UCONN | SCHOOL OF ENGINEERING

SENIOR DESIGN

DEMONSTRATION DAY 2022

HARRY A. GAMPEL PAVILION   APRIL 29TH

SENIORDESIGN.UCONN.EDU

ECONOMIC IMPACT STARTS HERE

The capstone Senior Design Project Program is a hallmark of success for engineering seniors. In this one or two-semester course, senior students are mentored by faculty and industry engineers as they work to solve real-world engineering problems for company sponsors. Students learn about the principles of design, how ethics affect engineering decisions, how professionals communicate ideas and the day-to-day implications of intellectual property.

Each year, dozens of leading manufacturing companies, pharmaceutical and medical firms, consulting practices and utilities present the School of Engineering with design challenges or problems they are encountering in their business. For a modest fee, the companies suggest a particular problem and assign a technical representative from their company who will help guide and mentor the senior engineering students as they work to properly frame the problem and develop meaningful solutions.

The students research and analyze the problem, conceptualize alternate solutions, design and refine one device or method, construct a working prototype, and provide the sponsoring company with regular reports plus a working prototype. This true design experience allows the students to apply the technical skills they have acquired during their undergraduate years, and to stretch their abilities in analysis-based innovation and decision making.

For more information:
Charles Maric, Director of Technical Business Development, Senior Design Projects
UConn School of Engineering
261 Glenbrook Road, Unit 4031 Storrs, CT 06269-4031

Mobile: (860) 428-2258
Office: (860) 486-2297
charles.maric@uconn.edu

Address a Challenge or Explore a New Idea

Sponsoring a Senior Design project allows sponsors to address a problem without the large investment.

Strategic Recruiting

Sponsors have nine months to collaborate with, cultivate and evaluate undergraduate students as prospective employees.

Access to UConn's Unique Resources

Senior Design Projects also give you access to UConn faculty, who have expertise and state-of-the-art laboratories and equipment.
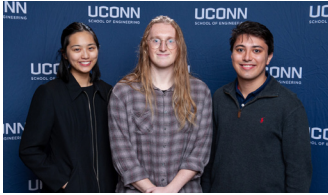
Visibility

As student teams and faculty gain exposure to your organization's resources, products/processes and culture, they will spread awareness of your organization.

Value

Business and organizations have meaningful access to talented engineering students who provide high-level insight and innovative technological solutions, for a small financial investment.

Greetings and Welcome to Our Senior Design Demonstration Day!

Senior Design is the final experience of our students' undergraduate career, a year-long process that provides a hands-on application of the principles and theories they have spent the previous three years honing. Students learn and apply the principles of design; the complex interplay among engineering solutions and societal, environmental, economic and ethical considerations; the language of industry; and the power of engineering to catalyze new solutions to entrenched problems such as sustainable energy, access to clean water, agriculture, transportation and health.

Each and every year, 75-plus organizations, large and small, partner with the UConn School of Engineering to not only fund projects, but also donate valuable mentorship time, as well as solidify the unique information-sharing pipeline that the School and University has with the engineering community. With the generous support of all of our sponsors, seniors get direct access to talented engineers in the industry, as well as valuable hands-on experience in a group setting. Additionally, by solving real-world problems, and creating innovative solutions for companies, the School of Engineering, and its students, drive significant economic impact towards the sponsoring companies and the state of Connecticut as a whole.

These students will be graduating shortly. They will soon embark on the next portion of their engineering journey, whether that be graduate school or the beginning of their careers. They are the future of our discipline, and I am both proud of the role UConn has played in their development and humbled at the thought of what they can achieve.

Cordially,

Kazem Kazerounian
Dean, UConn School of Engineering

TEAM 1

Max Barton
Joseph Castellano
Ling Chi

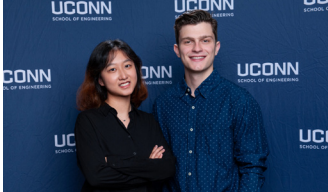**ADVISOR**

Guoan Zheng

SPONSOR

UCONN
SCHOOL OF ENGINEERING
BIOMEDICAL ENGINEERING

Device and Mobile App for Retinal Imaging Diagnosis

The purpose of this design project is to build a smartphone-based non-mydriatic device that can capture and diagnose a fundus image for diabetic retinopathy and other ocular diseases. The device will consist of a smartphone and an adapter that will include a 45 degree mirror that will be used along with a solid core fiber optic cable to make the smartphone camera and the light coaxial. The image is captured through a 20D lens that magnifies the retina. An Android smartphone application provides a simple UI that allows for image capturing and diagnosis using a trained deep learning image classification model. This product is designed with off-the-shelf and 3D printed PLA components to allow for easy access to income countries which account for 90% of global visual impairment cases.
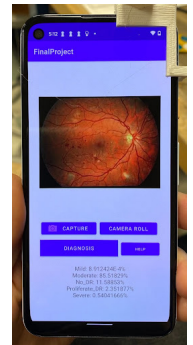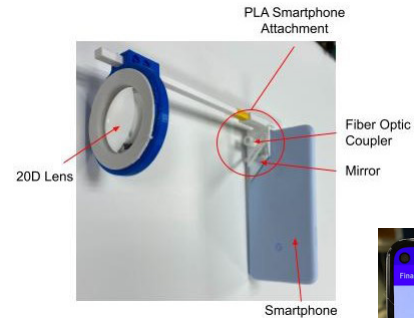
TEAM 2

Vlad Ilies
Yuan Wang

ADVISOR

Patrick Kumavor

SPONSORS

Jeff Holland
Nathaniel Rickles

Opioid Misuse Prevention Packaging

The purpose of this design project is to propose a novel, affordable, and effective design to replace current opioid packages/containers with enhanced child-resistant and senior-friendly features in an effort to curb the opioid epidemic in the United States. The focus is on refining and improving the child-resistant features of current opioid packaging techniques while at the same time discouraging opioid misuse and abuse in adults using a novel self-closing and dose-controlling opioid packaging design.

TEAM 3

Sofia Berrio
Silas Decker
Grace-Curley Holmes
James Roberts
Amy Tran

ADVISOR

Fayekah Assanah

SPONSOR

UCONN
SCHOOL OF ENGINEERING
BIOMEDICAL ENGINEERING

Genetically Modified Yeast as a Novel Viral Detection Mechanism for Bovine Viral Diarrhea Virus

Proof of principle study for robust viral detection methodology using genetically engineered yeast.

TEAM 4

Jacqueline Cooper
Margaret Easson
Nayara Zainadine

ADVISOR

Liisa Kuhn

SPONSOR

Beekley Family Foundation,
Connecticut Breast Health
Initiative, UConn School of
Engineering

Biosymmetrix

The purpose of this design project is to develop improved breast forms for women who have gone through a single or double mastectomy. After a mastectomy, breast cancer survivors are left with scars from the procedure where their breasts once were. This can leave patients with a feeling of being noticeably different and impact their overall self-esteem. Current breast forms are commercially available and come in a myriad of materials and styles, however, they all encompass the same issues: lack of natural symmetry with patients' chest walls, uncomfortable fit, and a heavy weight that acts as a reminder of the breast forms' existence. Through the use of a bioprinter, an elastomer will be used to create a more suitable breast form for each individual patient. The fit, restoration of a symmetric shape and durability will be tested by volunteers that will wear the prototypes and provide feedback.

TEAM 5

Dean Segal
Aman Malhorta
Ardi Mrruku
Nadya Ponthempilly
Rebecca Riter
Uyen Tran

ADVISOR

Yupeng Chen

SPONSOR

UCONN
SCHOOL OF ENGINEERING
BIOMEDICAL ENGINEERING

Design of Microfluidic Systems via 3D Printing

The objective of this project is to design and fabricate a microfluidic device that successfully models the development of osteoarthritis in the knee. Microfluidic systems have recently been utilized to mimic the function of human organs. These tissue chips allow for different cell types in the tissue to communicate as they would in the body through the microchannels. Our tissue chip design consists of six channels. Four of the channels hold cells and the other two channels are used for fluid circulation. The channels from left to right on the chip design are: media circulation, bone cells, articular cartilage (AC) cells, synovial fluid circulation, synovial membrane cells, and the other media circulation connected with the first. These are specifically aligned to mimic the anatomy of the knee joint and cell signaling with osteoarthritis. The circulation channels are being circulated using automated pumps outside the system that push the nutrients around the chip for all the cell channels. A pneumatic actuator design consists of a vacuum chamber surrounding the AC cell channel to create stretch and pressure forces that stimulate the stresses on the tissue as osteoarthritis develops. Each cell channel is about 1.5 millimeters in width and the entire chip fits onto 75 millimeters by 25 millimeters glass slide.
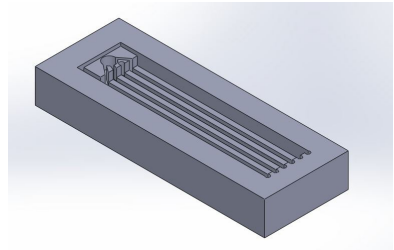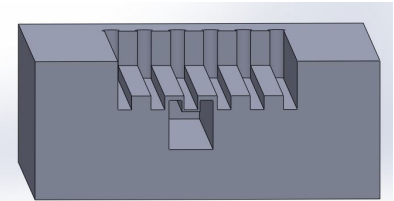
TEAM 6

Heather McGrath
Xiaolei Huang

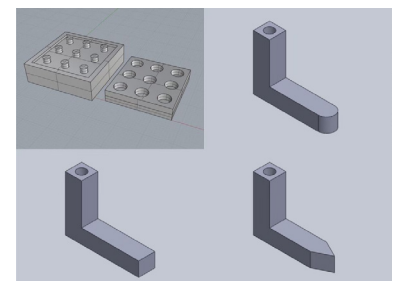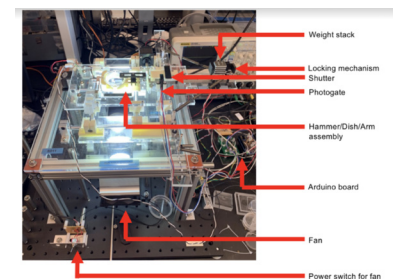**ADVISOR**

Kazunori Hoshino

SPONSOR

UCONN
SCHOOL OF ENGINEERING
BIOMEDICAL ENGINEERING

An In Vitro Study of Spinal Cord Injury

The purpose of this design project is to perform experiments on spinal cord cells to test how the applied force and speed affects the damages on the spinal cord, utilizing the testing system built for the study of Traumatic Brain Injury from previous research. The testing system consists of Arduino, camera, fan, dish, hammer with arm, locking mechanism, shutter, various weights and spring. The arduino is coded from the previous senior design team, it controls the switch to turn on the lights for the camera, sensors to measure the magnitude of the forces, and trigger the camera to take pictures when the locking mechanism is triggered; the fan is to keep the temperature consistent for the camera; testing tissue is placed in the dish that is assembled with the hammer and the arm; the applied force is varied by the weight and spring used, and the distance between the edges to the beginning of the shutter. Different hammer mechanisms will be used to mimic varying types of impact on the spinal cord. The result of this project provides the amount of forces applied and the damages to the tissues with changes in force and impact.

TEAM 7

Arushi Mathur
Megha Shankar

ADVISOR

Kazunori Hoshino

Two-Layer Tubular Structure for 3D Cancer Cell Culture and Microtissue Analysis

The purpose of this design project is to fabricate an in vitro three-dimensional two-layer tubular cell culture structure through the usage of alginate and agarose hydrogels as an environment for tumor cell growth. MCF-7 breast cancer cells will be embedded within the inner layer of the hydrogel structure. This layer will be supplemented with CollaGel, a collagen/hydrogel mixture used in place of Matrigel, a common hydrogel that mimics the in vivo basement membrane matrix in cancer cell experiments. The outer layer will resemble peripheral tissue layers. The design of such a structure lends itself to the study of cancer cell migration and invasion. The interactions between material, biological substances, and tissue behavior in relation to active tumors will be studied. By modeling the environment of a tumor in three dimensions, more accurate data of in vivo conditions can be obtained when combined with therapeutics for the treatment of diseased tissue. The result of this project provides valuable information to pharmaceutical companies and cancer patients, in addition to researchers as it expands on cancer research on an in vitro scale and provides more knowledge on the interaction of drugs with tissues outside the body.
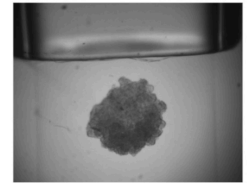

Figure 2 – Early prototype of the inner layer consisting of a tumor spheroid, CollaGel, and agarose without the incorporation of the sodium alginate outer layer
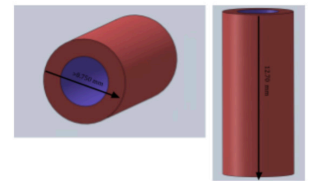

Figure 1 – SolidWorks prototype of a two-layer three-dimensional structure for cancer cell culture with an inner layer (purple color) created by incorporating MCF-7 tumor spheroids with CollaGel (Matrigel alternative), and agarose micro-dipped in an sodium alginate hydrogel outer layer (red color).

TEAM 8

Devin Kot-Thompson
Courtney Luker
Sophia Murphy
Gillian Murray
Joel Thomas Sajan

ADVISOR

Kazunori Hoshino

Development of a Smart Shunt System

The purpose of this design project is to further develop an interface to non-invasively monitor cerebrospinal fluid (CSF) flow in commercially available cerebral shunts. The two main components of this interface system are the internal, implanted sensor unit and the external unit. The main goal of this project is to provide an improved quality of life for patients with hydrocephalus. A smaller sensor housing unit will improve patient comfort, while the addition of a spectrophotometer will detect contaminants in the CSF and provide more information to the patient. Using Bluetooth transmission, CSF flow rate and CSF quality data will be sent to the patient's smart device which will display real-time information and alert the patient if necessary. The wearable external unit will be redesigned for optimal patient comfort for continuous monitoring. Providing the patient with real-time data will reduce the number of unnecessary hospitalizations for hydrocephalus complications and will provide the patient with piece-of-mind that their shunt is functioning properly.

