500 gallons per day of combined feedstock in the form of manure and food waste, producing an estimated maximum of 265,000 kWh per year from the system's combined heat and power generator. A power output that is equivalent to the average annual electricity use of 15-20 four family homes!

ENVIRONMENTAL ENGINEERING

Senior Design 2024 – Environmental Engineering Team 6

Team 6

Valentine Falsetta
Wilmalis Rodriguez
Nicola Bacon

Faculty Advisor(s)

Dr. Alexander Agrios

Non-UConn Advisor

None

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Dr. Amine Dahmani

Other Sponsor (Text)

No Sponsor

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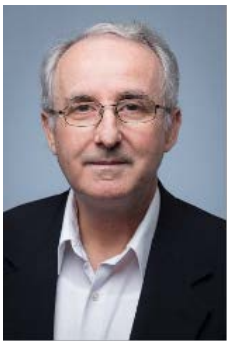

Remedial Design of a PFAS Contaminated Site in Connecticut

Description

Our project scope included designing the remediation of a Connecticut-based site contaminated with per- and polyfluoroalkyl substances (PFAS). The target site was contaminated due to the historical application of Aqueous Film Forming Foam (AFFF) used during firefighter training activities. Approximately 40 gallons of AFFF concentrate were mixed with 1,300 gallons of water and applied over the eastern and southern fields of the site in 2014. Since 2014, PFAS-contaminated soil has remained untreated on the site. Left unchecked, contaminated soil and groundwater will continue to impact the nearby brook and potentially contaminate neighboring drinking water wells. Remedial alternatives including excavation, soil capping, and in-situ soil stabilization (ISS) were considered, and the most feasible alternative for the final design was recommended.

ENVIRONMENTAL ENGINEERING

Senior Design 2024 – Environmental Engineering Team 07

Team 7

Grace Carravone
Amanda Jacobson
Sara Makula
Jason Contreras

Faculty Advisor(s)

Manish Roy

Non-UConn Advisor

Gregory Gallagher

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CTNG

Other Sponsor (Text)

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Stones Ranch Road Drainage Upgrades and Erosion Control

Description

The Stones Ranch Military Reservation, situated in East Lyme, CT, serves as the primary tactical training facility for the Connecticut National Guard. This facility heavily relies on a gravel road network to access critical infrastructure and support tactical training activities. In recent years, a specific high-traffic intersection has faced severe challenges including flooding, erosion, and washout. These issues are attributed to the terrain's contour, the substantial use of large vehicles, and heavy rainfall. Senior Design Team ENVE07 provided engineering services associated with the gravel roadway design, drainage analysis and design, and erosion control design. In addition, they provided construction documentation to facilitate CTARNG units in executing troop labor projects.

Management Engineering and Manufacturing Program Senior Design Teams

Senior Design 2024 – Management and Engineering for Manufacturing Team 01

Team 01

Alex Domingo
Madeline Corbett
Brett Pierce
Alexander Pearl

Faculty Advisor(s)

Rajiv Naik

Non-UConn Advisor

Tranquillo Aloi

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Belimo Americas

Other Sponsor (Text)

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Reliability Testing and Design Risk Assessment to Enhance Product Quality and Business Sustainability

Description

Reliability Testing and Design Risk Assessment to Enhance Product Quality and Business Sustainability outlines Belimo's need to improve the reliability testing schedule in order to properly test over 1000 different control valves for HVAC systems. Current testing focuses on the most popular products, rather than the models with the most failures. This project's objective is to enhance the testing schedule by analyzing failure data and identifying and categorizing design failures, in order to properly test the valves with the most faults. With the increased testing, thorough design analysis and recommendations for improvements can be made. The deliverable will include an updated testing schedule and a design risk analysis. With this enhancement, Belimo can minimize product recalls and improve resource allocation, ultimately reducing costs. Creating reliability and dependability for consumers is Belimo's priority, and ensuring proper reliability testing will continue to maintain this standard.

Senior Design 2024 – Management and Engineering for Manufacturing Team 03

Team 3

Justin Mattiello
Marcella Ripper
Jared Osinski

Faculty Advisor(s)

Rajiv Naik, Craig Calvert

Non-UConn Advisor

Jason Kumnick

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Central Wire Industries

Other Sponsor (Text)

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Development of Sensor to Detect Wire Breakage in Tubular Strander and Reduce Time and Resource Waste

Description

Loos & Co., a wire and cable manufacturer, faces frequent wire breakage in their manufacturing process, resulting in substantial losses of time, money, and resources. Wire breaks occur 20-30 times daily, often undetected until significant damage is done. To address this, a wireless sensor system is proposed to detect breakage immediately in the tubular strander, stopping the machine and allowing quick resolution. The proposed sensor mechanism involves resting a bar on the wire, which falls and triggers a proximity sensor upon breakage, ensuring rapid detection and communicating with the programmable logic controller (PLC) which will stop the machine. The project scope encompasses developing a prototype wireless communication system with a sensor for use in the strander bay.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

Senior Design 2024 – Management and Engineering for Manufacturing Team 04

Team 4

Mathes Payne
Ian Lyon
Samuel Quevedo
Catherine Wasiyo
(not pictured)

Faculty Advisor(s)

Craig Calvert & Rajiv Naik

Non-UConn Advisor

None

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GKN Aerospace

Other Sponsor (Text)

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GKN AEROSPACE

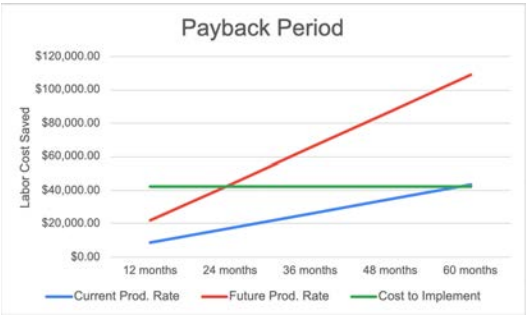
Implementation of a Collaborative Robot (Cobot) to Optimize Adhesive Bonding Process by Increasing Throughput, Decreasing Cycle Time and Waste

Description

GKN Aerospace's adhesive bonding process falls well short of projected growth numbers for the future. With an average production of 12 fan fairings per day, GKN looks to increase throughput by 2-4x and decrease waste. The current process is statistically out of control leading to parts sitting in quality checks for extended periods of time. Analysis of time study results revealed a massive bottleneck at the adhesive application step. The time was disproportional to the rest of the process; the highest cycle times among all the steps were related to physical application of adhesive. With all these factors in mind, implementation of a Cobot work cell would solve the major problems GKN is faced with. The Cobot is equipped with a Bipack Fancort dispensing solution that includes a 16 element static mixer to combine the adhesive parts. This process is statistically in control, reducing the need for quality control. Once fully implemented, GKN will see a project cycle time reduction of 57% as well as a throughput increase of 130%. The payback period is calculated based on reduction in labor-hours per year at the new production rate. With the increased process capability the payback period is calculated to be 25 months, whereas the current process would take 58 months. Additionally, quality control calculations for adhesive squeeze-through were performed; each run is statistically in control, a massive need for GKN. With a process that is repeatable and in control, GKN will greatly reduce material and labor spent on QC.

Figure One

Figure Two



MANAGEMENT AND ENGINEERING FOR MANUFACTURING

Senior Design 2024 – Management and Engineering for Manufacturing Team 05

Team 05

Nimai Browning
Quinn Reelitz
Steven Jaret
Austin Muzzy

Faculty Advisor(s)

Craig Calvert, Rajiv Naik

Non-UConn Advisor

Tim Sasur

Sponsor (Text)

HORST Engineering

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

HORST ENGINEERING

Modernizing Raw Material Marking and Inventory System to Enhance Traceability

Description

Horst Engineering commissioned this team to modernize their raw material marking and inventory processes. Enhancing this system will bring it into line with the Industry 4.0 standards employed in Horst's new factory in East Hartford. This project tested multiple marking methods and determined that durable barcode labels are optimal for their operation. These labels are computer printed and will link to their Enterprise Resource Planning (ERP) system through their existing tablet scanners. This upgrade will substantially reduce traceability failure, eliminating unnecessary information recovery labor and potential costly material losses.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

Senior Design 2024 – Management and Engineering for Manufacturing Team 06

Team 06

Brennan DiMauro
Matthew Ekstract
Michael Hendrickson

Faculty Advisor(s)

Prof. Martin Huber

Non-UConn Advisor

None

Sponsor (Text)

UConn College of Engineering

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

Immersive Learning in MEM: Embracing Industry 4.0 through Augmented Reality Education

Description

To improve the Management and Engineering for Manufacturing (MEM) curriculum and the development of the lab space regarding Industry 4.0 technologies (I4.0), the University of Connecticut, with the support of the Navy STEM program, will implement an Augmented Reality (AR) and Computer numerical control (CNC) to create an educational environment for the MEM Innovation Lab. To create the educational environment this will involve the purchasing, programming, and educational use of Microsoft HoloLens for activities such as real-time augmented-reality process instructions. The HoloLens will then be linked to the CNC machine that is embedded with sensors to give real-time feedback regarding axis speed and temperature to display on the HoloLens. The team will learn the required skills to code relevant programs for using the HoloLens, CNC machine, and Arduino as desired for this project. The team may also work in tandem with the ME and OPIM departments for support regarding this aspect of the project.

Senior Design 2024 – Management and Engineering for Manufacturing Team 07

Team 07

Hua Zhe Wang
Benjamin Viselli
Sean Atkinson
Alexander Paro

Faculty Advisor(s)

Rajiv Naik

Non-UConn Advisor

John Courtney

Sponsor (Text)

OMG Inc.

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

Creation of Proprietary Stress Plates for OMG Roofing

Description

OMG Roofing offers a plate fastener that is induction welded to secure roofing membranes via an OMG RhinoBond welder. However, the OMG welder can be used with non-OMG branded plate fasteners. This poses a significant challenge for the company as a substantial portion of their profits relies exclusively on sales from the plates. The project aims to develop a process in which the welder can reliably identify OMG branded plates from competitor plates, even when separated by a half inch thick roofing membrane. This will be done via measuring its electrical properties during the weld. By adding a thin coating to the OMG plate, in combination with its proprietary composition, the plate's have a resistance reading that uniquely identifies them as OMG branded.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

Senior Design 2024 – Management and Engineering for Manufacturing Team 08

Team 08

Anna Lidsky
Valeria Nieto
Isabelle Bunosso
Lauren Hart

Faculty Advisor(s)

Craig Calvert

Non-UConn Advisor

None

Sponsor (Text)

PepsiCo Frito-Lay

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

Enhancing Smartfood Popcorn Line Efficiency to Reduce Downtime and Boost Production Performance

Description

PepsiCo Frito-Lay's popcorn line is an almost fully automated manufacturing line beginning with kernels and ending with packaging. Once the kernels have been popped, the popcorn goes through a tumbler where cheese mix is added to flavor it. This tumbler has a pipe attached to it that runs six feet from a slurry container with two nozzles that spray the popcorn with the cheese slurry. These two nozzles must run concurrently for the correct amount of product to be sprayed on the popcorn. This nozzle clogs regularly, and when this happens, the line must be shut down and the entire 6 foot pipe must be removed to clear the nozzle, which causes immense downtime and lost profits. Additionally, the popcorn line has the opportunity to improve its bulk density testing. The bulk density system sits next to the popcorn line. It is a simple bucket on a scale where every hour, the bucket is manually filled with coated product and excess popcorn is cleared from the rim. The weight is recorded in the computer system. This currently requires someone to manually measure the Smartfood popcorn density, taking the operator away from other tasks and reducing efficiency. Since this is a fully manual process, it is also not being completed as routinely as it should. There is an opportunity to automate how this is done to ensure the popcorn weight is being measured hourly. The data from the bulk density testing allows Frito-Lay to keep track of the amount of cheese sprayed onto the product to maintain their quality standards. To improve the efficiency of the line, the group will propose a solution for two designs that will decrease downtime both for the cheese sprayer clogging problem and the bulk density testing problem. The overall objective for the solutions is improving the efficiency of the popcorn line.