TEAM 9

Jeremy Bilicska
Amy Dave
Ryan Demarco
Jonathon Intravaia
Maxwell Landolina
Joshua Saba

ADVISOR

Syam Nukavarapu

SPONSOR

UCONN
SCHOOL OF ENGINEERING
BIOMEDICAL ENGINEERING

Handheld in situ Bioprinter

Our senior design project focuses on developing a handheld bio-printing device that can be utilized in tissue defect repair and regeneration. The device consists of two syringes, one for the desired bio-ink and the other for the intended crosslinker, two servo motors, and a multichannel nozzle. Ultimately, this device would be used for in situ bio-printing, which is a novel technique of tissue repair where tissues are fabricated and/or repaired directly on the intended anatomical location of the defect, using the body itself as a bioreactor.

TEAM 10

Changhun Lee
Randall Radcliff
Norlinda Steward

ADVISORS

Eirik Holbert
Patrick Kumavor

SPONSOR

NASA

Reduced Gravity Simulator for Field Environments: Drone-Augmented System

The project aims to develop a method for offloading a suited subject to simulate the reduced gravity of the moon or Mars. It will do so by suspending the person's weight with a weather balloon that will have its position guided by a drone. The drone will take inputs from the harness or the suit that the user subject is wearing, and will respond in real time to the movements made by the person. This means that the balloon will always be on top of the subject and will always be offloading a set amount of weight.

Our team collaborated with Mechanical Engineering Team 30 on this project.
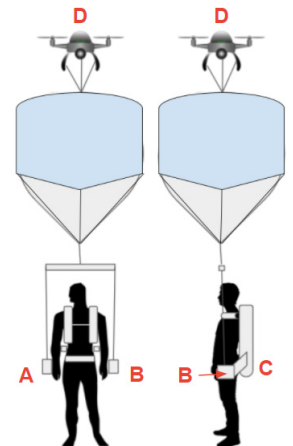
TEAM 11

Aston Foley
Arshia Puri
Jonathan Rodriguez
Kyle Vallee

ADVISOR

Patrick Kumavor

Joystick Operated Ride-On Device for Children with Cerebral Palsy

Children with cerebral palsy (CP) who have limited mobility are not able to fully benefit from traditional physical therapy methods that can help improve motor control, hand-eye coordination, strength, and their ability to interact with the environment. Traditional therapies are repetitive and unintuitive, often involving hours of repeated daily exercises. This is not engaging for CP patients which on its own reduces efficacy of the treatment. A powered-cart based therapy has the potential to be more engaging so that the patient is unaware they are undergoing physical therapy. Current powered-carts lack size adjustments to accommodate for the varying physical limitations of CP patients, control adjustments to ensure a safe experience, and data tracking to ensure the patient is progressing with their therapy. This project aims to develop a size-adjustable cart with remote safety features and data tracking for use in physical therapy of CP patients. This will be done by using an Arduino microcontroller to modify the existing cart shown in Figure 1 for accessibility, added safety, and comfortability. The result of this project will be a fun, engaging, dynamic, and accessible ride-on cart that can be used by physical therapists and families with children who have CP. The design consists of a repurposed Power Wheels ride-on cart, an Arduino Mega microcontroller, two MegaMoto Arduino shield motor drivers, a Bluetooth module, two ultrasonic sensors, and two configurable joysticks. The ride-on cart will be stripped of its existing microcontroller and joysticks and only the frame, 12V battery, and existing wheels will be utilized. The Arduino will take the place of the existing microcontroller to control all of the onboard signal processing and will be wired as shown in Figure 2. The MegaMoto drivers will take information from the Arduino and output a varying voltage to the DC motors based on the input from the joysticks.

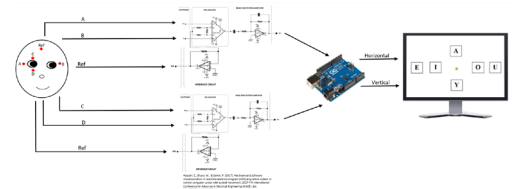**TEAM 12**

Emma Braten
David Zalozhin

ADVISOR

Sabato Santaniello

EOG-based Communication System for Patients with Locked-in Syndrome

Classical Locked-in Syndrome is a debilitating medical condition that presents as total immobility except for eye movement. To allow Locked-in Syndrome patients to communicate, human machine interfaces (HMIs) have been created and have been proven to be an effective solution. HMI technology can be defined as the combination of hardware and software components used to provide a user the ability to control an external device using signals generated by physiological processes, such as brain waves or eye movement. Electrooculography (EOG) is one of the most widely used biomedical signals in HMIs as it is typically less demanding technically, relatively low cost, and completely noninvasive. This project aims to develop an EOG-based communication system for patients with Locked-in syndrome. The goal for this design is to create a computational algorithm that will detect eye movements, such as blinks and saccades, which will be recorded by electrodes connected to an amplifier circuit. The circuit will send the signal through an arduino to the MATLAB code for classification. To identify these eye movements in the EOG signal, the first order derivative of the signal will be searched. In this new, processed signal, eye movements will result in peaks that can be easily detected. A thresholding algorithm will determine where the user is looking on the graphical user interface (GUI), and choose the correct character. The GUI will consist of the main menu and six submenus. Once the desired character is chosen, it will appear in a text box on screen, effectively allowing the user to complete words and phrases. The GUI has been designed in such a way that letters are grouped together by their frequency in English words. The accuracy and speed of character selection will be tested and compared to EOG-based spellers previously created.

TEAM 13

Jacqueline Balch
Anirudh Kurup
Abigail Potorski

ADVISORS

Andrew Abercromby
Jocelyn Dunn
Patrick Estep
Derek Haab
Patrick Kumavor

SPONSOR

Reduced-Gravity Simulator for Field Environments: Mobile Frame System

NASA seeks to advance its astronaut training programs by integrating reduced gravity simulation in field environments to prepare its astronauts better for the exploration of Lunar or Martian terrains. Currently, NASA's most advanced reduced gravity offloading system is the ARGOS, a 41' x 24' x 25' fixed frame structure that can offload a portion of an astronaut's weight to simulate any given gravitational condition. However, its static nature does not allow for in-field training at geographical locations on Earth that resemble Lunar or Martian terrains. We provide a solution through this project by demonstrating a proof-of-concept design for an automated mobile offloading system that maintains a constant ⅚ G offloading force on an astronaut and can move as the astronaut moves. For simplicity, we are focusing only on the simulation of Lunar gravity, which is equivalent to approximately ⅙ G. This project combines the knowledge and skills from three different departments: Biomedical Engineering, Mechanical Engineering, and Dramatic Arts. Due to the complexity, budget constraints, and safety risks associated with developing a full-scale, mobile structure, we decided to split the project into two major components: a static, large-scale, frame structure (similar to ARGOS) that demonstrates the offloading capabilities and a dynamic, small-scale, chassis-wheel design that demonstrates mobility through the integration of motion sensors with mecanum wheels and maintains stability on rough terrains and slopes through the integration of a simple suspension system.

Our team collaborated with Mechanical Engineering Team 31 on this project.

TEAM 14

Hadleigh Eastman
Riley McNaboe
Sarah Myrick
Raghavi
  Shanmuganathan
Alexi Switz

ADVISOR

Krystyna
  Gielo-Perczak

SPONSOR

Stress of Patients under Compression of Hologic Paddle Designs for 3Dimensions™ Mammography System

This project aims to acquire and analyze physiological responses expressed by a participant during a simulated mammogram procedure to quantify the relative amount of stress and pain induced in this environment. Mammograms are routine procedures used to detect breast cancer and other tumors but are both mentally and physically taxing on patients. A multimodal approach is used to measure the participant's physiological and psychological response during their interaction with Hologic's 3Dimensions™ Mammography machine. The model considers metrics from Electrocardiogram (ECG), electromyography (EMG), galvanic skin response (GSR), and center of mass (COM) data sets as relative and reliable indicators of stress, pain, and focus. ECG measures the electrical activity of the heart, EMG measures the electrical activity in innervated muscles, and GSR measures change in skin conductance representative of sympathetic tone. The BIOPAC MP36R system is used to collect data during ECG and GSR measurements, the Delsys Trigno system is used to collect data from fourteen different muscles during the EMG measurements, and two AMTI Force Platforms are used to collect data during COM measurements. These various biophysical signals are simultaneously measured during four different paddle compressions utilizing both a traditional flat paddle and Hologic's SmartCurve Paddle. Participants are presented with a questionnaire before and after the simulated procedure to determine their history with mammograms and acquire a self-reported measure of their experience. Analysis conducted on the resulting data will provide a list of indices from each respective signal allowing for a comprehensive comparison to be made between the two paddle designs as well as an overarching empirical-based conclusion on general mammography-related stress and pain.
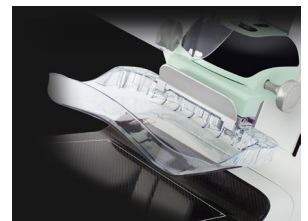
TEAM 15

Joseph Caruso
George El-Haoui
Ryswick Innocent
Aiden O'Conner
Dylan Zitomer

ADVISOR

Krystyna
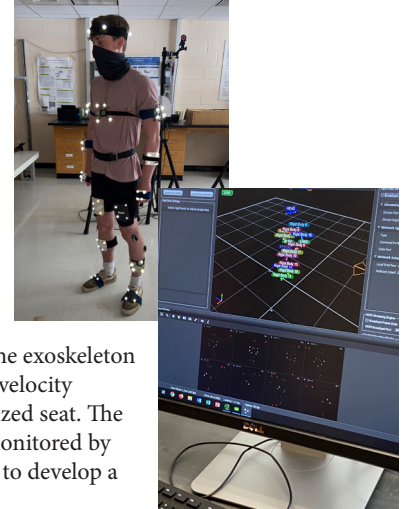 Gielo-Perczak

SPONSOR

UCONN
MSML

Multi-Systems Approach in Evaluation of Leg Exoskeleton

The purpose of this design project is to develop an exoskeleton brace that facilitates the sit to stand process. This process involves creating new motion capture markers that promote organic motion, and designing the an exoskeleton that does not limit the range of motion or degrees of freedom in the knee. In addition, the exoskeleton implements the use of an EMG trigged microcontroller to assist the motion of the leg. The exoskeleton brace is tested on patients to peform multi-system analysis using motion capture, force platform, wireless EMG, Anybody Technology, and 3D Rendering to determine the benefits the exoskeleton has on the knee joint. This is done by testing the exoskeleton by performing the sit-to-stand motion without no motorized assistance, sit-to-stand with constant velocity provided by a motorized seat, and sit-to-stand with constant acceleration also provided by a motorized seat. The control is found by repeating the trial without the use of the exoskeleton. These trials are activley monitored by the students using motion capture software along with musculoskeletal modeling software in order to develop a complete conclusion of the effects of this exoskeleton on the lower extremity.

Our team collaborated with Biomedical Engineering Team 16 on this project.

TEAM 16

Gabi Kwiatkowski
Frank A. Lewis
Adam Markowski
George Powley
Tyler Rodrigues
Cara Tran

ADVISOR

Krystyna
 Gielo-Perczak

SPONSOR

UCONN
MSML

Inverse Dynamics Analysis of a Lower Extremity Sit-to-Stand Exoskeleton

The purpose of this design project is to use the state-of-the-art software, AnyBody Technology, to analyze the mechanical effects of the use of an exoskeleton in sit-to-stand motion. In comparison to other motion capture analysis tools, AnyBody Technology software provides features such as: custom calibration, musculoskeletal analysis, force/moment-dependent kinematics, motion prediction, and visual simulation that allow us to both quantitatively and qualitatively determine how the exoskeleton influences natural motion. Motion capture data collected from a variety of subjects performing the sit-to-stand motion both with and without the exoskeleton is first configured for simulation accuracy. Complex data analysis then outputs time-dependent force and moment values corresponding to specific locations of the body. The result of this project will provide valuable feedback to biomechanical engineers on the effectiveness of exoskeleton designs, as well as subject-specific treatment information.
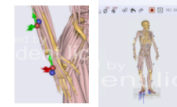
Figure 1: Simulation marker configuration done by manual readjustment of x, y, and z coordinates within AnyBody
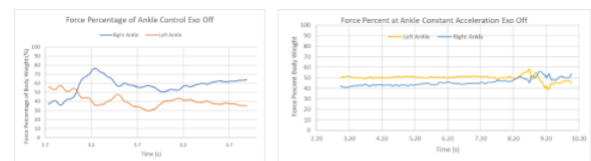
Figure 2: Normalized force percent body weight at the ankle (control trial exoskeleton off on left, constant acceleration exoskeleton off on right). This method of data analysis allows us to directly observe the impact of experimental changes on the forces at lower body joints. This normalization also allows us to compare results across different test subjects.

Our team collaborated with Biomedical Engineering Team 15 on this project.

TEAM 17

Kyle Chernoff
Rishi Krothapalli
Taylor Martel
Pradhi Patel
Eric Zeiberg

ADVISORS

Krystyna
 Gielo-Perczak
Haley Strassner

SPONSOR

Medtronic

Esophageal Testing Model for Orvil Development

The purpose of this design project is to create an anatomically accurate three-dimensional model of the oropharynx, larynx, and upper gastrointestinal regions of the human body in order to test Medtronic's Tri-Staple Orvil device for use in esophagectomies. In order to create a useable physical model, a simplified CAD model is designed to determine the relevant anatomy with the correct dimensions of a 50th percentile female so that the model represents the constraints of a majority of the adult United States population. Imitation esophageal tissue from LifeLikeBio will be used due to its similar mechanical properties to real human esophageal tissue. Uniaxial, biaxial, and inflation testing will be performed on sample LifeLikeBio tissue and compared to results from tests done on porcine tissue samples to validate the properties of the tissue used for the model. The LifeLikeBio tissue will be attached to the 3D printed CAD model creating a life like mucosa for the esophageal model. Both aspects of the three-dimensional model will create an anatomically and biomechanically accurate human model.
The results of this project will allow Medtronic to begin testing their stapling device on a model that is as close to humans as possible, providing valuable insight on the device's effects on human anatomy for the rollout of their surgical device, while also aiding in the testing of newer and better technologies for future projects.

Our team collaborated with Mechanical Engineering Team 28 on this project.