Senior Design 2024 – Management and Engineering for Manufacturing Team 11

Team 11

Ian Carrillo-Londergan
Tomás Persano
Megan Cunningham
Amelia Antonucci

Faculty Advisor(s)

Rajiv Naik

Non-UConn Advisor

Joe Konicki and Nick Perkins

Sponsor (Text)

Unicorr

Other Sponsor (Text)

Unicorr Packaging Group

Sponsor Image

Cost-Effective Redesign & Sourcing Strategies for Tampers & Small Roller Wheels

Description

The Unicorr Packaging Senior Design Project, led by MEM Team 11 & ME Team 59, aimed to revamp efficiency through cost-effective redesign and sourcing strategies for critical parts in Unicorr's machinery. The project focused on recreating and locally sourcing components such as feed rollers, tampers, and rubber wheels to reduce production costs by 20%. This initiative is driven by the high costs and dependency on overseas suppliers, with a vision to enhance part longevity, reduce downtime, and cut overall production costs.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

Senior Design 2024 – Management and Engineering for Manufacturing Team 12

Team 12

Matthew Dion
Jacob Tanner
Lucca Riccio
Sawyer Logan

Faculty Advisor(s)

Craig Calvert, Rajiv Naik

Non-UConn Advisor

None

Sponsor (Text)

Waypoint Spirits

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

Design and Implementation of a Liquor Container Neck Label Applicator to Improve Packaging Throughput

Description

The project deliverable is a device that will assist in two activities: removing a tamper-proof seal from its roll, and assisting the operator in applying to to the cap of a liquor bottle. Another key component is the accuracy of the label placement. Before the project, everything had been done manually, which has led to inaccurate seal placement and a massive throughput bottleneck.

Figure One

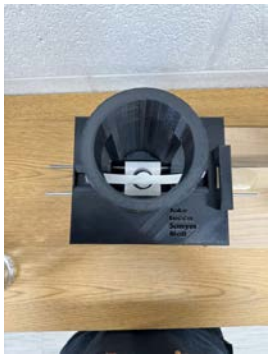


Figure Two

Materials Science and Engineering Department Senior Design Teams

Senior Design 2024 – Materials Science and Engineering 01

Team 1

Kevin Li
Matthew Maramo

Faculty Advisor(s)

Alexander Dupuy

Non-UConn Advisor

James Jerolimo

Sponsor (Text)

ARKA

Other Sponsor (Text)

ARKA

Sponsor Image

Citric Acid Passivation Process Development

Description

Materials Science and Engineering Team 1 is working with ARKA to develop a process to enhance the corrosion resistant properties of stainless steels. The process called passivation involves the removal of surface contaminants in a part with an emphasis on iron by immersing parts in a passivating acid/solution. This leads to the formation of a chromium-enriched surface to form a layer of chromium oxide, which prevents further oxidation of the alloy. Various issues appeared at ARKA when utilizing the conventional nitric acid with major concerns to the health and safety of workers, the environment, and product quality. An alternative, citric acid, is known to be much safer and biodegradable. Our project goal is to develop a successful and reliable procedure for passivation in citric acid.

MATERIALS SCIENCE ENGINEERING

Senior Design 2024 – Materials Science and Engineering 02

Team 02

Yuexuan Gu
Jaclyn Grace

Faculty Advisor(s)

Fiona Leek

Non-UConn Advisor

Dr. Ken Brown

Sponsor (Text)

ASSA ABLOY

Other Sponsor (Text)

ASSA ABLOY

Sponsor Image

ASSA ABLOY

Bio-Based Material Commercial Door Components Footprint

Description

Looking at core materials for ASSA ABLOY 707 doors. Materials tested include: cellulose board, hemp fiber, polyethylene foam, and hybrid materials. Materials must meet or exceed properties of currently used expanded polystyrene. Tests include sound transmission loss, heat transfer, stiffness, 3 point bend test (modulus), and density. AADG has a company wide mission to reduce carbon footprint by 28% by 2030 and become net zero by 2050.

MATERIALS SCIENCE ENGINEERING

Senior Design 2024 – Materials Science and Engineering 07

Team 7

Charlotte Chen
Sanjana Nistala
Jenna Salvatore
Allison Determan

Faculty Advisor(s)

Fiona Leek

Non-UConn Advisor

None

Sponsor (Text)

UConn Biomedical Engineering Department

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

Joint-on-a-chip Osteoarthritis Disease Modeling for Evaluating Anti-inflammatory Drug Performance

Description

This project aims to emulate the in vivo environment of a knee joint affected by osteoarthritis (OA). This will be accomplished by designing a chip that mimics the immune response and mechanical strain that cells in an affected joint experience in the human body. The chip will then be fabricated and seeded with cells present in the osteoarthritic joint. The chip can then be used to study the interplay between immune response and mechanical stimulation, as well as to test treatments for OA.

Mechanical Engineering Department Senior Design Teams

Senior Design 2024 – Mechanical Engineering Team 01

Team 1

Kevin Gonxhe
Alexandria Black
Daniel Andrade

Faculty Advisor(s)

Dr. Vito Moreno

Non-UConn Advisor

None

Sponsor (Text)

ABB

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

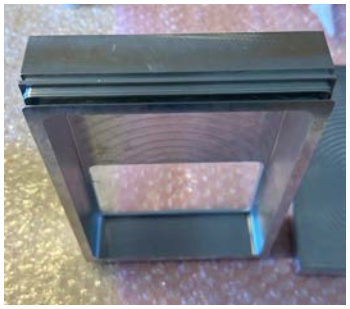
N4 Gasketless Enclosure

Description

The objective of this project was to design and test a NEMA 4 rated electrical enclosure without the use of any gaskets or gasketed materials in response to supply chain shortages. Since the 2019 pandemic, ABB has experienced challenges with gasket supply, leading to increased manufacturing costs and production time for NEMA 4 enclosures. By developing a gasketless solution, ABB aims to increase throughput for electrical enclosures while gaining a competitive advantage within an untapped market. To meet UL certification guidelines, the electrical enclosure underwent a hose down test at 10-12 feet, from a 1 inch hose, at 65 gal/min for around ¼ in/sec. ME01 successfully developed a unique enclosure technology which uses geometric manipulations to divert water away from any seams, validated rigorously at the UConn fire department in both metal and plastic to ensure no water ingress in pilot prototypes. This solution not only provides the intended environmental protections of an electrical enclosure, but also provides significant cost and production time savings for ABB. Moving forward, the solution and research provided hold promise for broader industry adoption and innovation within enclosure design.

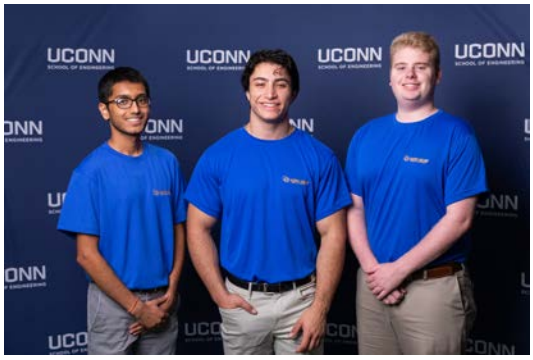
Figure One

Figure Two



MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 02



Team 02

Aditya Awasthi
Adam DiDomenico
Christopher Taylor

Faculty Advisor(s)

Ryan Cooper

Non-UConn Advisor

None

Sponsor (Text)

Aerogear

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

Process and Tooling for Uniform Spiral Bevel Gear Finishing

Description

Aero Gear provides a superfinishing process to their gears in order to increase efficiency and power provided. The project's fixture will be attached to their spiral bevel gear during the superfinishing process, which consists of parts moving through a tumbler filled with ceramic material. The material polishes and smoothens the exposed part surfaces; the fixture will expose the gear teeth and protect the rest of the part. Aero Gear currently subjects their straight-cut gears to superfinishing and plans to extend superfinishing into their spiral bevel gear production process. This project provides the design, manufacture, and testing for a 3D printed fixture device to be used for superfinishing processes. The fixture will be implemented on Aero Gear's spiral bevel gears and will expose the gear teeth to superfinishing while protecting all other surfaces of the gear. The fixture must rotate in a specific manner in the tumbler during the superfinishing process to properly remove material from the gear flanks. The required size and shape of the fixture to induce this motion, as well as the motion required are unknown. The ideal size(s) and shape(s) of the ceramic media and the frequency range of tumbler operation to facilitate spiral bevel gear superfinishing are unknown.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 03

Team 03

Kristen Angeli
Emily Root

Faculty Advisor(s)

Dr. Farhad Imani

Non-UConn Advisor

None

Sponsor (Text)

AI-Tek Instruments

Other Sponsor (Text)

AI-Tek Instruments

Sponsor Image

Improved Performance of Magnetic Speed Sensor Analyzer

Description

Speed sensors are devices that connect the mechanical and electrical worlds, converting rotational motion of an object into voltage in order to measure rotational speed. The sponsor of this project, AI-Tek Instruments, manufactures over 100 different types and sizes of speed sensors that must meet the requirements of their customers prior to leaving the facility. To ensure the safety of the speed sensors, test analyzers are used to check for proper quality and characteristics. The goal of this project is to redesign a currently defective speed sensor analyzer that will eventually be used in the testing process. Due to the high volume of speed sensors that will be tested at one time, or batch testing, this analyzer must be fully automated, ensuring that the variables for each testing process remains unchanged for hundreds of speed sensors being tested consecutively and also saves the company time with less manual adjustments being made. It is the goal of the project to significantly increase the repeatability of the analyzer, reduce noise in the outputted data, as well as reduce the time it takes to test each individual sensor to help AI-Tek Instruments increase efficiency and production.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 06

Team 06

Ryan Maguire
Nathan Garala
Ashley Sciacca
Spencer Alsup

Faculty Advisor(s)

Dr. Vito Moreno

Non-UConn Advisor

Michael Briscoe

Sponsor (Text)

ASNE

Other Sponsor (Text)

American Society of Naval Engineers

Sponsor Image

Electric Powered Boat

Description

This Senior Design project is focusing on the design and fabrication of a fully electric powered boat for entry into the Promoting Electric Propulsion (PEP) competition run by the American Society of Naval Engineers (ASNE). The competition is a 5-mile course in Virginia required to be completed in less than 55 minutes. Students chose to focus on unmanned vehicles although manned was an option. Both a 2-ft prototype hull and a scaled up 4-ft “full-sized” hull were designed, built, analyzed, and tested. Students focused on hull design, electric propulsion equipment, and the steering system. The hull was chosen to be a planing monohull and was designed and built by the students. Many components of the power and propulsion system were influenced by last year’s team. Students simulated the boat using Ansys Fluent and combined this data with test results to determine power requirements. The steering system included servos and focused on making sure the boat was still waterproof.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 08

Team 08

Brett Pierce
Alex Pearl
Alex Domingo (Not Pictured)
Madeline Corbett (Not Pictured

Faculty Advisor(s)

Rajiv Naik

Non-UConn Advisor

None

Sponsor (Text)

Belimo Americas

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

Reliability Testing: Risk and Failure Mode Analysis for Reliability Test Plan

Description

The objective of this project is to generate a reliability testing plan for control valves. Belimo is commercial HVAC industry leader in control valves, actuators, and sensors Current Approach: ❑ Annual Reliability test schedule for quality lab is based on sales volume Our goal: ❑ Analyze existing failure and sales volume data to detect “at risk” control valves ❑ Use test data from “at risk” products to improve the design of the products and increase reliability

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 09

Team 9

Baiquan Chen
Nicholas Bassett
Samuel Nichols

Faculty Advisor(s)

Chao Hu

Non-UConn Advisor

Marcus Chiesa

Sponsor (Text)

Belimo Americas

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

Torque Testing Rig for Actuator Verification

Description

Design, prototype, and implement a new torque testing set-up. Efficiency, ease of use, compactness, and safety are the key factors taken into consideration. Current rig utilizes hanging weights to produce a torque on an actuator that resists that torque while opening to a certain angle and then closing. Replacing the physical weights with an electronic torque source is a primary goal. This electronic source will improve the speed that actuators can be tested. Physical weights will still be used for the larger actuators, but they will be optimized to eliminate all safety concerns associated with them.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 10

Team 10

Claire King
Julia Rosati
Joshua Mudano

Faculty Advisor(s)

Dr.Lee

Non-UConn Advisor

None

Sponsor (Text)

Biomass Controls

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

BIOMASS CONTROLS PBC

Menstrual Hygiene Safe Disposal Thermal Efficiency

Description

The goal of this senior design project was to achieve a safe external surface temperature below 60 C for a prototype combustion system designed to burn menstrual products at 1000 C, particularly targeting the waste disposal issue in India and Nigeria. Sponsored by the Gates Foundation for Biomass Controls PBC, the project utilized simulation-based approaches with ANSYS Workbench software, focusing on thermal and airflow models to improve user safety by lowering the external temperature of the device. By adjusting insulation, airflow, and heat exhaust within the simulations, the project aimed to identify design solutions to maintain a surface temperature safe to touch, enhancing the device's safety and efficiency in disposing of menstrual hygiene products in an environmentally friendly manner.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 13

Team 13

Alexander Guzman
Will Goss
Vinicius De Souza

Faculty Advisor(s)

Tom Mealy

Non-UConn Advisor

We do not have a non-UConn project sponsor advisor. Our sponsor wasn't listed. It is "The Chamberlin Mill"

Sponsor (Text)

University of Connecticut

Other Sponsor (Text)

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Sponsor Image

Model and Operation of a Single Saw

Description

The Chamberlin Mill, Inc. is a nonprofit organization dedicated to preserving and sustaining a rare surviving water powered circular sawmill that is now powered by an electric motor. The Mill includes an 1873 circular saw, powered by a rebuilt 1928 Studebaker engine that was in use in 1939 and decades following. In addition to this, the Mill also has a Muzzy shingle machine, that although it is not the original, it is identical to one that once belonged to the Mill. While the Mill is being preserved as a historical site it is also an important educational STEM asset. Due to this, the sponsor tasked us with conducting a mechanical analysis, and creating a working CAD model of the Muzzy shingle machine. By being able to understand the design and operation of the shingle machine it will greatly help the Mill in their education of future STEM students.

Figure Two

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 17

Team 17

David Neal
Daniel Perez

Faculty Advisor(s)

George Matheou

Non-UConn Advisor

None

Sponsor (Text)

Connecticut Air National Guard (CTANG)

Other Sponsor (Text)

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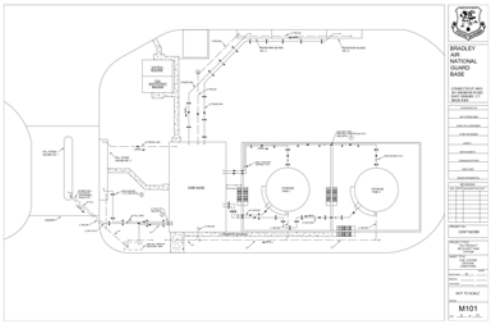
POL Product Recovery Tank System

Description

David Neal and Daniel Perez are on Mechanical Engineering senior design team 17 working with the Connecticut Air National Guard to remodel their jet fuel product recovery system. They have been working closely with Cory Knick, Base Civil Engineer, Lt. David Pohl, Deputy Base Civil Engineer, and Scott Pearsall, Senior Construction Project Manager. Due to changes in environmental regulations, the old system's underground piping and product recovery tank need to be moved above ground for leak detection capabilities and policy compliance. The team has been tasked with developing initial concept drawings or 35% drawings using 2D AutoCad. These drawings will detail the necessary changes in the system in order to comply with the updated environmental policies. The best design will focus on implementation, cost, and environmental impact. With the change in elevation, the team must also determine if new pumps must be added to the system.

Figure One



MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 21

Team 21

Drew Smith
Julia Sacchi
Daniel Flanagan

Faculty Advisor(s)

Professor Jason Lee

Non-UConn Advisor

Mr. Jim King

Sponsor (Text)

Eljen

Other Sponsor (Text)

Eljen Corporation

Sponsor Image

Alternative Aggregate Material for Flow Systems

Description

The objective of this project is to design, create, and test an alternative to stone aggregate made from plastic. The alternative created will be tested to determine if it is as strong and durable as traditional stone aggregate. Traditional stone aggregate is used in the majority of septic and drainage systems, however it is heavy and difficult to transport, making it expensive and laborious to use. Additionally, stone aggregate is coated in a thin layer of stone dust. When this dust comes in contact with water, it forms a thin, cement like layer that inhibits the waste water from easily seeping into the soil. This directly hinders the design and purpose of septic and drainage systems. Eljen is a leader in designing and manufacturing septic and drainage products globally. Eljen is looking to explore new alternatives and has been working on initial design concepts to overcome the existing problems with stone aggregate. The new aggregate made of plastic must perform to the same standards as stone aggregate or better. Specifically, this alternative aggregate needs to be able to be transported easily, be stackable, have an H-20 rating, and stack randomly and not re-stack after being blown into trenches.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 22

Team 22

Riley Carlson
John Gomes
Benjamin Roy
Adel Khan

Faculty Advisor(s)

Ryan Cooper

Non-UConn Advisor

None

Sponsor (Text)

Hamilton College

Other Sponsor (Text)

Hamilton College

Sponsor Image

Design and Fabricate a Wetland Treatment System

Description

The objective of this project is to develop and test a land-based wetland treatment system (LBWTS) capable of removing nitrogen pollution from small to medium-sized bodies of water. Nitrogen water pollution, also known as eutrophication, causes an excess of algae to grow in bodies of water. This algae strips resources from other lifeforms in the water, destroying the natural ecosystem.

Figure One

Figure Two

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 23

Team 23

Michael MacKinnon
Olivia Ferrigno

Faculty Advisor(s)

Vito Moreno

Non-UConn Advisor

Robert Croce

Sponsor (Text)

HarcoSemco

Other Sponsor (Text)

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Sponsor Image

Braze Joint Strength Evaluation

Description

Braze joints are unions between metals by a braze paste. This paste, usually having a melting point much lower than the base metals, is melted and then dried. This process acts like a metallic glue to fuse the base metals together. This project explores the strength of braze joint unions through conducting tensile and shear tests. There are many different ways of setting up braze joints; single lap, butt joint, double lap, scarf joints. The variables of this experiment include the setup of the specimens (within the single lap and butt joint configurations), the base materials (such as stainless steel 304 and stainless steel 316), and the overlap distance for the single lap joints. All our specimens used the same braze paste and process. This created a comprehensive design of experiments, which was formulated through Minitab's factorial analysis. Through Minitab factorial analysis, relationships between these variables and joint strength were identified, while ANSYS modeling was employed to predict the performance of these joints. Our preliminary findings suggest that the strength of the braze joint is lower than the control base metals for all configurations.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 24

Team 24

Kevin Lyle
Carole Nyenyezi
Nicholas Cody
John Frank

Faculty Advisor(s)

Nejat Olgac

Non-UConn Advisor

Wei Zhang

Sponsor (Text)

HSB

Other Sponsor (Text)

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Sponsor Image

HSB
A Munich Re company

Rotating Machinery Fault Simulator

Description

Rotating machinery faults refer to malfunctions that occur in equipment with rotating components, such as motors, pumps, turbines, and other rotating parts. There are various faults that rotating machinery can experience, including misalignment, unbalance, bearing failure, and many more. The occurrence of these faults on components indicate underlying issues within the machine. Identifying and addressing these faults is crucial for ensuring reliable and efficient operation of industrial equipment. In response to the demand for proactive equipment health monitoring, the Hartford Steam Boiler (HSB) advocates the use of Internet of Things (IoT) sensors on equipment health monitoring to allow for timely diagnosis and servicing, preventing serious and costly problems. This project aims to design a desktop simulator that can simulate and recreate the motion characteristic of a faulty machine for the development and testing of vibration sensors' fault detection capabilities.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 25

Team 25

John Sanchez
Jarred Drickler-Bourgart
Conor Blake

Faculty Advisor(s)

Ryan Cooper

Non-UConn Advisor

None

Sponsor (Text)

ABB

Other Sponsor (Text)

Henkel

Sponsor Image

Loctite Demonstration Tool

Description

Henkel Application Engineers work closely with their sales force to support the Loctite brand and its adhesive solutions. A large part of that support is training end users on these adhesive technologies including application techniques and the benefits of their use in applications. During these trainings, demonstrations are often used and performed with attendees to establish and reinforce the capabilities of an adhesive solution. Some of these demonstrations have room for improvement and standardization so trainers across the globe can leverage them to create effective and memorable moments. We are currently improving the current demonstration tool so that the sales team can more easily exhibit the high performance of Loctite products.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 26

Team 26

Cody Ottinger
Alper Arslan
Joe Gaffney

Faculty Advisor(s)

Martin Huber

Non-UConn Advisor

None

Sponsor (Text)

HyAxiom

Other Sponsor (Text)

Sponsor Not Avaiable

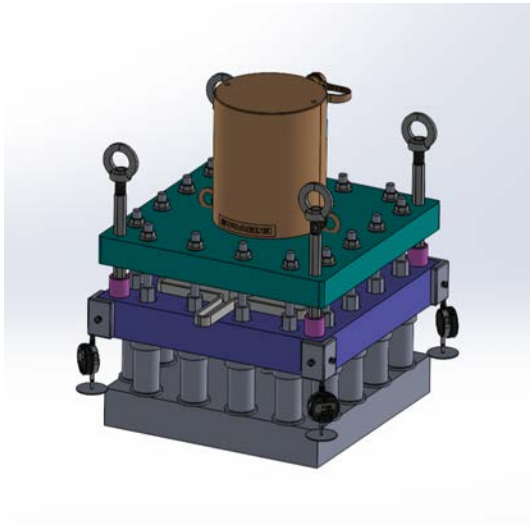
Sponsor Image

Cell Stack Compression Fixture for Tierod Tightening

Description

The objective of this project is to engineer a tool capable of uniformly compressing Belleville washers across a cell stack assembly, thereby ensuring a consistent preload on all tie rods.

Figure One



MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 27

Team 27

Reagan Pelton
Jacob Roediger
Ashley Sirowich

Faculty Advisor(s)

Dr. Georgios Matheou

Non-UConn Advisor

Mr. Joseph Camean

Sponsor (Text)

United States Coast Guard

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

Hydrokinetic Electric Generator

Description

We were tasked with creating a Hydrokinetic Electric Generator for use in rivers with low flow velocities, and with tidal effects that periodically reversed the flow of the river. The original scope of the project was to produce 1kW of electricity in these conditions, but as the project continued, it became clear that this goal was unachievable. As such, the project was transformed into a feasibility experiment to see if there was a design that could work. This project is a continuation from last year, however after analyzing the H-Darrieus turbine that was produced last year, our team decided to explore other options. After research, our team decided to create a modified savonius turbine that could work under water. This decision was formative in our group's desire to create a drag force based turbine. Based on testing, our generator had to be spun at or above 100 rpm to produce the voltage required to create a meaningful power. In our prototype testing, which was done to prove that a drag force based design was feasible, it became apparent that our current design could not spin at very high rpm but had a large torque when it was spinning. In order to increase the rpm, a gear reduction was suggested to be added. This would then increase the torque required to spin the generator by a factor equal to the gear ratio. Since the turbine spun a a low rpm, to generate the torque needed to spin the generator, the arms of the generator had to be increased in length. Since we are working with such a small testing chamber, it was deemed impractical to extend the arms. Therefore, the turbine was modified such that there was more surface area facing the flow. Tests will be run on this current iteration of the design and recommendations will be made on how feasible this renewable energy concept is.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering
Team 28

Team 28

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Non-UConn Advisor

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Sponsor (Text)

Charles Gray Airboat

Other Sponsor (Text)

Charles Gray

Sponsor Image

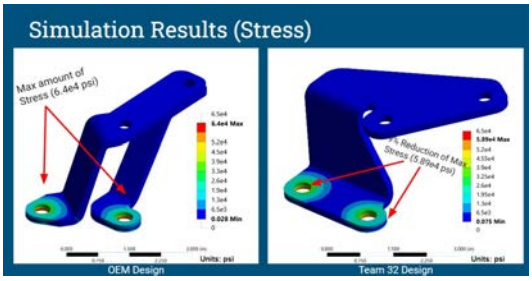
Bracket Redesign to Extend Operating Life Round 2

Description

The air canister brackets on the Kubota BX23 tractor are failing at the mounting locations. These brackets are mounted to the engine, via studs that protrude directly from the engine itself. Charles Gray; the sponsor of this project and the owner of a Kubota BX23, reports that the brackets fail after approximately 100-130 hours of operation. Last year's team set out to eliminate this problem and developed a bracket that successfully increased operating life, but also increased oscillation at low RPM's. According to Gray; the new bracket caused the air canister to oscillate more violently than the previous bracket design at low RPM, but dampened the vibrations in the higher RPM range. The goal of this project is to modify the bracket geometry to decrease oscillations throughout the entire RPM range of the tractor, while still retaining the improved operation life achieved by the previous team.