TEAM 18

Leah Faber
Sydney Griger
Olivia Rice
Leah Sobotka
Kristen Soldau
Apolline Vincent

ADVISOR

Fayekah Assanah

SPONSOR

UCONN
SCHOOL OF ENGINEERING
BIOMEDICAL ENGINEERING

Design and Fabrication of Soft Hydrogels to Mimic Brain Matter to Model Traumatic Brain Injury

The purpose of this project is to design and fabricate a hydrogel that mimics the mechanical properties of brain matter. This will provide an accurate in vitro brain model to study traumatic brain injuries. The design being considered is a natural and biocompatible gelatin-alginate based hydrogel. In this study, the concentrations of both gelatin and alginate are varied to fabricate a hydrogel that mimics the linear and non-linear viscoelastic properties of the brain matter as studied in the literature. Rheology testing will validate the mechanical properties of these hydrogels to that of the brain matter. Thus, this design will provide an accurate three dimensional (3D) in vitro brain tissue model that can be utilized by future researchers to study the cellular response of the brain when subjected to forces comparable to the ones that cause traumatic brain injuries.

TEAM 19

Zachary Briggs
Nader Kasem
Hailey Parsons

ADVISORS

Patrick Kumavor
Matt Valentine

SPONSOR

defibtech
Life-Saving Technology Within Reach

Mechanical Human Thorax Model for Automatic and CPR Device Testing

The mannequins for CPR training used today is not an adequate and accurate model of an actual human chest. The human chest contains organs and tissues which will cause the chest to recoil more than that of an empty foam dummy. There must be a device implemented that will provide the recoil or dampening effect into the CPR mannequins. The design of a new mannequin with a dampening effect along with other changes to produce a more effective training program and device is needed to appropriately train regular people and first responders on CPR. Our goal is to design a cost-effective CPR device that resolves this issue and gives a better simulated CPR training experience and can be readily available for people to utilize. This would include adding a dampening feature within the compression device that houses the spring. As a result, our design will help medical professionals become proficient at giving high-quality CPR and will give more of the average laypersons the opportunity to learn this valuable skill and ultimately result in saving more lives.
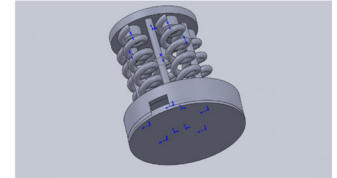
Figure Two
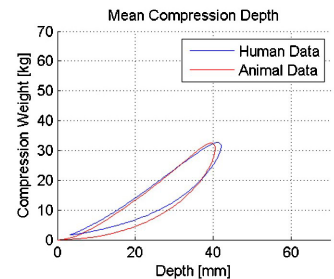
TEAM 20

Aaron Beams
Thomas Koba

ADVISORS

Patrick Kumavor
Krystyna
 Gielo-Perczak
Bing-Shiou Yang

SPONSOR

Boehringer Ingelheim

Automatic Shear Device for Biopharmaceutical Process Development

Microfluidic-based model to simulate the sheer rate typically seen during biopharmaceutical processing. The design allows users to input small samples, the desired shear rate, and the desired duration of application. The sample then returns to the user after the proper shear rate is applied.

TEAM 21

Andrew Christenson
Jennifer Field
Jonathan Lebo
Sean Walters

ADVISOR

Krystyna
 Gielo-Perczak

SPONSOR

UCONN
SCHOOL OF ENGINEERING
BIOMEDICAL ENGINEERING

Utilizing 3D Motion-Capture to Optimize Prostheses for K3 and K4 Amputees

The purpose of this design project is to fabricate a part that can be attached to a K4 prosthesis to convert its functionality to that of a K3 prosthesis. Essentially, an individual would be able to add or remove this part to allow the switch between running, walking, or hiking modalities. The main functions associated with the design are in relation to the ease of use and overall accessibility to switch between K3 and K4 modalities. Additionally, the device design aims to assist in weight shifts and balance of the user, while providing the full range of motion in the joints. It also aims to normalize step cadence and return of power across the modalities. Analysis of relevant data will focus on rollover shape testing, comparing center of pressure for the prosthesis in both K3 and K4 modes to a non-amputee individual. The result of this project provides beneficial information to prostheses manufacturers and production teams by introducing an alternative hybrid device design.
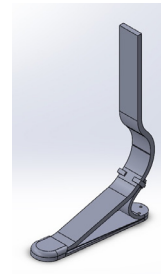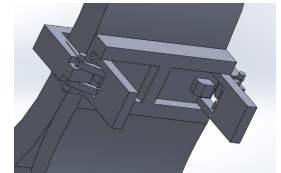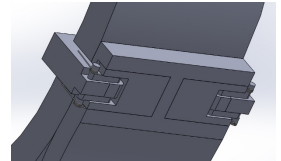
TEAM 1

Stoney Brooks
Nathaniel Grogan
Vahidin Kandic
Rahul Raman
George Fuller Walker

ADVISORS

Burcu Beykal
Steven Lathrop

SPONSOR

Pfizer: Transition to Predictive Maintenance

To keep up with rising global demand in the pharmaceutical industry, UConn's Senior Design students paired with Pfizer's Portable Continuous Miniature Modular (PCMM) facility in Groton, CT to analyze and reduce the scheduled manufacturing maintenance, calibration, and care downtime. Using Pfizer's historical preventative maintenance records, the senior design students are able to assess the efficiency of the existing annual and/or semi-annual maintenance schedule for each piece of equipment. To accurately determine how to modify a maintenance schedule, the team analyzed the health and performance of equipment alongside the measured runtime extracted from Pfizer's database, looking for trends between runtime and recorded wear. Equipment with superfluous maintenance received modified maintenance schedules, while equipment that saw significant wear between maintenance either received shorter spells between maintenance checks or a reevaluation of lubricants, belts, seals, or bearings. With the lack of data for some equipment, the results were inconclusive and will be reevaluated when more data is available.

Our team collaborated with Management & Engineering for Manufacturing Team 16 on this project.

TEAM 2

Cat Odendahl
Sloane Putnam
Christine Sharabun

ADVISORS

George Bollas
Andy Roemer

SPONSOR

nel·

Computational Fluid Dynamics Analysis and Symbolic Regression of a Water-Oxygen Separator in the Hydrogen Production Process

Nel produces hydrogen and innovates its various applications in renewable energy and fuel. Hydrogen is produced via electrolysis which involves splitting water into hydrogen and oxygen. Because this process is not 100 percent efficient, a downstream water-oxygen separator is in place to isolate the unreacted water into a recycle stream back into the electrolyzer. Our project goal is to maximize the efficiency of the separator by manipulating its current design. We used ANSYS Fluent to test different internal and external geometry features to observe their effect on separation efficiency. The team then used ALAMO, a machine learning regression software to obtain a mathematical model of separation efficiency with respect to different geometries, vessel size and other measured variables. Having an efficient separator and an experimentally verified model as a basis for design will allow downstream unit operations to also operate efficiently, minimizing energy and material waste in the process.

15

TEAM 3

Craig Allen
Samuel
 Degnan-Morgenstern
Nicholas Skovran

ADVISORS

Kelly Burke
Bill O'Connor

SPONSOR

BOMAR

Modeling Mixing Dynamics Across Multiple Stirred Batch Reactors

Bomar, a supplier of oligomeric materials for coating and adhesive applications, utilizes a variety of production-scale and lab-scale continuously stirred batch reactors for the synthesis of these oligomeric products. During the operation of these reactors, controlling the impeller speed is critical to maintaining repeatable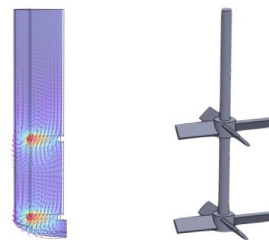 reaction dynamics, ensuring product quality, and achieving desired batch cycle times. The mixing dynamics in the reactors are not uniform between reactors, and mixing speeds are currently set using empirical guidelines instead of being theoretically modeled. This may be contributing to unnecessary increases in production times, utility costs, and first pass yield issues. The goal of our project is to develop a model-backed approach to characterize the mixing dynamics and determine the minimum agitator setting to achieve thorough and consistent mixing when scaling across reactors. To solve this problem, we first modeled the Bomar reactor and impeller geometries using SOLIDWORKS. Using these designs, we performed simulations of mixing dynamics in COMSOL for a variety of reactor geometries, baffle and agitator designs, and product viscosities. Based on the results of these simulations, we created a database for each reactor that specified the minimum agitator setting necessary for each product viscosity. This guide will ensure consistent reaction conditions, reduce utility costs, and aid in a more repeatable scale-up process from the laboratory scale to the production floor.

Our team collaborated with Management & Engineering for Manufacturing Team 8 on this project.

TEAM 4

Stephanie Cuervo
Bobbie James
Valeria
 Ramirez-Cubas

ADVISOR

Yongku Cho

SPONSOR

UCONN
SCHOOL OF ENGINEERING
CHEMICAL & BIOMOLECULAR
ENGINEERING

Design of Antibodies for Improved Tumor Penetration

Therapeutic antibodies have become one of the fastest growing classes of drugs in recent years. Antibodies are central to the body's response to a viral infection. They work by recognizing and sticking to antigens in order to remove them from the body. Monoclonal antibodies are laboratory-made proteins that have become very prevalent during the COVID-19 pandemic in fighting the virus and protecting from future infections. The market for therapeutic monoclonal antibody drugs has grown tremendously as new drugs have been approved by the US FDA to treat many cancers, autoimmune, metabolic and infectious diseases. Monoclonal antibodies are now the best selling form of drugs in the pharmaceutical area with a reported global market value of USD 145.7 Billion in 2021. Although using monoclonal antibodies to target tumors seems like a simple concept, drug efficacy is dependent on many physiological characteristics. Both the tumor environment and biochemical properties of the antibody such as its ability to bind to an antigen play a large role in tumor penetration. The goal of this project is to design a new antibody based molecule to improve transport into a tumor. By reviewing existing literature on antibody tumor transportation and reproducing existing models on MATLAB, we can develop and improve on our antibody-tumor model and identify parameters which have been observed to impact antibody tumor distribution. From this we will design experiments to test the outcome of the model which is predicted to improve efficacy.

TEAM 5

Kevin Rodriguez
Phil Rudak
Daouda Williams

ADVISOR

Yongku Cho

SPONSOR

UCONN
SCHOOL OF ENGINEERING

CHEMICAL & BIOMOLECULAR
ENGINEERING

The Encapsulation of Biomolecules

The CoVid-19 virus has caused over 6 million deaths. Due to the continuous mutation of the virus, the demand for mRNA vaccines has been critical for public safety. One key aspect of mRNA vaccines is using lipid nanoparticles or "LNPs" as the delivery vehicle. LNPs protect mRNA from physiological conditions and ensure that they reach the cells in the body. The primary method used to mass-produce these vaccines involves the use of a T-junction connector. However, the manufacturing of the vaccine via the T-junction has seen a significant reduction in throughput compared to traditional vaccine production methods. Despite the reduction in throughput, the T-junction is of critical importance as it connects two microfluidic channels that transport mRNA and lipids, ultimately encapsulating the mRNA by lipid formulation. This encapsulation process allows for successful transportation through the human body. Our capstone design project aims to develop an improved mixing process with a higher throughput while also considering the economic feasibility of the process. Our team aims to accomplish this goal by developing a COMSOL model of the existing mixing process and identifying the physical parameters which affect the mixing process. Analyzing physical parameters, such as shear stress, velocity profile, and the concentration gradient will aid in our understanding of the mechanisms which drive the mixing process. Ultimately, these efforts bring us a step closer to developing a mixing process that can meet future demands for mRNA vaccines.
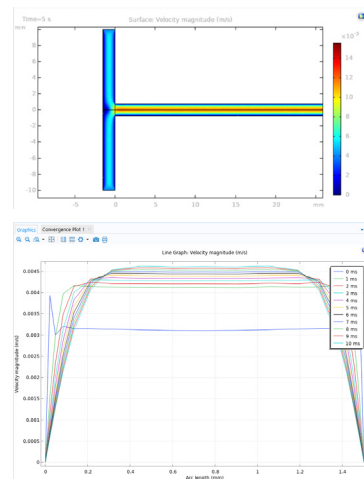
TEAM 6
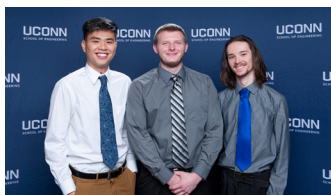
Will Kraus
Alyssa Borden
Ally Brogan

ADVISOR

Yu Lei

SPONSOR

UCONN
SCHOOL OF ENGINEERING

CHEMICAL & BIOMOLECULAR
ENGINEERING

This team's project description could not be published for privacy reasons.

TEAM 7

Vinh Do
Noah Herington
Benjamin Leveille

ADVISOR

Yu Lei

SPONSOR

Evaluation of In-Situ Technologies to Remediate of Sequester Per- and Polyfluoroalkyl Substances (PFAS) in Soil

Per- and polyfluoroalkyl substances (PFAS) are a class of synthetic compounds found in many products such as clothes, food packaging, non-stick cookware, and most predominantly, fire-fighting foam. These compounds are known to find their way into water and soil and cause health effects such as cancer, liver damage, decreased fertility, and thyroid disease. PFAS compounds are highly resistant to degradation, heat, and chemical agents due to their chemical structure. While some research has been conducted on remediating PFAS from water samples, removing PFAS from soil remains a challenge, with the currently available soil remediation methods (off-site disposal and incineration) being costly and ineffective. Connecticut Department of Energy and Environmental Protection has given our team the task of evaluating in-situ PFAS soil remediation methods for their viability in bench-top or full-scale implementation and conducting a preliminary study on the most promising methods. We initially reviewed remediation methods that included In-situ Soil Washing, Bioremediation, Soil Liquefractionation, Ball Milling, and Electron Beam Treatment. Our team found that the most testable methods given our resources were Electrochemical Oxidation, Electrokinetic Remediation, and Thermal Degradation under a catalyst. We analyzed the effectiveness of these three methods in removing PFAS from spiked soil samples that match concentrations found in soil at the Cherry Brook Primary School in Canton, Connecticut. With this project, we aim to further the research efforts of the scientific community in finding an implementable PFAS soil remediation technology and help clean PFAS contaminated sites.