Figure One

Figure Two



MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 29

Team 29

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Sponsor (Text)

Coast Guard Academy

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

Practical Linear Generator

Description

A 2022 2023 Senior Design Team designed and fabricated a Liner Generator .The engine was able to run for a brief time (seconds) but exhibited issues with speed control and carburation. The objective of this project is to improve the operation and performance of the Linear Generator developed last year.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 30

Team 30

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Sponsor (Text)

NUWC

Other Sponsor (Text)

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NAVSEA
NAVAL SEA SYSTEMS COMMAND

Ambient Temperature Phase Change Launcher

Description

The ambient temperature phase change launcher is a patented underwater launch system created by NUWC. The launcher aims to be a safer, cheaper, and more environmentally friendly alternative to current underwater launch systems. The launcher uses pressure created by the phase change from liquid to gas of Carbon Dioxide as the driving force to launch the payload. This payload needs to be able to deploy from underwater. The tank containing the pressurized CO2 needs to be less than 25% of the launch cylinder's volume. Furthermore, the maximum acceleration of the payload should not exceed 8g's. Under these constraints, the team has been tasked with continuing the efforts of creating a functional prototype of the patent to determine its feasibility.

Figure One

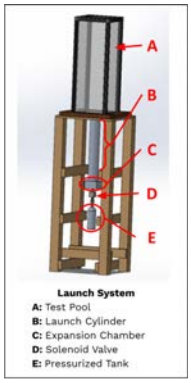

Figure Two

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 31

Team 31

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Professor David Giblin

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Nicholas McCarthy

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NUWC

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Universal Data Collection Mount

Description

This project aims to create a mounting system to be used aboard submarines during testing. The US Naval Undersea Warfare Center (NUWC) currently designs unique mounts for all data collection equipment that is being used. In order to save on resources, the team has been tasked with designing a universal mounting system that is able to suit all equipment that is used by NUWC during testing. The team has produced a prototype that is capable of mounting to a vertical I-beam with a platform suitable for the equipment that the team was informed about. A working prototype made from durable PETG filament has been produced, with NUWC planning to manufacture the design using steel and aluminum.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 32

Team 32

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None

Sponsor (Text)

NUWC

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

Universal Payload Gripper

Description

The design and development of a soft robotic gripper capable of applying controlled force without self-damage. Current methods for securing payloads usually require constant modifications depending on the object's shape, size, and weight. The Naval Undersea Warfare Center would like to develop a gripper that can hold a wide variety of objects placed within it. This gripper must feature soft robotic fingers made of a flexible and strong elastomeric material.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 33

Team 33

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Sponsor (Text)

Pfizer

Other Sponsor (Text)

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Energy Consumption and Efficiency Initiatives for Building 257

Description

Global warming poses a critical environmental threat, primarily driven by the release of greenhouse gases into the atmosphere, resulting in heat trapping and subsequent climate change. Industries worldwide contribute significantly to this issue, necessitating urgent actions to reduce their carbon footprints in alignment with global policies. Pfizer, a prominent pharmaceutical company, operates within this context and bears a substantial responsibility in addressing climate change. Given its deep involvement in global health, Pfizer is obligated to minimize its carbon emissions and transition toward carbon neutrality. Vital measures include implementing sustainable practices, reducing emissions in operations and supply chains, investing in renewable energy sources, and innovating environmentally friendly manufacturing processes. By embracing sustainability and aiming for carbon neutrality by 2040, Pfizer can serve as a model for the pharmaceutical industry, positively impacting the planet's health while prioritizing human well-being. This report presents efficiency data for Building 257's HVAC/AHU, lighting, refrigeration, and air control systems, along with proposed energy-saving solutions for future implementation, including heat pumps, electric controls, solar energy, and LED lighting. Additionally, a cost/savings analysis and emissions reduction strategy will be provided.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 34

Team 34

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Bryce Cronin-Carlson

Sponsor (Text)

Whitcraft LLC

Other Sponsor (Text)

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Pursuit AEROSPACE

Right Sized Press

Description

Pursuit Aerospace requires a replacement press that can output 60 tons to bend sheet metal while simultaneously decreasing footprint on the shop floor. Large machinery and cumbersome hydraulic systems cause flow line disruption and takes up excess space on the finite shop floor. Decreasing the overall shop floor footprint for one piece flow line implementation will allow for smoother production with interchangeable die sets while keeping the operator as safe as possible.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 35

Team 35

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Non-UConn Advisor

None

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Pratt & Whitney

Other Sponsor (Text)

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Auxiliary Gearbox Shaft Behavior

Description

To develop a criteria on which a bearing will "walk off" the shaft bearing seat under engine loads.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 36

Team 36

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None

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Pratt & Whitney

Other Sponsor (Text)

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Bearing Stress Effects on Bolted Joints

Description

Bolted joints are important elements of all mechanical systems, including gas turbine engines produced by Pratt & Whitney. The assembly consists of a bolt, a nut, a washer, and stack members (such as a flange). At assembly, the bolt is tightened, putting the bolt in tension and the stack in compression. Consequently, the bolt tries to return to its original length but the stack prevents it from doing so. The clamping force that keeps this system together is referred to as bolt preload. Bolts are tightened to certain preloads to ensure that assemblies remain tight during the flight cycle. This project considers what happens to the bolt preload force when compressive yielding occurs in the stack under the bolt head. The first objective of the project is to investigate the effect that compressive yielding in the stack has on bolt preload. This is done through a series of hand calculations and elastic/plastic finite element analysis (FEA) using Ansys. The second objective is to design and fabricate a test rig that will validate the effect of compressive yielding on bolt preload as found through the prior analysis.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 37

Team 37

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Pratt & Whitney

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Experimental and Analytical Investigation of Bolted Joint Loosening Due to Vibration

Description

One of the most common failures of a bolted joint assembly is the self-loosening induced by transverse cyclic loading caused by relative movement or vibrations. Self-loosening of bolted joints is a phenomenon that is present in all types of structures used in different industries including automotive, aerospace, and oil and gas. This phenomenon can cause catastrophic failures that result in loss of revenue, maintenance, accidents and health issues, and environment damage. The objective of this project is to investigate the loosening process using a rig that applies transverse vibration to a bolted connection. Fasteners of various thread type and size are tested to determine the effects on the loosening process. Loosening curves that display loss of preload over number of cycles are vibration are constructed to visualize and analyze the loosening process.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 38

Team 38

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Pratt & Whitney

Other Sponsor (Text)

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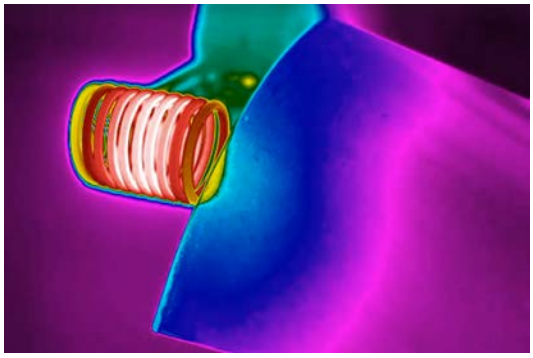
Feasibility of Using Eddy Currents for Fan Blade Tip Deicing

Description

Our project examines the feasibility of using an eddy-current type sensor to de-ice the tip of a turbofan fan blade. Eddy-current sensors are currently used to sense the displacement of fan blades by inducing a magnetic field in the blades. This change in magnetic field is resisted by the blades and induces loops of electric current, known as eddy currents, within the blades. These currents are detected by the sensor and their strength is used to determine the position and displacement of the blade tip relative to the sensor. Deicing methods already exist for turbofan blades; however, the tips of the blades are still susceptible to ice accumulation. Proving that eddy-current sensors are dual purpose would be advantageous for engine weight and complexity. However, it is unknown if contemporary eddy-current sensors can produce the energy required to de-ice the fan blade tips.

Figure One



MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 39

Team 39

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Pratt & Whitney

Other Sponsor (Text)

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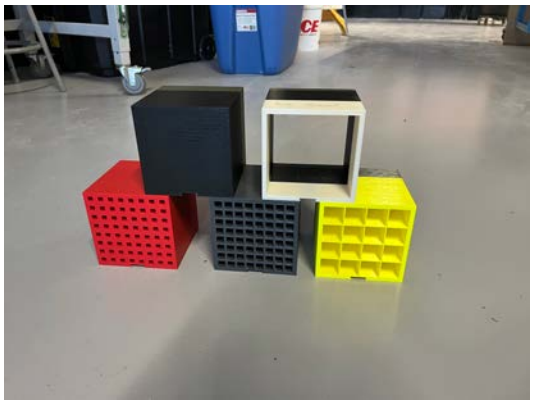
Heat Exchanger Bypass Duct Modeling

Description

In gas turbine engines, the management of critical fluid (oil, cooling air, etc.) temperatures is accomplished with heat exchangers (HEX). One of the major thermal sinks is accomplished by ducting bypass air to a HEX or placing it in the bypass air flow path. The fan duct bypass flow is a major contributor to engine thrust in a commercial gas turbine engine. Heat exchangers can have an impact on overall duct performance as a result of size (blockage), porosity (flow thru Hex), and position in the duct. The sponsor would like to have a reduced order mathematical model of the flow around a heat exchanger in a duct as a way to conduct preliminary design studies before a final design is established.

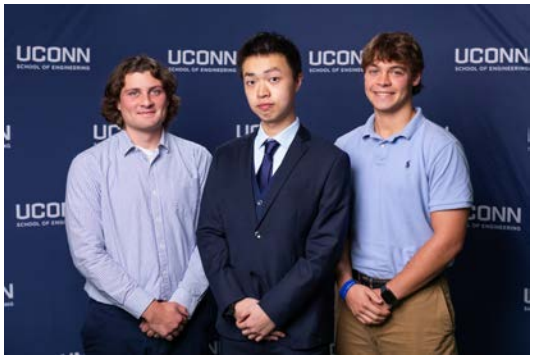
Figure One

Figure Two



MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 40



Team 40

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Sponsor (Text)

Pratt & Whitney

Other Sponsor (Text)

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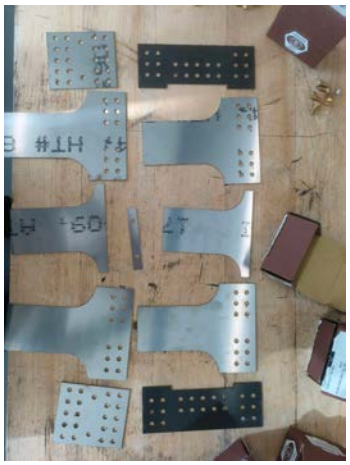
Hybrid Composite Metal Case Design

Description

Pratt & Whitney (P&W) strives for designing and manufacturing dependable long-lasting engines in both military and commercial industries. Sustainable engines are the future for lowering emissions, and Pratt & Whitney's commercial GTF (Geared Turbo-Fan) engine program strives for peak efficiency in every engine they make. The addition of gears in new engines allows for high-pressure turbines to spin at different speeds than the low-pressure turbines, allowing each turbine to operate at optimal RPMs at cruising speeds. The gears add significant weight to the engine despite driving a higher efficiency. Pratt & Whitney looks to lower the weight in other areas of the engine, one focus is the implementation of composites. A downfall of composites is their integrity when implemented with fasteners, our goal is to explore flange designs that can optimize and strengthen metal flange-to-composite case interfacing. Our sponsors, Connor Perry and David Lussier strive to deliver high-efficiency engines at lower weights by nearly halving the weight of traditional all-metal fan cases by integrating composites safely and ensuring integrity of flange connections. This project aims to test various axial flange arrangements found on engine fan cases through tensile tests on composite materials fastened to traditional metal components. Originating from Pratt & Whitney's goal to reduce engine weight, the project builds on the 2022-2023 ME 46 Senior Design team's findings on circumferential flange joints, extending the investigation to axial flange configurations. The challenge lies in designing and fabricating test panels based on a simple 2-D axial flange arrangement design provided by P&W.

Figure One

Figure Two



MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 41

Team 41

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Horea Ilies

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Pratt & Whitney

Other Sponsor (Text)

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PRATT & WHITNEY
DEPENDABLE ENGINES
GO BEYOND

Automated Inspection Framework

Description

The objective of this project is to develop a process for the overlaying of multi format inspection data onto as designed CAD models for purposes of creating part specific analysis (FEA) models.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 42

Team 42

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Non-UConn Advisor

None

Sponsor (Text)

Pratt & Whitney

Other Sponsor (Text)

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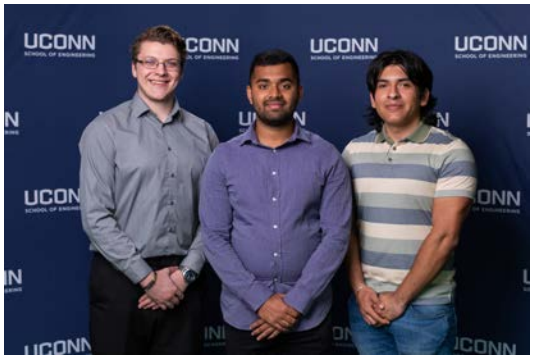
ME 42 Pin on Plate

Description

Our sponsors at Pratt and Whitney have tasked us with developing a more efficient way for their operators to complete tribology testing various materials. Essentially, the goal for us to complete is to design and fabricate a usable head for their tribology machine. This head must be able to achieve full contact with each material being tested and find full flatness in an easier manner. At this point in the project, a design has been selected and the materials have been ordered.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 44



Team 44

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Pratt & Whitney

Other Sponsor (Text)

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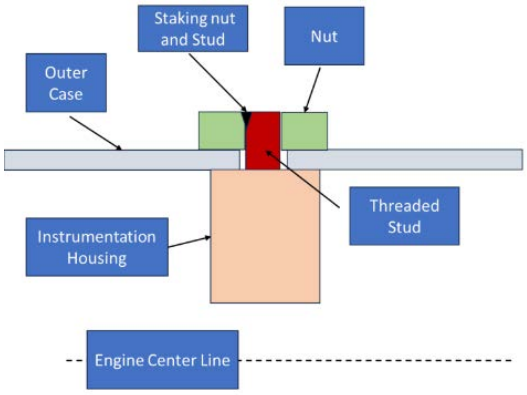
Vibra-staking For Anti-Rotation of Delicate Threaded Joint

Description

This project is based on a new staking method created by Pratt & Whitney. Aerospace engines undergo various types of testing, including vibration tests, deflection tests, temperature tests, and pressure tests. The instrumentation used to conduct these tests is typically attached to the engine case and exposed to vibrations. Staking a threaded connection to prevent the loosening of the nut due to vibration is a highly robust method that requires minimal effort. However, traditional staking, which involves a hammer and a hammer punch, can subject the threaded stack to a high impact load, potentially damaging some of the delicate instrument components. In this project, instead of using a hammer, an engraving tool will be employed to perform the staking. The engraving tool can be adjusted to reduce the amplitude of the stroke, resulting in a very low impact force that won't harm any instrument components. The objective of this project is to develop and demonstrate a repeatable process for using an engraving tool to secure locking nuts without damaging the underlying instrumentation components. Overall, using the method of vibra-staking can significantly improve the company's ability to obtain more reliable data during engine testing and provide a new method of staking threaded joints.

Figure One



MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 45

Team 45

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Non-UConn Advisor

None

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SedMed

Other Sponsor (Text)

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SedMed

Measure Patient Sit-Stand Ability

Description

Current testing methods for patient sit-to-stand ability rely on the patient's ability to complete repetitions going from seated to standing, counting the total completed over 30 seconds. The number of repetitions are then compared with age specific norms to determine if the patient needs aid. If unable to complete the repetitions, the patient automatically fails, and treatment is assigned to assist them. While this system works well for the patients who can reliably complete the repetitions, those who cannot do not receive the same nuance to their diagnosis due to the failure condition of the test. SedMed wants to provide a solution through the design of a device that can measure a patient's sit-to-stand ability using a gas spring lift system. By using their product, the SedMed Toilet Lift Assist product as a technology base, this new device serves as testing and rehabilitation device which uses interchangeable gas springs to provide lift to the patient and slowly raise them and the chair up to standing position. By considering the force rating of the gas spring and the patient's weight, their ability is measured even if the patient was unable to complete the standard 30 second sit-to-stand test. These gas springs can be used in combination or individually to provide varying levels of force to lift the patient for both testing and rehabilitation applications. The device seat level can be adjusted from a height of 17" to 22.5" to accommodate patients and is designed to handle patients weighing 75 to 275 lbs. This is all in an effort to provide medical staff with the means to better accommodate patients through more comprehensive testing and aided rehabilitation.

Figure One

Figure Two

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering
Team 46

Team 46

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Osama Bilal

Non-UConn Advisor

None

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Acc Masters

Other Sponsor (Text)

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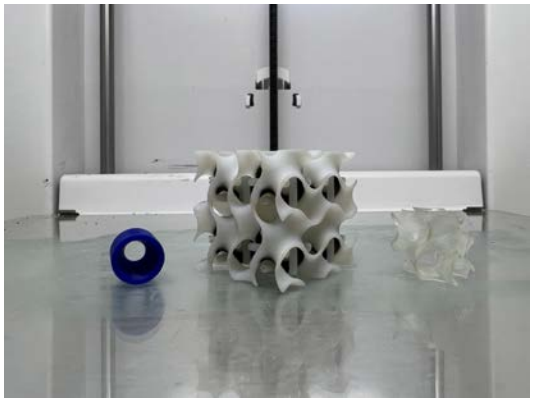
Multifunctional Metamaterial to Attenuate Acoustic and Elastic Waves

Description

The goal of the project was to research, design, and fabricate a metamaterial that is capable of effectively attenuating both elastic, meaning vibrations through solids, and acoustic, meaning noise propagating through air, waves. The metamaterial was tailored to operate within specific parameters, including an operating frequency range under 100 Hz, with load capabilities of up to 10 lbs, and a high stiffness-to-weight ratio greater than 1 MPa/kg. The project followed a two-branch approach where the elastic and acoustic unit cells were researched and created separately, before merging them into one single unit cell that can attenuate both elastic and acoustic waves. The elastic unit cell was modeled based on a gyroid, which has an excellent stiffness-to-weight ratio, but does not exhibit any attenuating characteristics. The acoustic unit cell was modeled based on a Helmholtz resonator, which can be tuned to attenuate desired frequencies. Both unit cells were manipulated until a bandgap, region of attenuation, was formed. After this, the unit cells were combined into a single unit cell that was successfully able to attenuate both elastic and acoustic waves at the required frequency. Experimental testing was then conducted on the unit cell with lab equipment including a signal generator, speakers, microphones, and software for data conversion for the acoustic testing. A Vibrometer and software for data conversion was used for the elastic testing.

Figure One



MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 47

Team 47

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Non-UConn Advisor

None

Sponsor (Text)

Sonalysts, Inc.

Other Sponsor (Text)

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SONALYSTS

Design and Development of PV/Thermal System for Greenhouses

Description

This project provides the design, development, and analysis of a scaled-down cost-effective photovoltaic/thermal system that can be integrated into a greenhouse roof. Photovoltaic and thermal systems are considered conventional green energy methods that work well but would be more beneficial if integrated together. This is because traditional photovoltaic systems can become inefficient when they reach high temperatures. By including a thermal system, cooling can be provided to the photovoltaic system while simultaneously producing thermal energy to heat a greenhouse. Although both photovoltaic and thermal systems are considered traditional energy systems, combining them to power a greenhouse is a relatively new concept. This project documents the integration plan for the photovoltaic thermal system for a hypothetical greenhouse located at the University of Connecticut.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 48

Team 48

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Non-UConn Advisor

Fr. Greg Galvin

Sponsor (Text)

Saint Thomas Aquinas Church

Other Sponsor (Text)

Saint Thomas Aquinas Church

Sponsor Image

St. Thomas Aquinas Church Storrs CT: Heating System Diagnosis and Performance

Description

St. Thomas Aquinas is a church located at the University of Connecticut's Storrs Campus. The church utilizes a heating system that receives steam from the UCONN Co-Generation plant. The lack of functioning thermal controls within the church causes temperatures to rise far beyond the ideal comfort range. There are two main deliverables for this project. One is to determine the faults of the steam heating system and propose a viable solution. The second is to create new mechanical system drawings utilizing AutoCAD and Revit because the existing construction documents containing the piping and HVAC system drawings are outdated and incohesive. Testing revealed the locations of steam valves and the temperature distribution present in the Nave of the church. The Nave of the church receives the majority of its steam supply from radiators connected in parallel that each have their own lever or radiator valve. However, these radiators are covered by wooden panels that are not easily removed. One current proposed solution is to improve accessibility for manual valve control by having the radiator covers on hinges. The second proposed solution is to replace the manual valves on each radiator with electromechanical control valves that respond when the ambient temperature is above or below the set point. Further surveying, testing, and research will allow for recommendations to improve the convenience and efficiency of control.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 49

Team 49

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Non-UConn Advisor

None

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UConn College of Engineering

Other Sponsor (Text)

John Fantry

Sponsor Image

Feasibility of Extending the Range of an EV Tractor-Trailer

Description

The objective of this project is to design and prove the feasibility of an energy generation/ storage system to be outfitted on a traditional tractor trailer with the intent to extend the range of electric semi-trucks. The transportation industry is pressured to reduce their emissions as they are the largest contributor of greenhouse gases. Therefore, companies are planning to integrate electric semi-trucks from producers such as Volvo and Tesla into their fleet. The most prominent limitation of electric semi-trucks is their short range. Our project's sponsor sees commercial opportunity in this limitation and wants to create an add on system for conventional trailers that would extend the range of the electric semi-truck. Specifically, he wants to explore the feasibility of using brake regeneration, solar, and wind turbine systems to generate electricity. The commercial availability, and ability to design a system that is compatible with produced semi-trucks will be determined to prove the system's practical for the industry. Our project aims to analyze the practicality of each technology and design a system that offers an extended range to electric semi-trucks, proving its commercial viability for our sponsor.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 50

Team 50

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Ethan Wicko
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Ethan Wicko, Alexander McLeod, Zachary Wisnefsky

Sponsor (Text)

Transcend Bicycle LLC

Other Sponsor (Text)

Transcend Bicycle LLC

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TRANSCEND

Belt Based Continuously Variable Automatic Transmission Prototype

Description

The sponsor of this project, Transcend Bicycle, is a startup company that has been aiming to achieve a completed design of a CVT-integrated bicycle since late 2020. With this project, they hope to obtain a prototype on which more comprehensive real-world testing can be performed on both the mechanisms of the CVT as well as the computer-controlled shifting algorithm, which will be developed by a separate Computer Science senior design team.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 51

Team 51

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Faculty Advisor(s)

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Edith Barrett, Kent Greenman, Bill Wiggin

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UConn College of Liberal Arts and Sciences

Other Sponsor (Text)

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Sponsor Image

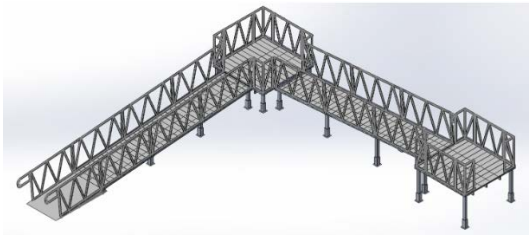
UCONN
COLLEGE OF LIBERAL ARTS AND SCIENCES

Development of an Affordable Wheelchair Ramp with Emphasis on Recycled Materials

Description

UConn College of Liberal Arts and Sciences (CLAS) has collaborated with the Mechanical Engineering Department to develop and prototype an accessibility ramp that focuses on modularity, affordability, and sustainability using recycled materials, all while ensuring compliance with Americans with Disabilities Act (ADA) regulations. This innovative ramp is tailored to assist individuals with health conditions or impairments, providing access to elevated surfaces with specific criteria. Our design comprises of two primary components: the run section and the landing section. The run section is completely composed of modular parts which are: run beams, aluminum channels, under-structure beams, and warren truss handrails. Similarly, the landing section also consist of modular parts which are: landing beams, aluminum square frame, warren truss handrails, and under-structure beams. The design predominantly utilizes Polyethylene Terephthalate (PET 1) supplemented with recycled aluminum in key components such as the starting ramp incline, legs, inverted t-insert, aluminum channels, and aluminum square frame. All of our modular parts are less than thirty pounds and made from recyclable materials. Ease of assembly is prioritized in our design, eliminating the necessity for professional installation which further highlights the design's affordability and accessibility.