TEAM 8

Duncan Edel
Nina Huczko
Tim Rodrigue

ADVISORS

Anson Ma
Krista Pereira
Evan Smith

SPONSOR

Characterization of Aeration Techniques for Skincare Products

Every day 2.5 billion people in over 190 countries use Unilever products, including their well-known skin care brands. Unilever must consistently innovate their product lines to continue to impress consumers. With the help of last year's team, Unilever created a scalable aeration technique that incorporates compressed air into a lotion, laying the groundwork for an innovative product with a light, whipped texture. This year our goal was to analyze this aeration technique to see how the process affected the products over their intended shelf-life. Our analysis compared the non-aerated and aerated samples across several metrics including specific gravity, viscosity, and microscopy. To test specific gravity, we developed our own procedure to avoid eliminating the product's entrapped air. Rheological experiments were carried out to assess how the viscosity changes over time after aeration, while optical microscopy was performed in parallel to characterize the number and size distribution of air bubbles. Comparing the non-aerated and aerated samples across these three metrics over time indicated that the aerated product experienced significant physical changes over its shelf-life. Based on our findings, Unilever can reevaluate their formulation and aeration techniques to create products that will have a stable shelf life and desired whipped texture for consumers.

TEAM 9

Alyssa Kraus
Rebecca Lee
Joanna Liang

ADVISORS

Jeffrey McCutcheon
Edward Wazer

SPONSOR

U.S. DEPARTMENT OF ENERGY | Office of Science

Solar-Thermal Driven Membrane Distillation

Currently, the oil and gas industry produces 20-30 billion barrels of high-concentration salt water per year. At inland facilities, this brine is typically disposed of through injection wells or evaporation ponds. Consequently, this discharge affects the surrounding soil and water quality, posing both safety and environmental hazards. Brine disposal, especially in large volumes, comes with the risk of spills during transportation, increased costs of evaporation-based treatment, and higher rates of equipment failure. These problems are prevalent in the southwest region of the US, which has the most oil wells in the nation. To mitigate these risks, it is necessary to reduce the volume of brine through desalination. Although a pressure-driven membrane process called reverse osmosis is commonly used for desalination, it cannot effectively treat high salinity brine due to osmotic pressure limitations. Instead, membrane distillation is an attractive alternative due to its low sensitivity to salinity, lower capital cost per unit, and better design flexibility relative to other thermal processes. For this project sponsored by the US Department of Energy's Solar Desalination Prize, we designed a pilot-scale solar-powered ceramic-based membrane distillation system to concentrate high-salinity brine. The system installation will occur at the Kay Bailey Hutchison Desalination Plant in El Paso, Texas and will cost no more than $750k. Membrane distillation can easily integrate with alternative energy, so our proposed system is powered by solar energy. This system is driven by a vapor pressure gradient and removes water from brine over a hydrophobic and porous ceramic membrane. We modeled our system on Aspen Plus to optimize equipment size and energy consumption to stay within the economic constraints. As a result, we developed a potential solution for disposal of high-salinity brines, minimizing their environmental and human impact while utilizing a source of alternative energy.
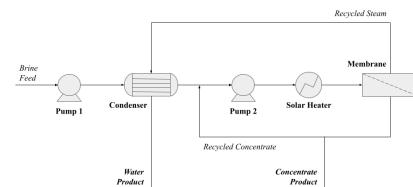
TEAM 10
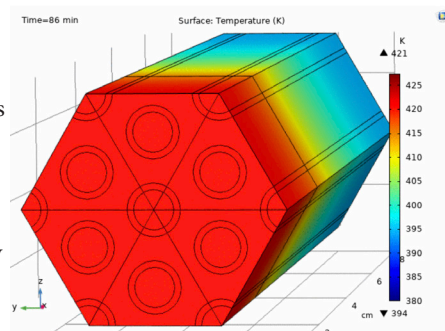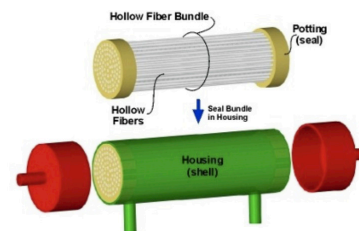
Ronghui You
Luqi Zhang
Yajing Zhao

ADVISOR

Mu-Ping Nieh

SPONSOR

UCONN
SCHOOL OF ENGINEERING
CHEMICAL & BIOMOLECULAR
ENGINEERING

Designing Epoxy Potting of Caps for Capillary Filtration

Water is an absolute necessity for all species that live on the earth because water is very important for the human body since all cells, organs, and tissues use water to help with temperature regulation and keep our bodies under-hydration to maintain bodily functions. However, increased pollution, climate change, and a rapidly growing population have threatened the pure water supply. As a result, the demand for water filtration keeps increasing. Our team designed and built a water filtration system called capillary filtration in 3D modeling software. The polluted water will pass through the bundle of porous capillaries and a housing shell will collect the filtered water. We applied epoxy at the two end caps to keep all the capillaries stay in a bundle. The process of epoxy potting is an exothermic reaction that induces thermal stress and breaks the capillaries when the temperature is above a certain ceiling temperature. This will cause the failure of the water filtration device. We simulated the temperature profile in the reactor cap as a function of curing time by applying some equations. This design could be a valuable advancement for water filtration which can reduce the impact of polluted water on humans and the environment. It is also environmentally friendly because we choose the epoxy that is biodegradable so that it will not behave like plastic which will exist for a long time. The water filtration industries can manufacture this design for large-scale production.

TEAM 11

Rachel Boislard
Anna Kurkjy
Steven Tricarico

ADVISOR

Mu-Ping Nieh

SPONSOR

UCONN
SCHOOL OF ENGINEERING
CHEMICAL & BIOMOLECULAR
ENGINEERING

Designing Epoxy Potting of Caps for Capillary Filtration

Over one billion people face water scarcity globally, and this number is only increasing as humanity's population grows. One solution to this issue is to develop smaller, more efficient water filtration systems that filter and sanitize non-potable water. Our project focuses on refining the design for the epoxy setting within capillary filtration devices. Capillary water filters consist of bundles of thin, hollow, glass fibers potted in epoxy caps to ensure that the fibers stay bundled together as water passes through the filter. To create these caps, technicians pour the liquid epoxy over the fibers and allow it to harden. This process, known as curing, releases heat that can damage the capillary fibers and render the filtration system inoperative. Our project focuses on modeling the heat released from the epoxy curing process and developing a solution to control this heat so that the capillary fibers remain intact. We used COMSOL to model the three-dimensional geometry of the filter and to vary three parameters: the initial temperature of the filter prior to potting, the material of the capillary fibers, and the porosity of the epoxy. The resulting model optimizes the time it takes for the epoxy to fully cure and reduces the heat generated by the reaction. Ultimately, this model has the potential to improve the manufacturing of water filtration systems and expand access to safe drinking water across the globe.
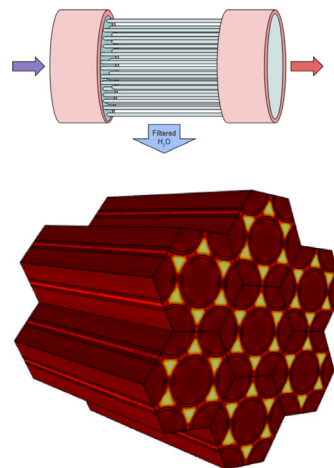
TEAM 12

Anna Clinkscales
Alexis Kacmarcik
Montserrat
 Sanchez-Guzman

ADVISOR

Jennifer Pascal

SPONSOR

UCONN
SCHOOL OF ENGINEERING
CHEMICAL & BIOMOLECULAR
ENGINEERING

On-Campus Pilot Scale Brewery

Since 2012, the number of craft breweries in the state of Connecticut has more than tripled, with more than 30 of them being owned by UConn alumni. This has led to a boom in the number of breweries and the styles of beer available, especially in the state of Connecticut. The style, flavor, and rate of production of beer are determined by chemical engineering principles, making chemical engineers well equipped to optimize beer production. The goal of this project is to design an on-campus, pilot-scale brewery. With industry and academic knowledge, we designed a 1 barrel (bbl) pilot system that is user-friendly for students with limited brewing experience. We performed a comprehensive capital and production cost analysis based on a production rate of 1000 gallons per year. Our group determined the size of equipment needed to maintain this production, as well as the demand for raw materials, water, and energy. Since brewing is a water-intensive process and generates wastewater, we thoroughly reviewed ethical and environmental considerations. With these factors in mind, we were able to design an amber ale recipe that was both easy to brew and palatable to a wide range of people, using the concepts of mash efficiency, hop bittering, and fermentation kinetics. We incorporated this recipe into a standard operating procedure (SOP) for the pilot system design to guide future engineering students who wish to get involved in brewing science at UConn in the future.
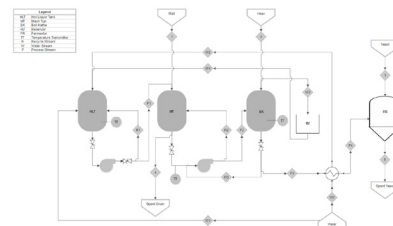
TEAM 13

Massita Camara
Andreya Gardner
Nia Samuels

ADVISORS

Cheryl Fields
Shannon Pociu
Yang Qin

SPONSORS

Determination of PFAS Presence in, and Leachability from, Artificial Turf

Per- and polyfluoroalkyl substances (PFAS) are human-made compounds used in many products such as nonstick pans, rain repellent boots, and grease-resistant food packaging for their heat, oil, and water-resistant properties. They are composed of a strong carbon and fluorine bond that makes them almost impossible to break. Recently, the public has expressed concerns about the possibility that artificial turf used in institutions such as schools and parks may contain PFAS. These compounds are known to cause life-threatening diseases such as cancer, increased cholesterol, and reproductive damage. The Connecticut Department of Energy and Environmental Protection (DEEP) and Department of Public Health (DPH) have partnered in sponsoring this project to determine whether PFAS are present in artificial turf and investigate their leachability into groundwater. To identify if PFAS are present in artificial turf, we designed a laboratory-scale protocol intended to separate the components of the artificial turf blades, the infill, and the backing into smaller molecules that can be extracted into water. We also designed a laboratory scale process to simulate the effects of acid rain, sun exposure, and movements on an artificial turf sports field to identify the conditions in which PFAS may leach from each component of the turf. Our team collected the samples to be tested by an external laboratory to ensure an EPA gold standard measurement. In the event that PFAS are present in the turf samples, and their leachability is quantified, this project will lay the foundation for identifying a source of PFAS in groundwater. At the conclusion of this study, the methods and results will be documented in a scientific publication.

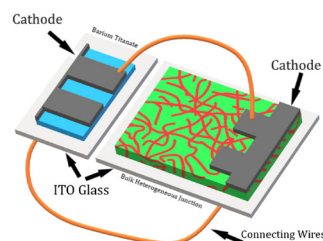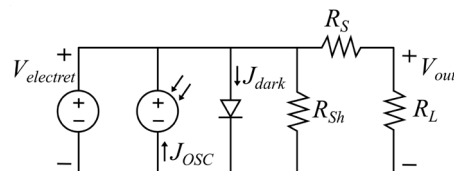**TEAM 14**

Justin Arroyo
John Feller
Vladimir Marosz

ADVISOR

Yang Qin

SPONSOR

UCONN
SCHOOL OF ENGINEERING
CHEMICAL & BIOMOLECULAR
ENGINEERING

Electret Enhanced Organic Solar Cells

Improving the power conversion efficiency (PCE) of organic solar cells (OSCs) has the potential to unlock a highly adaptable and easily scalable energy solution. An organic solar cell absorbs photons of light and generates electrons in an amorphous composite organic layer known as a bulk heterojunction. Along the journey through the active layer, some electrons are lost by returning to a lower energy state before reaching the electrodes due to the poor charge transport capabilities of organic materials. With the use of a permanent dipole material, known as an electret, generating a photo-activated electric field, fewer electrons will be lost and more power can be produced by the cell. With funding provided by the NASA CT Space Grant Consortium, the goal is to assess the PCE improvements after incorporating an electret into a OSC. One application for these electret-enhanced OSCs is the power supply of small satellites such as CubeSats. OSCs are the ideal energy source for CubeSats because of their light weight and unique flexibility, allowing for greater power capacity. However, the stability of OSCs in the temperature environment of low Earth orbit (LEO) has not been extensively tested. We will characterize the cell under a fluctuating temperature regime to evaluate the change of PCE that could occur in LEO. If stability and power generation of OSCs can approach the performance of the multi-junction cells currently used in space, then embedded electret materials can be a breakthrough solution to high efficiencies of OSCs on a commercial scale.

TEAM 15

Rayne Santiago
Samantha Stofflet
Bradley Stutzman

ADVISORS

Bill O'Connor
Matthew Stuber

SPONSOR

BOMAR

Modeling and Redesign of Temperature Control Systems for Reactors

Bomar Specialties is a global corporation that manufactures oligomers used in various UV Cure applications, such as nail polish and 3D printing. Oligomers are medium molecular weight chemical compounds formed by reacting several smaller molecules together. The reaction temperature is critical to the reaction consistency of the oligomers. Bomar's process uses jacketed reactors. The jacket controls the reaction temperature to facilitate molecular interactions and prevent hazardous reactor conditions. The jacket temperature is adjusted through a piping loop containing a heat exchanger. For heating, steam from a boiler is fed into the heat exchanger while the loop fluid recirculates in a Closed Loop Configuration. For cooling, chilled water is introduced to the loop while in an Open Loop Configuration. Currently, operators manually adjust the temperature setpoint of the jacket loop to modulate the reactor temperature. This manual control method has several drawbacks, notably the variation between operators in modulating the reactor temperature, and the potential for incorrect temperature setpoints to be input. The goals of this project are to show the benefits of automated temperature control and to investigate the implementation of a cascade control system into Bomar's process. We used MATLAB to model the reactor temperature to the heat transfer through the reactor walls. The model plots economic savings in temperature control for both processes. In addition, we looked at Bomar's existing controllers and recommended the proper equipment that can use a cascade control system. This control system would allow Bomar to maintain a more consistent and economical oligomer production.
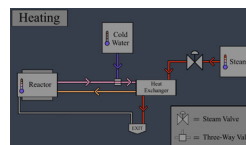
Our team collaborated with Management & Engineering for Manufacturing Team 9 on this project.

TEAM 16

Dylan Carzello
Jason Dumont
Daniel Kloyzner

ADVISORS

Matthew Stuber
Thomas Tampone

SPONSOR

Boehringer
Ingelheim

Self-Learning Flow Reactor

It can take many experiments to refine a chemical process when finding the most optimal way to run it. This can make optimization difficult to do by hand in a cost-effective way, especially with the possibility of human error which increases with the number of iterations done with a particular reaction. The goal of this project is to create a system that when given a set of parameters, and a particular measurement to optimize, will use optimization algorithms to adjust a reactor process in real time. This will both remove the element of human error from the process, as well as save time otherwise taken up by continuously stopping the process to adjust different variables before restarting. The project uses Matlab for both the optimization algorithm itself and for the use of a "digital twin" of the system. The digital twin is used to calibrate and test the algorithm to compare with results from using the system in a lab environment. The reactor, when in a physical setting, will give data of the outputs to the ReactIR software. This data is then passed to the algorithm in Matlab, which will then connect to the Labview program to in turn adjust the pumps and heat exchanger of the reactor setup. The changes made will then cause changes in the output data, which will continue to refine and optimize the process. This project will cause increases in lab productivity, while also decreasing costs. In the long term, this can impact the speed of development for life-saving drugs, and can speed the advancement of medical science, as well as development in several other fields of chemistry.

TEAM 17

Sebastian Corales
Alain Olhaberry
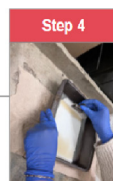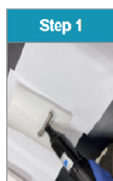Mahamadsaad
 Vahora

ADVISOR

Luyi Sun

SPONSOR

UCONN
SCHOOL OF ENGINEERING
CHEMICAL & BIOMOLECULAR
ENGINEERING

Sustainable Polymer Packaging

Plastic waste is growing rapidly and is the main culprit of municipal solid waste management (MSW). In 2018, waste from plastic containers and packaging amounted to 14.5 million tons. Additionally, most of the packaging was made from polyethylene terephthalate (PET) and high-density polyethylene (HDPE) which can take hundreds of years to decompose and break down. The majority of all plastics formed are single-use plastics; meaning that we throw them away as soon as we're done with them, resulting in massive environmental issues. The goal of this project is to find alternative sustainable materials that can be easily composted, recycled, and mass-produced. Current research and developments have found alternatives such as polylactic acid (PLA) and polyhydroxyalkanoate (PHA) which are bio-based polymers made from abundant renewable resources. Our group focused on paper, coated with nanoparticles as the sustainable material. The biggest challenge with determining a proper alternative is finding a polymer with the same strengths as traditional plastic film. After filtering through modern research being developed in this area, we have gathered information on different types of packaging films. Overall, what we want to do is to further develop the potential of using bio-based polymers as an alternative to single-use plastics. In doing so, we can provide a sustainable alternative to reduce municipal solid waste resulting from packaging.

TEAM 18

Blaise Costa
Nour Hashem
Nick Woods

ADVISOR

Luyi Sun

SPONSOR

UCONN
SCHOOL OF ENGINEERING
CHEMICAL & BIOMOLECULAR
ENGINEERING

Sustainable Plastics for a More Sustainable World

In recent years, the scale of the plastic pollution crisis has come to light along with the negative impacts it has on our planet. The goal of this project is to not only determine an effective alternative to modern day plastics, but also to better understand methods of disposal and re-use to decrease the damage being done to the environment. Plastics used around the world today have been designed to not break down over time and therefore remain in the environment after their use. By using alternatives such as Polylactic Acid (PLA) or Polycaprolactone (PCL), the degradation process can occur much quicker than traditional plastics, and recycling can become more effective. The process of degradation in these plastics eliminates the issue of microplastics which are much more difficult to collect than other plastic waste as they can spread much further into waterways and oceans. Another key aspect of the degradation process is that it is possible to stop degradation at a certain point, to not completely degrade, to allow for upcycling, creating a more valuable product from discarded materials. Recyclable plastics reduce the need for manufacturing of new plastics, consequently reducing carbon dioxide emissions in the plastic industry. While carbon emissions are separate from the plastic pollution crisis, mitigating pollution of all kinds is important when considering sustainability of plastics. For these bioplastics to replace traditional plastics effectively, improved composting and recycling technology must be developed along with preventative measures to keep pollutants out of waterways. On top of technological advancements, governments must begin to act, like what is being done in terms of carbon emissions. By switching to biodegradable plastics and focusing on proper disposal, the negative impacts of the plastic industry can be reduced in the environment allowing nature to heal and marine life to thrive once again in our oceans.
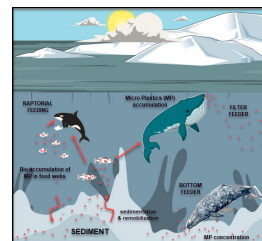
TEAM 19

Jared Anderson
Joey Bras-Jorge
Phillip Tang

ADVISOR

Ioulia Valla

SPONSOR

UCONN
SCHOOL OF ENGINEERING
CHEMICAL & BIOMOLECULAR ENGINEERING

Renewable Hydrogen

In an ever-growing world that is more interconnected than ever, our reliance on energy is at its greatest demand. Current methods of energy production involve combustion of fossil fuels that pollute and damage our environment. Globally, we are using as much as 84 million barrels of oil every day, resulting in an annual 0.32 °F increase in global temperature (1). Thus, it is imperative that we search and develop renewable sources of energy, such as hydrogen fuel. We want to focus on hydrogen production through electrolyzing water into its component gasses, hydrogen and oxygen. Today's power plants are already producing hydrogen fuel, but most of it is gray hydrogen because it uses methane and coal in steam reforming and gasification reactions. Our project will focus on the production of green hydrogen, which has minimal environmental impact and only relies on renewable, carbon neutral sources such as solar and wind power. PEM electrolysis is based on basic electrolysis cell design, but relies on ion transport between two electrolyte solutions across a membrane to increase efficiency. Through the process of PEM electrolysis, we are determining if it is economically feasible to meet our energy needs with hydrogen in place of current fossil fuel methods.

TEAM 20

Darryl Bredy
Nathan Kwak
Mitchell Holdmeyer

ADVISOR

Ioulia Valla

SPONSOR

UCONN
SCHOOL OF ENGINEERING
CHEMICAL & BIOMOLECULAR ENGINEERING

Renewable Hydrogen

In 2019, the United States contributed to 15% of the global greenhouse gas emissions and in total released 5.1 billion metric tons of carbon dioxide. Energy shortages and fossil fuel depletion have increased the demand for renewable energy options. Fuel cells provide a viable alternative to fossil fuels but require a large amount of hydrogen gas for fuel. Currently, the fuel cell industry lacks a clear procedure on how to readily produce pure hydrogen gas in a clean manner. The goal of this project is to develop a solution that uses methane pyrolysis with an iron catalyst to convert methane into solid carbon and hydrogen. The project aims to maximize hydrogen production with the help of both the MATLAB and ASPEN softwares using literature data. Also, the team will examine the economic feasibility of the process and how it compares to other alternative methods. With a profitable procedure to yield hydrogen, fuel cells will revolutionize the energy market and will limit the necessity of fossil fuels for energy production. Thus, this proposal will lead to a decrease in carbon emissions and overall better air quality. The long term effects of climate change are nearing a point of irreversibility, this project will contribute to a climate change solution resulting in a healthier planet.
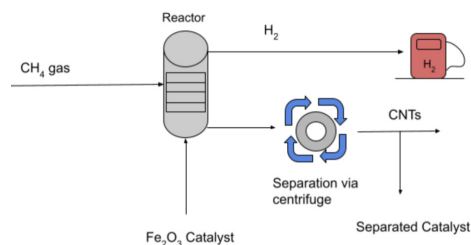
TEAM 21

Cody Dang
Dennis Han
Justin Rastinejad

ADVISORS

Jolly Lux
Kristina Wagstrom

SPONSOR

GUIDING LIGHT
ORPHANS, INC.

Designing a Food Storage System for Rural Uganda

Guiding Light Orphans (GLO) is a nonprofit organization that brings aid to the rural area of Masindi, Uganda. Currently, inadequate food storage causes crops to spoil after a few days. The goal of our project is to design a system that preserves the food grown in the rural communities. Our team explored food storage options where we considered cost, nutritional retention, shelf-life, taste, Masindi culture, and ease of operation. Our final system uses solar drying for short term storage and freeze drying for long term storage. Solar drying dehydrates food and prevents harmful ultraviolet rays from degrading food quality. Freeze drying removes water content without altering the taste or shape using reduced pressures and temperatures. We modeled the solar drying unit in ANSYS to determine an effective design to store a given amount of food. Our team also modeled freeze drying by determining the energy required for operation using photovoltaic cells and battery storage. This project will help combat the malnutrition Masindi faces by ensuring year-round access to food.
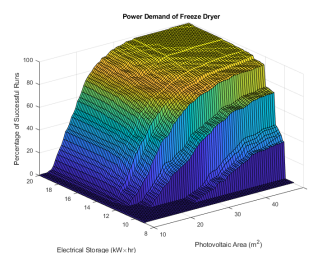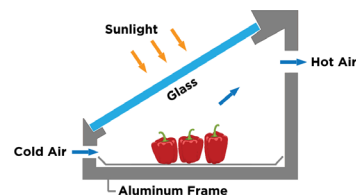
TEAM 22

William Gasparrini
Kenneth Klarer
Sylvia Rathmell

ADVISORS

Dawn Shaban
Kristina Wagstrom

SPONSOR

Connecticut Department
of Public Health

Designing an Automated Solid-Phase Extraction Method to Prepare Samples for PFAS Testing

Per- and polyfluoroalkyl substances (PFAS) are a class of toxins that have been linked to many illnesses and detected in major water supplies. Due to their strong carbon-fluorine bonds, they do not naturally degrade which causes them to accumulate in the environment. It takes 6-8 weeks on average for environmental laboratories to test for PFAS. This lengthy turnaround time is in part due to the labor intensive process to manually prepare the samples, which endangers communities with unknown levels of PFAS ingestion. The goal of this project is to increase the number of water samples that environmental laboratories can test per day by automating the solid phase extraction (SPE). Based on our extensive research and evaluation of the potential approaches, the instrument and approach we recommend is both economical and efficient in completing the SPE. The implementation of this instrument and approach will improve the speed at which environmental laboratories can test for PFAS, consequently enabling communities to address toxic water supplies faster.
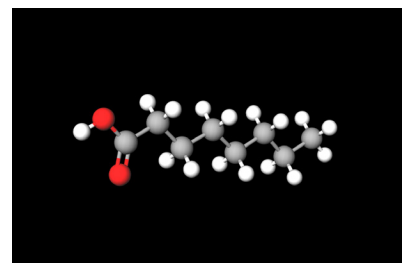
TEAM 23

Justin Amengual
Emily Miller
Kaylee Walsh

ADVISORS

Jessica Larkin-Wells
Kristina Wagstrom

SPONSOR

Aquaponics System for Spring Valley Student Farm

Spring Valley Student Farm is a UConn organization focused on providing food to the local community and creating opportunities for students to learn sustainable farming methods. The goal of our project is to design and implement a crawfish-based aquaponics system, creating a new sustainable method of organic agriculture for the farm. This aquaponics system is an ecosystem where crawfish produce nutrients for plants to grow, and the plants purify the water to provide a habitable space for the crustaceans. Crawfish were chosen for their high waste output and ability to rapidly produce offspring. The process incorporates both media bed and deep-water culture systems to allow for the growth of nitrifying bacteria and a greater variety of plants that can be grown. Our team used the key engineering concepts of fluid dynamics, heat transfer and chemical process kinetics to design and model the system using MATLAB and Aspen Plus. Using these modeling applications, we designed a demonstration oriented system which will allow an audience to learn more about the environmental benefits of aquaponics. Aquaponics systems consume less water and power compared to typical farming methods, while producing very little waste. In addition to the environmental benefits and learning opportunities that our system will create, the organic food grown will be harvested and brought to the UConn dining halls.
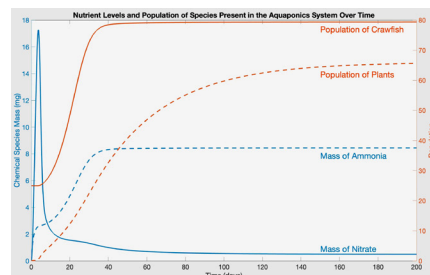
TEAM 1

Luke Lombardo
Miranda Zhang
Steven Matile
Jared Hodgdon

ADVISOR

John Ivan

SPONSOR

Strawberry Hill Avenue

Strawberry Hill Avenue is a major collector road running north/south in the center of the City of Stamford. It is a mixed-use road with two lanes running a 0.7 mile corridor connecting Colonial Road to Stamford's well known five way intersection with an annual average daily traffic of 16,700. Residential units, commercial businesses, a major healthcare facility, the city high school, and a new magnet elementary/middle school lie on this corridor. With these various land uses, the demands on the roadway change depending on the time of day. There is higher traffic flow during school drop off and pick up times and typical business peak hours. With increased pedestrian activity during school pick up and drop off hours it affects the traffic operations. In addition, the corridor does not accommodate pedestrian activity well which resulted in several pedestrian accidents. At times of low density, it brings issues of speeding due to the wideness of the roads which was initially intended to help drivers with congestion during rush hours. Several pedestrian accidents and the development of the city's new bicycle infrastructure create a need for updated roadway and traffic flow design.
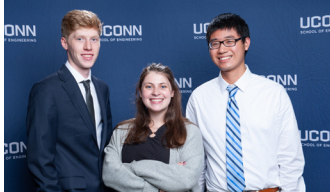
TEAM 2

Kevin Huang
Caroline St. Pierre
Cody Swanson

ADVISORS

John DiBiasi
John Ivan

SPONSOR

Manchester, CT I-384 Exit 2 Intersection Redesign

The Town of Manchester has identified operational and safety issues with the intersection of I-384 Eastbound Exit 2 Off-Ramp and Wetherell Street. On the off ramp, the vehicles experience significant delay and low level of service during peak hours. This leads to daily queuing of cars on the ramp that sometimes stretches back onto the highway. Our senior design project is to help the town study this intersection and offer potential intersection improvements to increase capacity and safety. As a team, we developed four alternatives for this intersection: Roundabout, Traffic Signals, All-Way Stop, and No-Change (Two-Way Stop). To select the best alternative, we ranked each using a multi-criteria analysis focusing on operational performance, safety, cost, and aesthetics. Through our analysis the roundabout alternative was selected to be the best solution for the intersection. Using AutoCAD, we designed a roundabout using FHWA guidelines and existing intersection constraints. We also made various pedestrian and cyclist improvements at the intersection and on Wetherell Street. For this project, our team deliverables include: Alternative Analysis, VISSIM Simulation Models, AutoCAD Drawings, and Preliminary Cost Estimates.