Figure One



MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 52

Team 52

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Faculty Advisor(s)

Reza Sheikhi

Non-UConn Advisor

None

Sponsor (Text)

Physical Sciences Inc., UCONN School of Pharmacy

Other Sponsor (Text)

UCONN School of Pharmacy, Physical Sciences Inc.

Sponsor Image

PSI Physical Sciences Inc.

Application of a Single Pharmaceutical Vial TDLAS Sensor for Monitoring Lyophilization Process Heterogeneity

Description

Freeze-drying, also known as lyophilization, is a dehydration process that removes water by sublimation to preserve perishable materials or to make materials more easily transportable. During the freeze-drying process, temperature uniformity inside of the freeze-dryer is crucial to ensure process efficiency. Currently, during this process, vials undergo the sublimation process at different rates inside of the chamber. Scientists at PSI have acknowledged this flaw in the freeze-drying process and are developing a TDLAS-based sensor cap to help observe this issue. The PSI-developed sensor is predicted to help improve the freeze-drying cycle by applying the knowledge gathered from the process heterogeneity measurements via the device.

Figure One

UCONN
SCHOOL OF PHARMACY

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 53

Team 53

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Alejo Navaresse
Christian Villandry

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Wilson Chiu

Non-UConn Advisor

None

Sponsor (Text)

Center for Clean Energy Engineering (C2E2)

Other Sponsor (Text)

Sponsor Not Avaiable

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C2E2 Center for Clean Energy Engineering

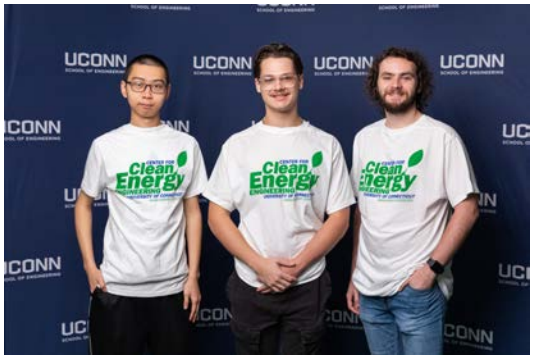
Fuel Cell Powered Drone -- Airframe

Description

This project's objective is to integrate a fuel cell into a remote-controlled plane to partially power and extend the flight time. In the coming years, there will be a fully custom RC plane powered solely by an on-board solid oxide fuel cell. ME Team 53 is in charge of sourcing and modifying an airframe for the power systems team to integrate this fuel cell with. This requires researching, designing, and building new wings for the airframe along with building housing for all the required internals of this drone.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 54



Team 54

Yun Ma
Ian Hubbard
Daniel McKeon

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Wilson Chiu

Non-UConn Advisor

None

Sponsor (Text)

Center for Clean Energy Engineering (C2E2)

Other Sponsor (Text)

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Sponsor Image

Fuel Cell Powered Drone

Description

The ultimate goal of this project is to create an RC plane that can fly for 10-15 minutes, while being powered, in part, by a fuel cell. During the process, it is necessary for our team to research available fuel cell stacks and components on the market, and provide rationale behind our choice of power and type of fuel cell. Important deliverables are lab testing to find fuel consumption rate and power output of the selected fuel cell, and extensive testing and vetting of additional fuel cell hardware (namely the fuel storage tank and the pressure regulator). These findings will be presented to the sponsors by the end of the curricular year. Finally, it is necessary to work with the ECE and Airframe teams to design and implement a system that allows for the fuel cell to be properly integrated into both the physical body of the plane, as well as feeding into the power system.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 55

Team 55

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Prof. Mihai Duduta

Non-UConn Advisor

None

Sponsor (Text)

Acc Masters

Other Sponsor (Text)

Sponsor Not Avaiable

Sponsor Image

THE ROBOT INCUBATOR

Fabrication of a Testing Rig for Dielectric Elastomer Generators

Description

This project is focused on designing and fabricating a testing frame for dielectric elastomer generators (DEG), for specific applications in wave energy harvesting. The DEG will transform the mechanical deformation caused by an actuator (simulating oceanic wave input) into electrical energy. These DEGs are primarily composed of two main components, an elastomer and an electrode. By studying the amount of energy that is outputted, an optimal combination of these materials can be found which creates the highest amount of electrical energy. Following this, application of this research can lead to alternatives to renewable energy sources, both for sustainability and robotic autonomy in oceanic environments.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 56

Team 56

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Non-UConn Advisor

None

Sponsor (Text)

UCONN, Dr. Lykotrafitis

Other Sponsor (Text)

Sponsor Not Avaiable

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Mobile Phone Game for Particle and Rigid Body Dynamics Virtual Experiments

Description

This project is an educational physics game with 4 levels based on simulating single-particle motion, spring-mass motion, pendulum motion, and particle collisions. The game is built in Unreal Engine 4.27 and emulates accurate visual physics. Each level displays the particle in motion as well as the associated graphical data in terms of their mechanical energies and velocity. In each level, it is possible to modify the mass variable of the particle and the force with which to launch the particle and observe the resulting change. The single particle motion has 3 different restitution levels to choose which will affect the particle's velocity after collision with the wall and floor.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 57

Team 57

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Heba Karkar

Faculty Advisor(s)

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Non-UConn Advisor

Eugene Chabot

Sponsor (Text)

UCONN, Dr. Lykotrafitis

Other Sponsor (Text)

Sponsor Not Avaiable

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UCONN | COLLEGE OF ENGINEERING

Design a wireless charging system for an autonomous underwater vehicle

Description

The objective of this project is to design and build a docking station for wirelessly charging an AUV. It is expected that a resonant inductive wireless power transfer configuration will be implemented using coupled coils as part of insulated primary and secondary circuits. The primary coil, which will be located on the charging station, and secondary coil, which will be located on the AUV, will be flat and have sub-centimeter gap resulting to a high coupling coefficient (~0.8. It is expected that the charging rate will be up to 4 A and the AUV will be recharged in ~ 5 h.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 58

Team 58

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Non-UConn Advisor

None

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UConn School of Engineering

Other Sponsor (Text)

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UNIVERSITY OF HARTFORD

Design of an Articulating Ankle Joint for a Lower SCUBA Prosthetic

Description

The objective of this project is to provide the University of Hartford Prosthetics and Orthotics M.S. graduate students a variable angle foot/ankle prototype for sub-surface dive environment testing.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 59

Team 59

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Non-UConn Advisor

None

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Unicorr

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Unicorr Packaging Group

Sponsor Image

Alternate Sourcing for Critical Parts

Description

The Unicorr Packaging Group wanted to increase the cost-effectiveness of their manufacturing process. Three parts used in corrugated cardboard manufacturing, the feed roller, small roller, and tamper, were redesigned and sourced from alternate locations to decrease cost by at least 20% and decrease the failure rate by at least 10%. Material analysis and testing showed that the rubber coating used in the feed roller should be Natural Rubber (NR), Neoprene (CR) or Polyurethane (EU/AU). Polyurethane is currently used, but NR and CR have similar attributes at similar price points. The MEM portion of the team redesigned the small rollers to achieve 98% cost reduction per year due to stronger parts reducing machine downtime and costing less. Based on manufacturability and strength, the metal used in the redesigned tamper is 7075 Aluminum. Further, Ansys simulation of deflection on the tamper under 96 psi showed that adding a bottom support bar measuring 1.5” by 3” to the base of the existing tamper design and decreasing the height of the vertical portion to 4.5” decreased deflection by 95.4% compared to the original design. The original cost of the tamper was $4.4k, with the production method and material unknown. Requesting quotes from local companies for the improved tamper design showed an average price decrease of $2.7k using various manufacturing methods. The cheapest fabrication method to be considered involved the use of additive manufacturing techniques like FDM and SLA. Investment casting options were overall better for bulk purchasing, and CNC was a cost-effective choice as well with an individual price decrease of $700. Overall, the redesign exceeded the initial goal of lowering the part cost by a range of 16.03% to 89.2%.

Figure One

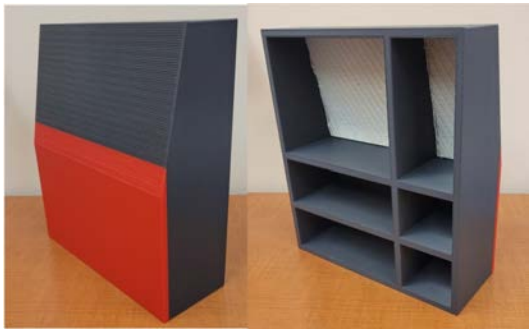

Figure Two

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 60

Team 60

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Non-UConn Advisor

Joseph Konicki

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Unicorr

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Unicoor Packaging Group

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Paper Dust Collection Imporvments

Description

Improvement of dust and scrap collection, for the 924 Die Cutter. This machine creates a lot of dust and scrap debris. We have been assigned the task to find a solution that would allow for easier removal of these scraps.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 61

Team 61

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Faculty Advisor(s)

Ryan Cooper

Non-UConn Advisor

None

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Willington Nameplate Inc.

Other Sponsor (Text)

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Sponsor Image

Automated Painting Process

Description

Willington Nameplate in Stafford Springs Connecticut are seeking to transform their permanent labeling solutions which serve many industries from automotive and aerospace to food. One of their most common manufacturing processes involves sheets of stainless steel approximately 0.020” thick measuring 18”x24”. The label information is etched approximately 0.001 - 0.003” deep and then the entire sheet is manually painted with a High-Volume Low-Pressure (HVLP) spray paint gun. Paint in the non-etched surfaces is removed before the individual labels are cut from the sheets. The manual spray painting process has many variables that can impact the quality of the labels. These variables include but are not limited to operator fatigue, spraying inconsistently across the sheet, and too high or low pressure on the gun. Senior Design team ME61 is tasked with integrating the manual spray gun into a seamless automated solution which utilizes a collaborative robotic arm. After the completion of the project, a proof of concept solution and optimal criteria for spray painting with robotics is to be provided to the sponsor. The team is working on designing an end-effector for the manual spray gun and electrical components to allow automatic actuation. In depth experiments with multiple trials are conducted at a paint booth in UConn to figure out the optimal painting path and fan shape configurations for the spray gun. The team will be assessing the quality of the finished paint job by following industry standards such as adhesion tests. Programming of the painting path will be done using the UR10e robot's complimentary software and teaching pendant. Safety requirements such as an emergency stop button and variable speed control are implemented to allow a manual operator to safely work alongside the robot. Furthermore, a protective sleeve and other coverings were applied to the robot to protect all of its vulnerable components.