TEAM 3

Luke Bowden
Nyomi Brown
Aleksandra Driscoll

ADVISORS

Garrett Bolella
John Ivan

SPONSOR

City of Norwalk - Wall Street Corridor Redesign

Image 1: Overview of project limits

Wall Street has served as a downtown area of Norwalk for almost 100 years until 1955. A flood resulted in catastrophic property damage to the Wall Street neighborhood. The economic challenges due to this flooding is still visible today with the number of vacant buildings along the corridor. The current design of the road network is vehicle-oriented with little consideration for pedestrians and bicyclists. Consequently, the corridor is lacking a sense of community. The City of Norwalk sees a need to revitalize the neighborhood and create a lively pedestrian experience that encourages activity and creates a sense of place. Our project focuses on three connected streets in the corridor: Wall Street, Belden Avenue and Burnell Boulevard. We aim to encourage activity and create a sense of place through increasing safety for pedestrians, simplifying the public transit system that is in place and improving vehicle mobility through the corridor. Our approach to achieve the stated goals is: simplifying the Wall Street and Belden Avenue Intersection, converting Burnell Boulevard into a 2-way road, and implementing parallel parking on both sides of Wall Street.

Image 3: Wall St./Belden Ave./Mott Ave./West Ave.

TEAM 4

Adel Hamedi
Sam Paglia
Connor Parrish
Sarah Powlishen

ADVISORS

John Ivan
Larry Murphy

SPONSOR

Jacobs Engineering

Washington Street Reconstruction

The Town of Stonington has asked us to design a full roadway reconstruction for Washington Street with the help of Jacobs Engineering as the consultant. Our design focuses on improving the grading/drainage system, pavement material and design, and analyzing traffic patterns to optimize flow while also ensuring the current on street parking is not compromised. In our final design we proposed widening the roadway to accommodate two way traffic, repaving and regrading the roadway to ensure proper drainage into the catch basin present, constructing a sidewalk for pedestrian use, and keeping all present on street parking.

TEAM 5

Christopher Cesare
Fatima Muhammed
Scott Seperack
Warren Strong

ADVISOR

John Ivan

SPONSOR

Downtown Mystic Transportation Improvements

The goal of this project is to redesign downtown Mystic to better accommodate parking for the rising number of visitors to the area and for better pedestrian accessibility. Both in turn will improve traffic flow and congestion in the area in the short term and long term. After visiting the site, we identified several areas which contributed most to traffic congestion in the area. These include: lack of parking accommodations, pedestrian accessibility, and Improved Signage. With only one parking lot available to the public and few on-street parking spaces, people circling the area looking for parking was a main contributor to traffic. While there are many crosswalks in the downtown area, pedestrian access to the storefronts can be improved. Mobility within the downtown area is key to a successful shared space. In order to incorporate our changes into the current environment, we propose the addition of signage that guides pedestrians from the new parking facilities to the storefront area. In order to solve the problems contributing to traffic congestion in the area, we have identified points of focus for our design phase. For parking accommodations, we propose an addition of a parking structure in place of the existing Art Museum Parking Lot along Water Street. For intersection design, we will redesign the intersection of Route 1 and Water Street which will be greatly impacted by the proposed structure on Water Street. Lastly we will improve pedestrian accommodations and way-finding by including proper signage and accessible pedestrian walkways.
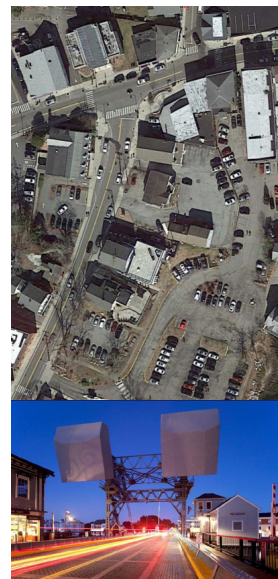
TEAM 6

Michael Arlet
Fernando Diaz
Isabel Diaz
Emily Goddard

ADVISORS

Eric Jackson
Shinae Jang

SPONSOR

CAV Test Track Design

The University of Connecticut Transportation Safety Research Center, is exploring the design and construction of a state-of-the-art training and testing facility focused on transportation safety, smart and connected cities, and automated and autonomous vehicles. This facility would need to be diverse in design and functionality as well as allow the region to enhance training and research across emerging areas of future technologies. Additionally, it would provide opportunities for public and private partnerships and regional training, including connected and automated vehicles, infrastructure resilience, bridge design, and traffic incident management. The design of this facility will need to replicate a wide range of real world conditions such as various intersections, buildings, parking, and bike and pedestrian facilities.

TEAM 7

Zachary Hattan
Ioannis Mastorakis
Carina Scher
Matthew Song

ADVISOR

Shinae Jang

SPONSOR

Parking and Pedestrian Safety Improvements Along Main Street in Old Wethersfield

For this project, Team CE07 is working with the Town of Wethersfield to address parking and pedestrian needs along Main Street in Old Wethersfield. Over the past few years, the Town has experienced an economic and social boom. The addition of a number of storefronts and restaurants to Main Street has turned this once calm residential neighborhood into a town center. While these recent additions have been primarily beneficial for the town, a few problems have arisen regarding vehicle and pedestrian accessibility to said businesses. The lack of parking in the area had become exceedingly obvious and patrons have voiced their complaints to the Town. With traffic from Main Street spilling into the town's residential neighborhoods, the Town was pressured to evaluate the situation. Team CE07 was tasked with designing improvements to the area that would accommodate heavier vehicle and pedestrian traffic on Main Street. There are a number of specific deliverables for this project, including (1) several current parking studies of the Main Street area, (2) designs for new/reallocated parking at the Keeney Memorial Cultural Center and Fire Station lots, and (3) designs that improve safety and visibility for pedestrians at the intersection of Hartford Avenue and Main Street and State Street and Main Street. Through research and consideration, Team CE07 has produced efficient and feasible designs for Main Street.

TEAM 8

Ryan Kornacki
Brian Mai
Torail Murphy

ADVISOR

Shinae Jang

SPONSOR

FUSS & O'NEILL
ENGINEERS • SCIENTISTS • PLANNERS

Redesign of Ella Grasso Boulevard

The City of New Britain has awarded our senior team with the opportunity to redesign Ella Grasso Boulevard from Fenn Road to Stanley Street. This section of Ella Grasso Boulevard is a mile-long roadway that neighbors Central Connecticut State University and has been identified as an area in need of improvement for increased safety and efficiency. Our proposed concept design will subject the boulevard to a road diet, bringing the two lanes in each direction down to one northbound lane and one southbound lane. The current median will be removed as the lanes will be shifted to sit up against one another, and a multi-use trail will be added on the north side of the street spanning the existing Stanley Loop Trail. Additionally, a buffer streetscape and pedestrian amenities will be included utilizing the space from the removed center median. The design also includes appropriate grading and a drainage plan for the redesigned area. We are performing an analysis of the roadway utilizing traffic analysis software Synchro 10. This analysis makes use of existing signal plans and our traffic count data to rate the roadway's level of service to guide our AutoCAD redesign and ensure our proposed design is up to standard.
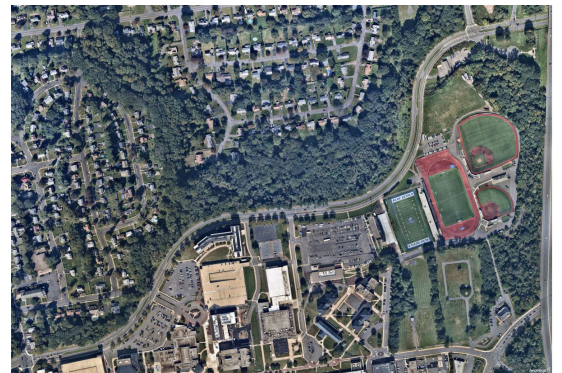
TEAM 9

Luigi Coppola, Jr.
Eain Goolsbey
Benjamin Tillman

ADVISORS

Shinae Jang
Mark Austin, P.E.

SPONSOR

Town of Hamden

Bridge 02016 Scour Repair for the Town of Hamden

This project is located in the Town of Hamden along Shepard's Brook as part of an ongoing project to repair scouring along the concrete culvert that runs below Dixwell Avenue. This project offers a plethora of opportunities to work on project management and the complexities of construction projects. This project occurs within the wetlands limits for the Town of Hamden, so all construction activities need to be as limited as possible to minimize the environmental impact fixing the scour will have. Beyond this, the project will involve the procurement of the new foundation to repair the scouring that has occurred along the base of the culvert. It will also include force diagrams as the Connecticut Heritage Trail runs just above the project location. A complete design package will be created for our sponsor that will cover all design aspects for the project, as well as all environmental considerations. There will also be a VR aspect to this project, which will encompass the scour locations and allow users to see how poorly the area has degraded since the culvert's construction.
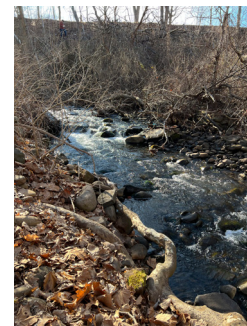
TEAM 10

Kaitlyn Kondos
Nicole Martocchio
Joseph Mikulewicz
Avishan Montazer

ADVISOR

Shinae Jang

SPONSOR

vhb

Modern Roundabout at the Intersection of Hunting Lodge Road and North Eagleville Road

Working alongside Vanasse Hangen Brustlin, Inc. (VHB), Team CE10 was assigned to investigate improvements to the University of Connecticut's traffic flow and campus safety. Specifically, the team evaluated the campus gateway of the intersection of Hunting Lodge Road and North Eagleville Road. After preliminary traffic flow and site condition analysis, Team CE10 evaluated three potential options for intersection improvement: a modern single-lane roundabout, traffic signalization, and pedestrian/cyclist improvements. Team CE10 ultimately came to the conclusion that the modern single-lane roundabout would be the most successful and cost-effective solution to traffic congestion and safety concerns. With the help of VHB, Team CE10 drafted a roundabout design for this intersection. Through thorough research, CE10 chose the most cost-effective and reliable options. Based on material prices with the ongoing supply chain challenges, the team assembled a thorough cost estimate. The final product consists of a finished set of drawing plans alongside a detailed cost estimate.

TEAM 11

Katherine Betsais
Alyssa Bisi
Anya Melick
Benjamin Theriault

ADVISOR

Wei Zhang

SPONSOR

Newark Plaza Tower

DeSimone Consulting Engineers are designing the structure for the Newark Plaza Tower located in Newark, New Jersey. This building consists of a retail shopping center, 4 level parking garage, and 27 floors of residential apartments. The Senior Design Team was been tasked with analyzing the cost of the current design of the 6th - 15th floors of the building. Using this as a baseline, two alternate structural designs were produced to present as more cost effective solutions. The modeling software, CSI Safe, was used to edit the structural designs of columns, beams, and slabs while analyzing the changes in loads and deflections to ensure our redesign stays within building code standards. With the recent changes in the world over the past few years, the cost and availability of building materials has never been more important. With the value engineered alternatives, we are offering DeSimone Consulting with solutions to problems they may have not known. These alternate designs have been able to save valuable building materials while maintaining structural integrity of the building.
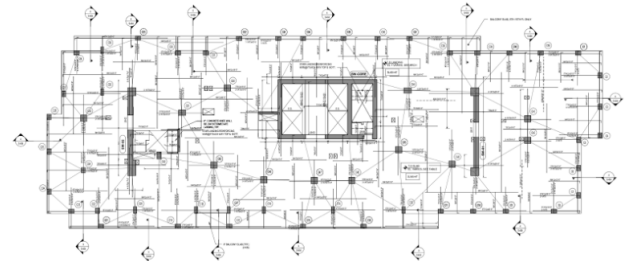
Page S-306 of the Structural Layout

TEAM 12

Fu Tan
Franklin Vasquez
Jacob Videira
Matthew Wendland

ADVISOR

Wei Zhang

SPONSOR

Rehabilitation of Bridge No. 03641

In this project the team has fully designed and analyzed the stringer and girder system running underneath the bridge as well as the deck running on top of the girder system. The team has described repairs and replacements to all other elements in the bridge including the rest of the superstructure, the substructure, the fiberglass sidewalk and the railroad shielding. In this project the team split into two teams team one has worked on the superstructure girder/stringer design and analysis while team two has worked on the deck design and analysis. The teams used external sources such as the CTDOT BDM, AASHTO codes, Microstation, SPSlab, MathCAD/Excel and Google Drive and other minor sources to fully obtain everything the group needed.

TEAM 13

Brandon
 Hermoza-Ricci
Jake Romano
Massimo Sirianni
Jack Torre
Connor Zarou

ADVISOR

Wei Zhang

SPONSOR

Stantec

Bridge NO. 05200 Bridge Redesign

For this project we will work on the redesign, and rebuild of Bridge 05200 in Salisbury CT. Obstacles to be taken into account for this project are; environmental concerns of surrounding ecosystems, road level gradation, East abutment wall and superstructure decking redesign and rebuild. All designs and work are to be estimated, scheduled, and priced.

TEAM 14

Kelvin Chung
Caitlin Jenkins
Andrew Mora
Zachary Sedor

ADVISOR

Wei Zhang

SPONSOR

wsp

Resilient Infrastructure: Coastal Flood Protection For Bridgeport Connecticut

Bridgeport's South End community is vulnerable to storms and hurricanes because it is at risk of severe flooding from coastal storm surges and rainfall. The impact of these events are only becoming more drastic due to climate change and increasing sea level elevation. Over the next 50 years, sea levels are expected to rise between 1.5 and 3.8 feet. During Hurricane Sandy, Bridgeport's coast was inundated with a storm surge of nearly 7 feet above normal high tide resulting in the flooding of streets and over 200 buildings—some residents lost power for weeks. The region also hosts facilities critical to the functionality of the Northeastern's power grid. In order to mitigate the impacts of flooding in the future, team CE14 has collaborated with WSP on a flood risk reduction project and have proposed a preliminary design and placement of a coastal floodwall defense system that will span across the peninsula's most vulnerable spots, and provide dry egress to residents and critical infrastructure such as electrical and gas lines. With a budget of 72 million dollars, team CE14 has conducted extensive research of the structural, geotechnical, and environmental aspects of this project, performed the necessary force calculations, and provided a cost estimate in their final proposal to WSP. Team CE14 will provide a 30-50% design of the floodwall and the foundation, pumping station design, pump selection, a list of potential permits needed, and a list of other deliverables needed beyond the 30-50% stage.