Figure One

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 62

Team 62

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Anna Tarakanova

Non-UConn Advisor

None

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Windham Dental

Other Sponsor (Text)

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Jaw Bone Quality Assessment Process

Description

This project aims to develop a method to assess the quality of medullary bone in the jaw, using a novel approach that utilizes both Ultrasound and CBCT scan imaging. We were able to perform preliminary imaging and processing of a bone sample. We also propose a method to implement an Inertial Measurement Unit (IMU) to facilitate the alignment of the two images for real-time co-registration.

Figure One

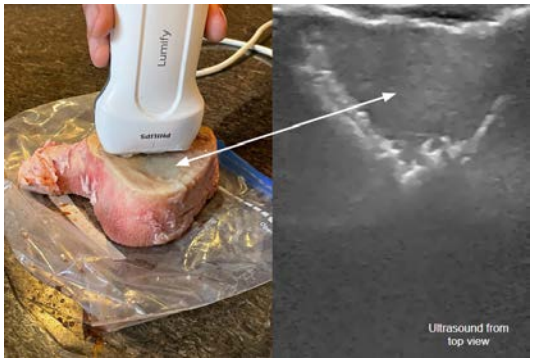
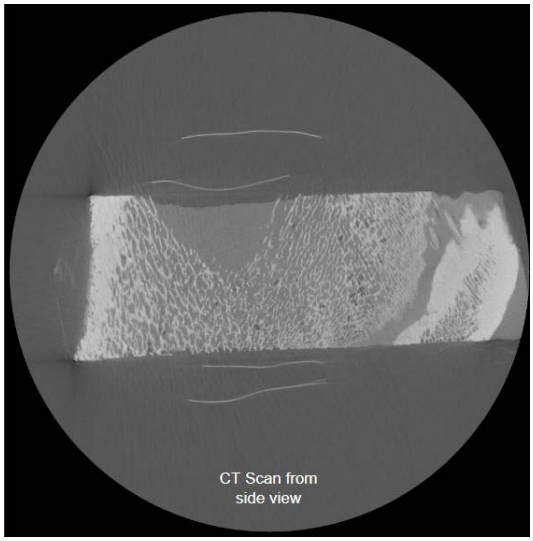


Figure Two



MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 63

Team 63

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Emerson Willcutts
Quinn Ottilige

Faculty Advisor(s)

Dr. Wilson Chiu

Non-UConn Advisor

None

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Zachry Nuclear Engineering, Inc.

Other Sponsor (Text)

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Pipe Freezing in Stagnant Lines

Description

Power plants must evaluate their susceptibility to incidents akin to the 2021 Texas power crisis. Frigid temperatures caused water-filled pipes outside the primary process flow (known as dead legs) to freeze, disrupting power generation and leading to widespread outages. This project aims to improve upon last year's setup for testing thermal mixing within a dead leg under freezing conditions. To achieve this, the flow rate of the primary process flow must maintain laminar flow to prevent momentum-induced mixing, a well-understood phenomenon. The ambient air surrounding the dead leg must be chilled to sub-freezing temperatures of at least 20 degrees Fahrenheit. Two dead legs, measuring 10 feet each, will be utilized in the experiment—one with a 2-inch diameter and the other with a 1-inch diameter. The fluid within the main process flow will be heated to temperatures ranging from 80 to 120 degrees Fahrenheit to observe the effects of thermal mixing at different temperature levels. It can be determined when freezing occurs within the dead legs using thermocouples inserted along its length.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 64

Team 64

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Ethan Bushman

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Professor David Giblin

Non-UConn Advisor

None

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Creative Conners, Inc.

Other Sponsor (Text)

Creative Conners, Inc.

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Design & Engineering of an Automated Entertainment Industry Chain Motor

Description

Chain motors, also referred to as chain hoists, are one of the most commonly used machines to apply mechanical advantage to position and maneuver loads. Current models available are typically intended for industrial purposes, where they are used to move heavy loads at single, slow speeds. For applications in the entertainment industry, slight modifications to chain motors are applied, such as painting it black and inverting it during installation. However, these alterations don't take the motor's horsepower or noisy operation into consideration, resulting in unideal speed and load capacities, and potentially disrupting a production or performance. This project aims to improve automation within the entertainment industry by designing, engineering, and prototyping a chain motor that operates quietly with a higher level of precision. Its targeted constraints are a load capacity of approximately 2000 pounds, and the ability to operate at variable speeds up to 12 inches per second. Our design takes full-system integration with our sponsor's product line into consideration with primarily off-the-shelf components, as well as simplification of both transportation and installation procedures. Design features include a static motor body, custom chain wheel and accompanying chain guides, and the ability to be rotated 90 degrees, such that it can be installed and rigged horizontally or vertically, depending on the venue and application. Our design abides by BGV D8+ rigging standards, which state that the hoist must be static, support the attached load without need for secondary supports, and cannot be operated while people are under the load. Additionally, the design considers the ESTA ANSI E1.6-1 and E1.6-2 certifications, which, respectively, refer to the design, inspection and maintenance requirements, as well as the selection, installation and use guidelines for chain hoists within the entertainment industry.

Figure One

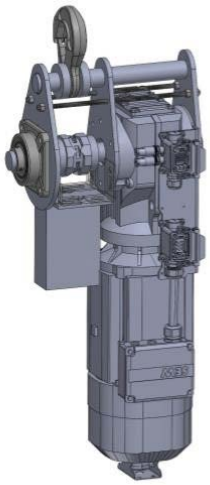
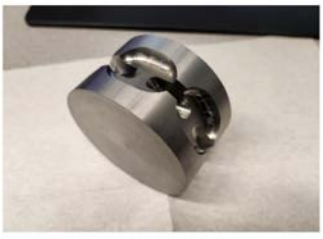


Figure Two



MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 65

Team 65

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Faculty Advisor(s)

Francesco Carbone

Non-UConn Advisor

None

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UConn School of Engineering

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Sponsor Image

Designing and operating an experimental facility to study non-premixed flames of pre-heated (and pre-vaporized) reactants.

Description

This project involves the development of a pre-heating system meant to vaporize liquid fuels and pre-heat reactants past room temperature and pressure to 650 K, for research applications in the FANTastic Laboratory. FANTastic Labs' main research focus is the study of the formation of carbonaceous particulate matter (soot). Currently, UConn's FANTastic Laboratory lacks the ability to effectively preheat fluid fuel and reactants to the 650 K target. This project aims to enable the lab to conduct research on the relation between soot formation and the pre-heating of pre-vaporized reactants. In the case of easily decomposing fuels (like Isooctane), pre-vaporization must precede significant preheating. This requires a more gentle initial preheating method, in the case of this project, achieved via a system that pre-heats and mixes a nitrogen stream (preheated from 298 K to 700 K) with an aerodynamically atomized liquid iso-octane stream. The mixed stream must then be re-heated to and maintained at a temperature of 650 K, prior to being sent for combustion and subsequent Gas Chromatography analysis. This report project involves the design, component selection, testing, and integration of the pre-heating/pre-mixing system with both a counter-flow and a planar mixing layer burner system.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 66

Team 66

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Faculty Advisor(s)

Julian Norato

Non-UConn Advisor

None

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UCONN, Dr. Julian Norato

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A Julia Implementation of Density-Based Topology Optimization for Dynamics Problems

Description

This project consists of two parts: the first is a Julia implementation of existing topology optimization algorithms written in MATLAB. The existing codes are simple compliance minimization problems, but due to the nature of traditional high-level scripting languages like MATLAB, become computationally expensive as problem sizes increase. Julia, while another high-level scripting language used for scientific computing, boasts that it is closer in terms of computation times to compiled languages like C. While still being slightly slower, it is computationally advantageous to perform such topology optimization algorithms in Julia compared to MATLAB. The Julia implementation of the compliance minimization topology optimization problems will demonstrate equivalent outputted results at a fraction of the computational cost. The second portion of this project will be to augment the Julia compliance minimization code for solid, isotropic structures to solve for dynamics based criteria. The extension to dynamics driven criteria will require additional features in the topology optimization code. The topology optimizer will be capable of determining and designing based on the natural frequencies of the structure, so an eigen-solver will be required in the code. There will also be additional requirements in the calculation of design sensitivities, as well as accommodating for spurious modes. The performance of the structures will finally be evaluated using ABAQUS.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 67

Team 67

Dwaritha Ramesh

Faculty Advisor(s)

Xinyu Zhao

Non-UConn Advisor

None

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Acc Masters

Other Sponsor (Text)

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Computational Thermal Fluids Laboratory

Detonation for Small Scale In-Space Propulsion

Description

This project is a simulation-based investigation undertaken as part of the Accelerated Masters program and aims to provide significant proof of the feasibility of Rotating Detonation Engines (RDEs) for use in small-scale space applications. Currently, most satellites and small spacecraft use conventional liquid rocket engines for propulsion. However, the U.S. Air and Space Forces have emphasized that enhanced surveillance of cislunar space is essential to expand the capabilities of the space warfighter. This necessitates the introduction of more efficient and highly versatile propulsion systems. RDEs (which produce thrust through the propagation of detonation waves around an annulus) have been identified as a promising mechanism for small-scale applications, as they can be up to 10% more efficient than conventional rocket engines, significantly lighter, and mechanically simpler. In this project, computational fluid dynamics (CFD) simulation is used to study heat transfer in a small RDE with the objective of enhancing understanding of detonation, considering the range of complexities (such as curvature effects and added thermal stresses) associated with the small device scale. This simulation-based project is complemented by an experimental study at the University of Alabama in Huntsville, the results of which will be analyzed to further the overarching goal of contributing to a discussion on the feasibility of using RDEs for small scale in-space propulsion. Within the Senior Design scope, the focus of this project has been to produce high-quality meshes of a complex geometry and baseline reacting flow data to enhance future analysis and confirm boundary conditions.

Figure One

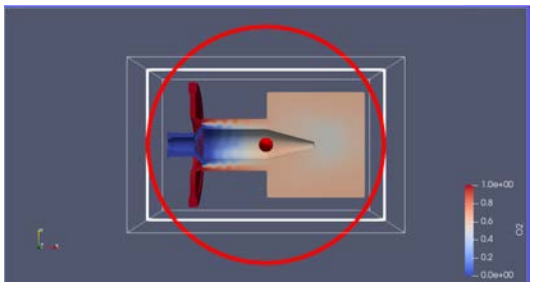

Figure Two

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 68

Team 68

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Faculty Advisor(s)

Mihai Duduta

Non-UConn Advisor

None

Sponsor (Text)

UConn School of Engineering

Other Sponsor (Text)

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THE ROBOT INCUBATOR

Fabrication of collapsible grippers for space applications

Description

This project focuses on the development of innovative collapsible grippers tailored for space applications. These grippers harness the cutting-edge technology of dielectric elastomer actuators (DEAs), enabling them to withstand the rigors of extreme space environments while offering unparalleled gripping versatility. Engineered for deployment from satellites, our grippers empower precise manipulation and handling of objects in the challenging conditions of outer space. Unlike conventional grippers, our solid-state dielectric elastomer proprioceptive gripper transcends many limitations posed by space environments. Its unique advantages include the ability to operate across a wide temperature range from -150°C to 500°C, resistance to compression, collapsibility into a compact form factor for deployment, and the adaptability of additive manufacturing to create custom gripper designs tailored to specific applications.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 69

Team 69

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Faculty Advisor(s)

Mishu Duduta

Non-UConn Advisor

None

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Acc Masters

Other Sponsor (Text)

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Optical Switching System in an Underwater Soft Robot

Description

The objective of this project is to create a working optical switching system that can control a Dielectric Elastomer Actuator (DEA) and Electroadhesive pad. This DEA must act as the robot fin in order to control the robot. The DEA must function with the optical switch in order to accurately control the movement of the robot based on the current flow. Being able to control the current flow and states of the DEA, on and off, will allow the robot to function for its intended purpose. Electroadhesion will be implemented in this project as well and attached to a soft robot to be used for a variety of applications and with the optical switch.