TEAM 15

Abdul Ahmad
Evan Murdzek
Fred Torres
Matthew Torres

ADVISOR

Wei Zhang

SPONSOR

Track Speed Improvement Program – Br. 08078R Railroad Bridge over West Broad Street in Stratford Replacement

A replacement deck was designed for railroad bridge 08078R over West Broad Street in Stratford. The original bridge deck supported 4 tracks and had a span of 39ft. The new deck is designed in a similar way, except the new deck is ballasted to improve track speed. It consists of 5 girders, each in between a track, along with 8 stringers, 2 under each track. Loads are transferred from the tracks, onto the stringers, onto 3 equally spaced floor beams, then onto the girders. The main design project deliverables included the sizings of the main girders and stringers that support the new deck, and the cost estimation and construction sequencing. Design loads and moments were all calculated based on the American Railway Engineering and Maintenance-of-Way Association (AREMA) code along with the expected use of the rail. Cost estimations were decided based on the Connecticut Department of Transportation (CTDOT) Estimating Guidelines as well as RSMeans data. A project schedule was created including traffic control, demolition, and installation of the new bridge.
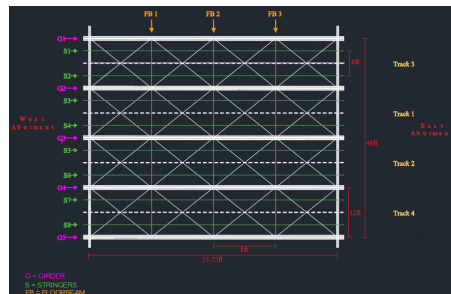
TEAM 16

Michael David
Jasmin Lugo
Sean-Michael
  Parkinson
Maxwell
  Wondolowski

ADVISOR

Richard Christenson

SPONSOR

Alexandra Hain, Connecticut Cooperative Transportation Research Program (CCTRP) Project 20-02

Superstructure Replacement Using Maintenance-Free Steel Beams

Project CCTRP 20-02 will be to design Accelerated Bridge Construction (ABC) staging plans for the superstructure replacement of a steel girder highway bridge that utilizes UHPC to stabilize girder ends. UHPC has been used to repair existing bridges with deteriorating girder ends but has not seen much application in new construction yet. The high compressive strength of UHPC combined with its improved durability against freeze/thaw cycles and corrosion from road salts makes it a great material to be used in highway bridges. CTDOT is seeking to design maintenance-free steel bridges so that their investments in the state's infrastructure have an as long a service life as possible.

TEAM 17

Shawn Dirck
Grace Ewoldt
Frantz Gabriel
Nathan Nye

ADVISOR

Richard Christenson

SPONSOR

Alexandra Hain, Connecticut Cooperative Transportation Research Program (CCTRP) Project 20-02

Life-Cycle Cost Analysis for Maintenance-Free Steel Bridges

The Connecticut State Department of Transportation (ConnDOT) is addressing the problem of beam end corrosion and is in search of a maintenance free solution rather than continuous repairs every 15-20 years. Some of the newer options like UHPC have become a new possibility aiding in this effort. Its sustainability and cost have become a crucial part in determining if it is the best option over other traditional methods of repairing and maintaining beam ends. We will be providing estimations of lifespans in the separate joints, evaluating the pros/cons of each method, evaluating initial cost for preventative measures, and performing a life cycle cost analysis. This will be given to ConnDOT as a single package with all assumptions explained, sources of all information obtained, and a modeled VR of each maintenance method for the I-84 East bridge span as the site. We will contact all contractors and manufacturing shops within 100 miles of Hartford, Connecticut to determine a price range for galvanization, painting, metalizing, weathered steel, and UHPC regarding beam end repairs and total girder protection.

TEAM 18

Erik Mihok
Victoria Ramirez
Matthew Stapell
Cameron Swanson

ADVISOR

Richard Christenson

SPONSOR

Structural Design of UHPC Encased Steal Beam Ends

Traditional bridge beam end diaphragms are connected perpendicular to the bridge beams web through weld to a bearing stiffener. The issue with the current design is primarily with the steel bearing stiffener itself. Due to the material properties of steel, it undergoes rusting when exposed to water and air which is not ideal for structures that are exposed to air and water daily. Processes have been developed such as metalizing, galvanizing, and even painting to prevent rust from forming on steel members. However, each of those three processes require costly routine maintenance to ensure the structural integrity of bridges. Our team has been tasked with developing a modern approach to replacing steel bearing stiffeners at bridge beam ends with ultra high performance concrete (UHPC) columns. UHPC offers many advantages. First and foremost is its increased compressive strength over traditional concrete. Although it may cost more to procure than the concrete currently used, the amount saved annually will quickly offset the initial cost. UHPC is also highly workable which allows it to flow more easily making the section less porous and more resistant to the environment.

TEAM 19

Kyle Krupansky
Michael Hazen
Christopher Shieh
Earl Stevens

ADVISOR

Richard Christenson

SPONSOR

UCONN
SCHOOL OF ENGINEERING
CIVIL & ENVIRONMENTAL
ENGINEERING

Casting of Ultra-High-Performance Concrete (UHPC) in the New Construction of Steel Beam Ends

This is an investigation of casting methods and processes for UHPC in steel beam ends for new construction. We will be focusing on time and cost efficiency, current casting infrastructure, and analysis and design of new elements that could be implemented.

TEAM 20

Fiona Casey
Aidan Fay
Katie Laresch
Meg Sirowich

ADVISORS

Manish Roy
Philip J. Katz, P.E.

SPONSOR

Stantec

Design of Site Work for the Reconstruction of Washington Elementary School, West Haven, CT

Washington Elementary School in West Haven, Connecticut has not had a major renovation in over thirty years. Recently, plans have been made to reconstruct the building to meet code requirements and create a better educational environment for the students. Civil Engineering Senior Design Group 20's role in this project was to work with STANTEC Consulting Services INC. to design a new site plan for the new building using AutoCAD. The current site has a small parking lot and a route for student drop-off and pick-up that often gets crowded with parental and faculty/staff vehicles, and school buses. The group's design better utilizes all the space available on the site to create efficient parking and drop off areas along with two new playgrounds for the students. The plans for the site included site gradation, drainage, and sediment and erosion control. A materials cost analysis report was also prepared.
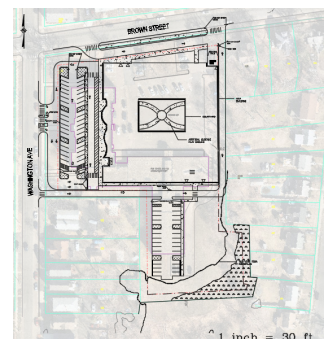
TEAM 21

Samuel Baum
Brad Kelle
Jacob Zakrzewicz

ADVISORS

Terrance Gallagher, PE
Ronald J. Nault, PE
Manish Roy

SPONSOR

Design of the Extension of Constitution Boulevard West in Shelton, CT

Senior Design Team 21 was tasked with designing the extension of an existing roadway through woodland to allow vehicular access to a large, City-owned property in Shelton, CT. This development has been a consistent top priority within the City's Plan of Conservation and Development to allow for industrial economic growth in a healthy mix within existing residential, light commercial, and open space land uses. Shelton has already developed connections with companies interested in constructing buildings on this land. Addressing project feasibility, Shelton divided this road extension project into two phases. This project's scope is defined by Phase 1 which extends the western end of Constitution Boulevard South from where it currently terminates at Bridgeport Ave. to terminate in a cul-de-sac approx. 3100ft into the woodland. The City of Shelton expects this completed roadway to stimulate economic development and increase public access to open land. Phase 2 will increase mobility and safety of commuting traffic by connecting Phase 1 to the existing intersection with Rt. 108.

The design process began with evaluation of existing conditions using publicly available data and hand calculations. Local ecology, current land use, and topography were evaluated through the use of ArcGIS Pro and OpenRoads. Hand calculations established the pre-development water runoff, infiltration, and storage. These approximations informed results derived using HydroCAD. Through the combined visualization of a 3-D terrain model, existing wildlife habitats, land use, wetlands, and property boundaries, three roadway alignment and profile proposal alternatives were developed. Each alternative was evaluated to determine the most cost-effective road design that minimizes environmental impacts, rock cut and fill requirements, and allows for future economic development that will not negatively impact water quality for the local community and regional ecology.

TEAM 1

James Paulella, Jr.
Bradshaw Pines
Kevin Romero
Foster Rowberry
Peter Virtue

ADVISORS

Lt. Col. Cameron
Sprague
Maj. Ryan Miller
Bing Wang

SPONSOR

CT National Guard Cyber Range

The CT National Guard Cyber Range 2021 Project focuses on working with the ongoing project that was developed last year. This year, the goal was to move the cyber range to the cloud for remote access. Currently, the cyber range simulates two blue team scenarios: a ransomware attack and a vulnerable Active Directory access page. As cyber attacks–more specifically ransomware attacks–are rising in use, this cyber security project holds real world, practical applications. With this year's team, each scenario is now remotely deployable, allowing CTNG trainees to practice National Guard battle plans from wherever. The project uses Amazon Web Services for cloud compute virtual machines, with Terraform for automating virtual machine deployment. Furthermore, practice scenarios are now easily addable due to the abstraction that was made possible through virtualization. The current scenarios are built with a variety of technologies, from Powershell scripts and Active Directory on Windows to Apache on Linux, but a wider variety is possible with ability to build and add any scenarios desired. Making the ongoing project more easily modifiable and adaptable allows the CTNG and any further teams to build quicker. This is essential as cyber security is now more important than ever, and any solutions in the field must be able to evolve quickly.

TEAM 2

Neha Ande
Donte Berberena
Rodney Jackson, Jr.
Jacob Lenes
Jack Violet

ADVISORS

Song Han
John McCandlish

SPONSOR

CGI

Connecticut's Health Equity Dashboard

In this project, we are creating a health equity dashboard for Connecticut. Our goal is the bring different data sources together and display to the users to show what types of programs or services should be provided in the different places in Connecticut. In order to accomplish this, we will be using Connecticut's Census data along with datasets from Centers for Medicare & Medicaid Services. We hope our webpage will be informative of the services we should provide in the various towns and counties of Connecticut.

TEAM 3

Likhitadevi Athina
Thomas Crosby
Kamila Krawczuk
Adarsh Kumar
  Nagendra
Noah
  Picarelli-Kombert
Sean Rowan

ADVISORS

Don Draper
Joseph Johnson
Jim Swanski

SPONSOR

Burns & McDonnell

Burns & McDonnell Project Management Software

As an engineering, construction and consulting company, Burns & McDonnell often focuses on program and project management for their clients. While they use a variety of industry leading technologies to provide their services, they also augment these tools with their own project management software. The goal of SDP CSE Team 3 was to modernize and optimize one specific piece of software used for workflow automation and report distribution. We worked towards setting up a relational database in order to have a centralized location to save automation configuration (aka tasks). In addition to that, there has been significant work put into updating the format that is used to load and save tasks, it had previously utilized an old format called XML which has been changed to JSON. This required updating the mechanisms for all existing task and module types for how the necessary information is saved and loaded. The software had also been streamlined by eliminating code and configuration that has been deprecated. Additional steps towards modernization were taken by updating the communication protocol that certain tasks utilize from communicating with a SOAP to utilizing REST commands.

TEAM 4

Marcus Barone
Jie Kong
Finn Navin
Millenia Polanco
Isaac Teles

ADVISOR

Amir Herzberg

SPONSOR

UCONN
SCHOOL OF ENGINEERING
COMPUTER SCIENCE &
ENGINEERING

CTng: An Improved Public Key Infrastructure Scheme

Web Public Key Infrastructure (PKI) is core for allowing web browsers to create secure connections with websites. Certificate Transparency (CT) is the system used by modern browsers to implement PKI. Certificate Transparency Next Generation (CTng) is a proposal for a new system by Hemi Leibowitz, Haitham Ghalwash, Ewa Syta, and Amir Herzberg which create, monitor, and audit digital certificates that prove the ownership of a cryptographic public key. CT as it is today has several issues including the abandonment of the "No Trusted Third Party" principle and insufficient support for the revocation of certificates. CTng is an existing redesign of CT which seeks to solve these problems while maintaining some backwards compatibility with existing CT infrastructure. Our project has two parts: First, given the

CTng security design document, create an implementation specification to outline a standard method by which various entities would interact. Second, implement this design while following accepted software engineering practices.
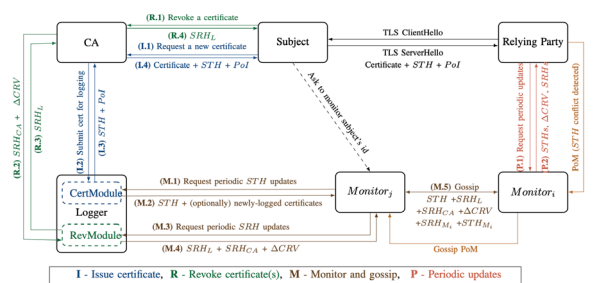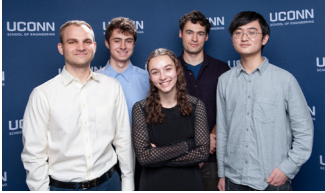
TEAM 5

David Dawidowski
Benjamin Norris
Serena Riback
Jack Winkelman
Zimo Zhang

ADVISORS

Anand Bahirwani
Amir Herzberg

SPONSOR

TERADYNE

Secure Sandbox Server

The goal of this project was to create an application which would allow for a client to easily deploy a given Docker Image to a server. The team was required to completely secure all communication between the client and the server, as well as protecting the server from potential attacks and ensuring the process of deploying Docker Images is completely fault tolerant.
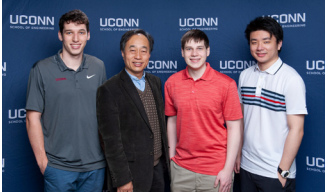
TEAM 6