Figure One

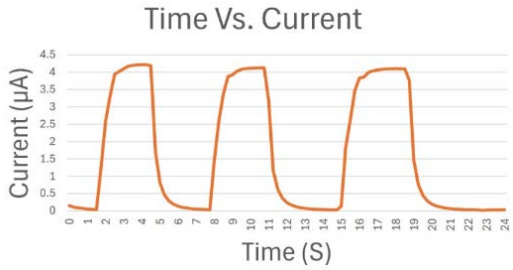
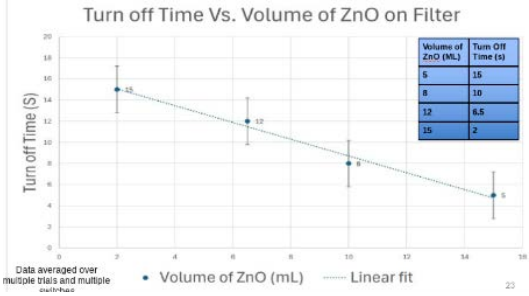


Figure Two



MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 70

Team 70

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Chao Hu

Non-UConn Advisor

None

Sponsor (Text)

Acc Masters

Other Sponsor (Text)

Sponsor Not Avaiable

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RELIABILITY ENGINEERING & INFORMATICS LABORATORY

Early Life Prediction of Lithium-Ion Batteries using Machine Learning

Description

Lithium-ion batteries are widely used as power sources, but they degrade over time. Knowing the remaining useful life of Li-ion batteries, especially at the early stage of their lifespans, promotes the early detection of abnormal or faulty cells. However, there don't currently exist commercially available software solutions that can streamline the process of data acquisition, data processing, and visualization, which are essential for future machine learning endeavors. By focusing on improving data acquisition and visualization capabilities, the aim is to lay a solid foundation for potential future machine learning applications.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 71

Team 71

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Faculty Advisor(s)

Mihai Duduta

Non-UConn Advisor

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University of Connecticut

Other Sponsor (Text)

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Fabrication of an Electroluminescent Surface

Description

The Engineering Challenge: Soft electroluminescent surfaces can be used for novel communication strategies, in conjunction with smart textiles, but are difficult to fabricate over large areas. Description of Problem/Project: Soft materials that can produce light are an exciting alternative to rigid components in that they can be added to smart textiles, incorporated in wearable medical devices, etc. Challenges include fabrication of large area materials, demonstration in biocompatible systems, such as those including silicone elastomers, as well as power and autonomy. Expected Deliverables/Approach for Senior year: Demonstrate scalable large area fabrication of luminescent soft materials. Develop control strategies based on off-board power electronics (to be developed by a graduate student) that can drive systems at >200 Hz. Demonstration of a luminescent skin on a robot body for enhanced camouflage and communication strategies.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 72

Team 72

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None

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Pratt & Whitney

Other Sponsor (Text)

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Gas Turbine Combustor Effusion Cooling Heat Transfer

Description

The effusion cooling project is an ongoing research effort in the Combustion and Gas Dynamics Laboratory (CGDL) at the University of Connecticut. This project is experimentally-focused, and seeks to quantify the heat transfer characteristics of effusion cooling designs for combustor linings in gas turbine engines. This involves the use of a test section placed downstream from a swirl burner and transition section, which adequately simulates the high thermal stresses inside a typical aero-engine combustor. Within the test section is an effusion test plate, as well as an inlet for the coolant, which in this case is carbon dioxide at specified blowing ratios. Several metrics such as hole angle, spacing, internal contraction, diameter, and coatings can be changed from one design to another. Two optical methods are used to quantify heat transfer characteristics: IR Thermography & Laser Rayleigh Scattering (LRS), and ME72 focuses on IR Thermography to gather information on cooling effectiveness of designs.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 73

Team 73

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Experimental Characterization of Effusion Cooling in Gas Turbine Combustors

Description

The objective of this project was to improve our Planar Laser Rayleigh Scattering (PLRS) test diagnostic and utilize it to characterize the temperature gradient and cooling film effectiveness of a set of effusion cooling configurations in gas turbine combustors. Effusion Cooling, a cooling technology utilized by Pratt & Whitney, is the technique of interest for this project and is an array of angled holes that allow coolant flow through the combustor liner and creates a protective film above the liner surface. Altering the geometry and patterns of effusion cooling holes can improve cooling performance and PLRS testing allows us to quantify and compare performance between configurations. The laser beam expanding optical setup was completely redesigned and implemented to improve PLRS, operating as a Galilean telescope and forming a laser sheet to cover the entire effusion array. This new setup will be used in an upcoming PLRS test campaign to test six thermal barrier coated and five uncoated effusion configurations and characterize their near-wall temperature gradient and cooling film effectiveness. Infrared Thermography (IR) testing was also done as a part of this project on these 11 configurations to obtain surface temperatures and cooling effectiveness data. This IR data coupled with PLRS data will allow us to identify high performing configurations and help Pratt & Whitney to further develop effusion cooling technology.

MECHANICAL ENGINEERING

Senior Design 2024 – Mechanical Engineering Team 74

Team 74

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NATIONAL INSTITUTE FOR UNDERSEA VEHICLE TECHNOLOGY

Machine Learning Based Digital Twinning Testbed

Description

The overarching goal of this project is to synthesize a digital twin testbed that can provide credible data for data analytics investigation. The testbed will then be subject to multi-scale modeling and analysis, and machine learning for fault diagnosis. Digital Twin is a virtual image of an asset, maintained throughout the lifecycle and should be easily accessible at any time. It is an essential part of our digital asset ecosystem, and will enable a new generation of advanced analytics and understanding of the product. Despite rapid progresses in data analytics for system diagnosis and prognosis, the research community as a whole lacks methodology validation using a controllable testbed that can exhibit various failure modes under different operational conditions. The scarcity of data and the general lack of systematic methodology of experimentation hinders the further advancement of digital twinning as the results obtained may not be easily extrapolated. In this project, leveraging an on-going naval research, we plan to synthesize an experimental testbed with representative machinery components and data acquisition system. Various failure modes will be injected into the testbed system. Preliminary data analysis will be conducted for modeling validation and fault analysis that leverage state-of-the-art machine learning techniques.

Figure One

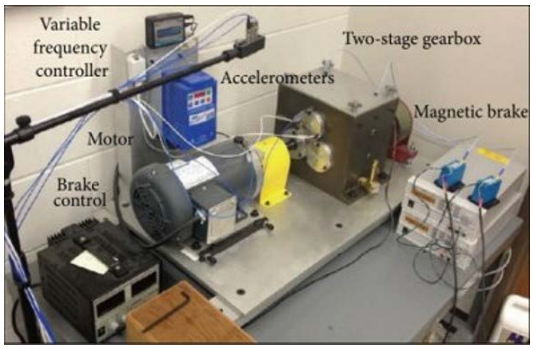
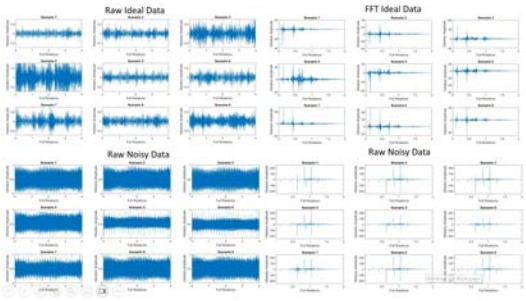


Figure Two



Systems Engineering Department Senior Design Teams

Senior Design 2024 – Systems Engineering Team 01

Team 01

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Pratt & Whitney

Other Sponsor (Text)

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Data Collection and Analysis for an Autonomous Electric Vehicle System

Description

An autonomous land rover is a sophisticated vehicle that exhibits complex behavior given various environmental conditions that may occur along a given path. The objective of this project is to develop and execute a data analysis framework capable of precisely predicting the self-driving vehicle's reactions to input directives. This framework aims to diminish fluctuations in responses within both Software-in- the-Loop (SITL) simulations and Hardware-in-the-Loop scenarios. The foundation of this initiative rests upon a data-driven control system tailored for electric vehicles, harnessing the power of machine learning algorithms. These algorithms are designed to acquire insights into the vehicle's behavior through data assimilation and subsequently fine-tune control parameters accordingly.

SYSTEMS ENGINEERING

Senior Design 2024 – Systems Engineering Team 02

Team 02

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Sonalysts, Inc.

Other Sponsor (Text)

Sonalysts, Inc.

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SONALYSTS

Kubernetes Cloud Orchestration Simulation

Description

Our senior design project is a locally-executed simulation of a Kubernetes' application scheduler that was created with our chosen simulation tool: KWOK. This project, sponsored by Sonalysts, Inc., was required to demonstrate several aspects of the scheduling process, including pod priority, pod failures, and the ability to show computing resource consumption. Before picking our final cloud technology, we conducted hands-on research on a number of other platforms like K3D/K3S, Alibaba, and Rancher. To rule out other options, we also considered evaluation criteria such as licensing/pricing, deployment time, and access to documentation. We completed this project by setting up a local instance of KWOK in a virtual machine so we could run commands, create nodes and pods, and showcase the behavior of the application scheduler. Through this, we found a variety of commands and pod test sets that allowed us to show various behaviors regarding how Kubernetes handles conflicting priorities and resource needs. We also streamlined the programming process by developing a Python script to simplify commands and test sets for easy use. Alongside our software deliverable, we also created a poster board, video, and documentation to compile all of our findings and research for this design project.

SYSTEMS ENGINEERING

Senior Design 2024 – Systems Engineering Team 03

Team 03

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ABB

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Sonalysts

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Design and Development of PV/Thermal System for Greenhouses

Description

This project provides the design, development, and analysis of a scaled-down cost-effective photovoltaic/thermal system that can be integrated into a greenhouse roof. Photovoltaic and thermal systems are considered conventional green energy methods that work well but would be more beneficial if integrated together. This is because traditional photovoltaic systems can become inefficient when they reach high temperatures. By including a thermal system, cooling can be provided to the photovoltaic system while simultaneously producing thermal energy to heat a greenhouse. Although both photovoltaic and thermal systems are considered traditional energy systems, combining them to power a greenhouse is a relatively new concept. This project documents the integration plan for the photovoltaic thermal system for a hypothetical greenhouse located at the University of Connecticut.

SYSTEMS ENGINEERING

Senior Design 2024 – Systems Engineering Team 05

Team 5

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Nel Hydrogen

Other Sponsor (Text)

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Optimizing Water and Oxygen Phase Separation in Electrolyzers with T-Junction Technology

Description

As we shift away from a carbon economy, hydrogen energy is emerging as a viable alternative energy form. Nel Hydrogen creates electrolyzers that produce hydrogen by splitting H2O into hydrogen and oxygen molecules through a process known as electrolysis. It yields a stream with liquid water and gaseous oxygen, and a separate stream of pure hydrogen. The liquid water enters an outlet stream because not 100% of the water splits into hydrogen and oxygen. The hydrogen stream can then be used, transported, or stored as a potential energy source. Pump cavitation is an undesired condition where gaseous bubbles enter pumps and potentially collapse or implode when they encounter regions of higher pressure. Pump cavitation causes intense localized forces on pump components, resulting in erosion, pitting, and structural damage to the pump. To prevent pump cavitation, we are simulating T-junction designs to separate the oxygen and water into different outlet streams using ANSYS Fluent software. By adjusting factors like velocity, tank length, and inlet and outlet diameters, we can conduct a sensitivity analysis. By manipulating variables, we can optimize the performance of the separator. By improving the separation efficiency, we can reduce the necessary inlet deionized water, reducing electrolyzer operating costs. This optimization will also improve the longevity and compactness of the electrolyzers. This project contributes to the ever-advancing landscape of green hydrogen energy as a step towards reducing our global carbon footprint.

Figure One

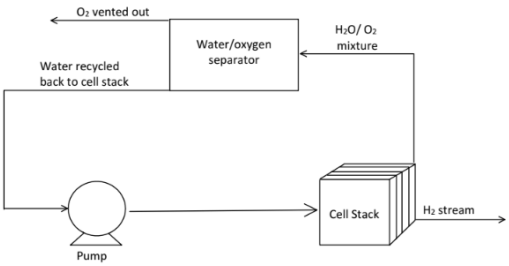

Figure Two