Christina Gorbenko
Sam Knowlton
Kaiyuan Luo
Ethan Rathbun
Joseph Schittina

ADVISOR

Wei Wei

SPONSOR

Machine Learning and Artificial Intelligence for Jet Engine Health Management

Jet engine health management is important for airlines' profit in commercial engine market and fleet readiness for military customers. It has the goal of doing the right maintenance at the right time and the right place. Doing the right maintenance will help reduce the maintenance cost by only conducting the needed work other than spending the resource to deal with false alarms; Doing the maintenance at the right time features the so-called Condition-Based Maintenance (CBM) where the maintenance is only conducted when it is really needed other than scheduled so that the maintenance cost is reduced and engine time-on-wing is extended; Doing the maintenance at the right place allows the needed facility and part inventory are in place to support the maintenance (for commercial airlines, this is usually the hubs). As an engine OEM, Pratt & Whitney is committed to provide dependable jet engine health management. The key to support doing the right maintenance at the right time and the right place is to identify a failure accurately and reliably at an early stage so that there will be ample time for the aircraft to get to the right place for maintenance. For most engine components, a failure is a state of the component that a fault is progressed to. By definition, a fault is a physical imperfection or impairment that is responsible for failure while a failure is a state of inability to perform a normal function. As shown in the P-F curve in Figure 1, the earlier a fault is detected, the less cost to repair would incur. It is well-known that the earlier a fault is detected, the more likely the detection is a false alarm. Excessive false alarms would defeat the propose of doing the right maintenance. Also, some of the fault may lead to safety critical failures, in which case, the recall rate of the detection has to be 100%. Overall, the goal for this project is to implement a machine learning algorithm which can accurately identify and diagnose engine faults.
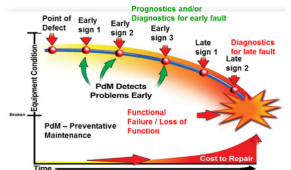
TEAM 7

Matthew Kropp
Katherine Miller
Sriram Mukund
Payalben Patel
Jeff Remy

ADVISOR

Seung-Hyun Hong

SPONSOR

Emanus LLC
Jose Torres

PEACE Project

PEACE is a cloud-based multi-party communications platform that enables parents, law enforcement officials, governments, etc. to monitor and be notified of who is driving a vehicle and who the other occupants are, particularly prior to the engagement of law enforcement officials with the driver/occupant of the vehicle (during a traffic stop or another encounter). In a preferred embodiment, PEACE's proprietary mobile app platform provides omnipresent awareness and communication between various stakeholders that is triggered by electronic and visual cues at the scene of a police traffic stop prior engagement with vehicle occupants. The system provides advanced information (e.g., age, medical condition, relevant prior history, etc.) about who has been authorized to drive the vehicle and others having permission to be in the vehicle. A goal of the system is to notify law enforcement officials during a traffic stop and prior to engagement that the driver/occupants have pledged to be compliant with police and law to avoid violent confrontation.

TEAM 8

Paul Verbo
Nicole Khusid
Faith Sporbert
Shaun Hergerton
Yanpei Zhang

ADVISORS

Song Han
Justin Morgenthau

SPONSOR

 triax

IoT Energy Consumption Analyzer

Battery powered IoT devices are a common tool in today's jobsite. However, the downtime required to charge or replace dead batteries is costly at a large scale, so it is in a company's best interest to optimize the battery life of their IoT devices. It is not uncommon to produce a noticeable decrease in the battery life of a device after even the slightest of updates to its firmware. Therefore, it is valuable to have the ability to run constant checks to ensure a device's expected battery life stays within a tight range. Our project will provide companies and technology developers an easy means of testing firmware changes before finalizing device updates in order to catch these power-draining bugs. We have partnered with Triax Technologies to develop an open-source continuous integration (CI) testing platform for analyzing the change in power consumption of a device following any update. Our goal is to simplify the user experience by creating a modular and highly-configurable framework that allows developers to use the CI platform and power profiler of their choosing and have complete control of all aspects of the testing. The output to the user includes graphical interpretations of the analysis and readable results that can be sent via email or added as a comment on a pull request.

TEAM 9

Dominic Anaeto
Alex Chen
Cameron Cianci
Zhixuan Lai
Matthew Marek

ADVISORS

Suining He
Stephen Zemanick

SPONSOR

CGI

CGI_Infection_Rates_ML_Modeling

Our team has spent the past two semesters working on machine modeling approaches to modeling COVID-19 infection rates in the United States. Our goal for this project was to create at least one model that performs better than the popular models currently available. We have gained professional experience working with data science and machine learning throughout the process. Specifically, we applied data collection, data preprocessing, analysis, machine learning model development, training, evaluation, and parameter tuning skills. We started with simple linear regression and autoregressive integrated moving average (ARIMA) models to set a baseline. Next, we shifted our focus to long short-term memory (LSTM) neural network models. Overall, we achieved two models that performed significantly better than existing models on the national scale. We then shifted to modeling COVID-19 infection rates in smaller regions, where we had more data to make the model more accurate.

New COVID-19 Cases Smoothed with Model Predictions
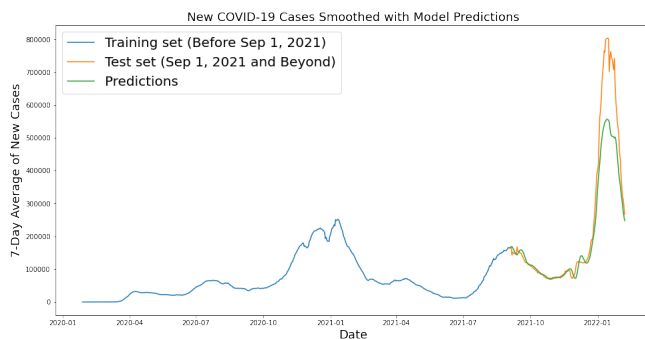
TEAM 10

Lydia Ashchepkova
Catrina Nguyen
Wyatt Reller
Rojaun Samuda
Enyinna Ugenyi

ADVISOR

Sheida Nabavi

SPONSOR

WHELEN
TRUSTED TO PERFORM™

Whelen Cloud Platform - Fire Feature

The project is focused on creating and implementing two features on The Whelen Engineering Company's web-based application: the Whelen Cloud Platform (WCP). WCP provides a real-time vehicle tracking service to emergency services with an interactive map that displays the locations and status of all vehicles. Our job was to implement two features for the the Live Map designed to be useful for coordinating fire fighting services during an emergency. While these features were originally specific to fire trucks, we designed them in such a way that they could be useful for any organization that Whelen provides services for, whether it be law enforcement, emergency medical services, or even the Department of Transportation.

TEAM 11

Nate Aboala
Sara Anwer
Aju Chitrakar
John Mercado
Samuel Schiffer

ADVISOR

Jake Scoggin

SPONSOR

WEBQUITY

Webquity Web Accessibility

The team has created a prototype Google Chrome extension to adapt website content to be more accessible. The tool adjusts color schemes, font size, font family, and line and letter spacing to benefit users diagnosed with dyslexia and minor visual impairments. The resulting software will allow users to have equal opportunity to access and digest information online.

TEAM 12

Maryam Aziz
Jacob Chan
Farhan Karim
Payal Shah
Owen Wight

ADVISORS

Mark Underwood
Wei Wei

SPONSOR

synchrony

Synchrony Cyber Range

A cyber range is a virtual environment in which users can simulate cyber attacks, test cybersecurity technology, host competitions, etc. In order to address the current limitations of cyber ranges, our team proposes that a domain specific language (DSL) should be used for cyber range development. A DSL within a cyber range would allow for customization of cyber range scenarios and standardization of scenario development. Our team will create a prototype of a DSL that could be implemented within a cyber range using Xtext, and write an NSF proposal supporting the use of DSLs in a cyber range. Our project also addresses the lack of accessibility with current cyber ranges. We suggest a hybrid licensing model, as well as more cost effective platforms to run our cyber range on (Raspberry Pi, existing cyber ranges, etc.).

TEAM 13

Samantha Gaebel
Theodore Gregor
Aisha Hussain
Justin Kocian
Aniruddah
 Manikandan

ADVISOR

Song Han

SPONSOR

UConn Kinesiology

Use of UWB and Vibro-Tactile Biofeedback System for Indoor Positioning and Navigation in Emergency Response Situations

Our project develops software for a specific vibro-tactile biofeedback system. This system is designed to help firefighters navigate smoke filled buildings. Our vibro-tactile biofeedback system uses patterns of vibration felt on the body to provide new ways of perceiving direction. UWB radio based positioning system is used to determine the ranging values and location of a mobile unit. These systems are integrated together to create a prototype device that can be used to blind-navigate around an indoor environment.

TEAM 14

Kai Bolat
Jacob Dillon
Christian Koloseus
Allison Morhardt
James Zhu

ADVISORS

Paul Adamski
Amir Herzberg
Bret Lynch

SPONSOR

PW Secure Embedded Architecture – Post-Quantum Cryptography (PQC)

The goal of our project is primarily about implementing three post-quantum signature verification algorithms to be run on the Xilinx ZCU102 development board and running performance tests on said algorithms. We seek to use the performance metrics in order to determine which algorithm has the best trade off between speed and security, especially in the context where the ARM processor must be reset and the boot time minimized.

TEAM 15

Austin Abate
Chloé Becquey
Tiana Wilson
Christopher Vassallo

ADVISOR

Sheida Nabavi

SPONSOR

LTI
Let's Solve

Climate Risk Strategy Analyzer

When climate disasters occur and damage properties, insurance companies are expected to pay for losses covered by a client's policy. The issue, however, is that many of these policies are determined by historical data. This historical data determines how much an insurance company is expected to pay if a claim is made and under what circumstances a claim is valid. This past data is rapidly becoming more and more dissimilar to what is happening today due to changes in the frequency and severity of climate disasters. It is vital that better solutions are developed in order to reflect the current circumstances. It is for these reasons that the project Climate Risk Strategy Analyzer (CRISTAL) was created. The purpose of CRISTAL is to act as a tool for broker agencies to evaluate their clients current insurance policies and determine what further coverage may be needed when the current climate situation is taken into consideration. By combining a climate risk analysis and a coverage gap analysis, CRISTAL will provide users with predictive and prescriptive analyses. Such analyses will include possible climate events that can affect a client's business, automated recommendations related to their policies, and advisories about potential financial changes. In order to achieve this goal, our aim is to implement three main features focused on flood events: a historic analysis of flood claims made in proximity to a given address, a simulation of a potential flood event, and a prediction of what damages may be incurred during such a flood event.
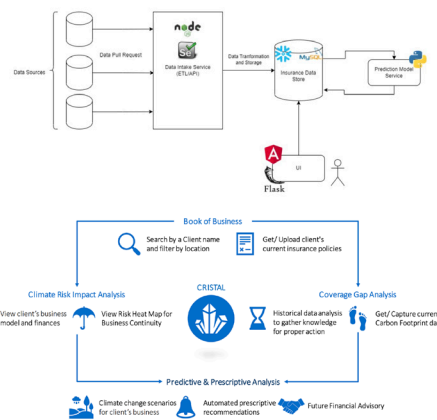
TEAM 16

Daryl D'Souza
Aditya Dubey
Matthew Pluta
Zecheng Wang
Rohit Yerram

ADVISORS

Matthew Ferrier
Jake Scoggin

SPONSOR

SONALYSTS

AR Mobile Application for Visualizing Spatially Anchored 3D Models

For this project, Sonalysts would like to have the students design and develop an AR application that interacts with static exhibits. Our project is an augmented reality mobile application that is able to render animated 3D holograms in real-time and geospatially anchor them on physical objects and/or tags in the real world. It is capable of image recognition, object detection, geolocation mapping, marker recognition, and it can support an augmented reality view that contains spatial awareness and AR sessions. In addition to this, our application is able to render animated 3D object models, retrieve and fetch them from a cloud database in real-time, contain a secure user authentication and authorization service, and should have a friendly and interactive user interface.

TEAM 17

Joseph DiCioccio
Neil Hemnani
Laing Jonathan
Jhin Mcglynn
Varun Sadhir

ADVISOR

SPONSOR

UCONN
SCHOOL OF ENGINEERING
COMPUTER SCIENCE &
ENGINEERING

This team's project description could not be published for privacy reasons.

TEAM 18

Joe Crawford
Mahdi Kazi
Tim O'Meara
Jacob Starks
Jacob Zadroga

ADVISOR

Steven Demurjian

SPONSOR

synchrony

Synchrony CareCredit

Synchrony, a financial services company, is looking to build upon their existing CareCredit application. This application provides avenues for customers to pay their medical bills. In its current form, one of the app's key functions is to allow customers to pay healthcare providers directly for the portion of their medical expenses that insurance will not cover. However, in CareCredit's current state, this key functionality is inefficient. As a result, Synchrony is interested in an enhancement of this feature, which would allow patients to scan their healthcare bills with their phone camera and autofill details. In addition, a check-in functionality will be implemented to allow a patient to check-in to an appointment on the app from their car, rather than having to enter the facility. A provider will see this check-in request and be able to approve or deny the patient using the application.

TEAM 19

Aditi Dubey
David Martinez
Rebecca Peng
Joseph Raccio
Paribesh Upreti

ADVISORS

Brian Nevinsky
Dongjin Song

SPONSOR

LOCKHEED MARTIN

Lockheed Martin Virtual Reality Robot

Students will provide a virtual reality experience where a remote user in a VR headset can peripherals can control a telepresence robot to solve macro and micro scale problems.

TEAM 20

Ya-Sine Agrignan
Nicholas Chmielewski
Darrell Draughn, Jr.
Blake Gaines
WingSheng Sze

ADVISOR

SPONSOR

UCONN
SCHOOL OF ENGINEERING
COMPUTER SCIENCE &
ENGINEERING

This team's project description could not be published for privacy reasons.

TEAM 21

Virginia Ho
Sebastian Puczynski
Tirth Patel
Elijah Rodriguez
Michael Wheeler

ADVISOR

Steven Demurjian

SPONSOR

UCONN
SCHOOL OF ENGINEERING
COMPUTER SCIENCE &
ENGINEERING

LabOnFHIR: An mHealth App for Patient Disease Tracking

One of the major trends in healthcare is an increasing desire for patients to exert more control over their protected health information (PHI) which contains data that they create and control and data that is maintained in the different health information technology systems that are deployed at hospitals, clinics, medical offices, test laboratories, imaging centers, pharmacies, etc. The LabOnFHIR mobile health application is a mHealth application that allows users to manage diabetes, heart disease, and fitness related data. The front end of LabOnFHIR has a side for the patient, in which patients can input and view their diabetes, heart disease and fitness related data such as glucose levels. Data can be visualized in such a way that is easy for patients to recognize and possibly correct negative patterns such as poor glucose levels or weight gain. This immediate knowledge of a patient's glucose levels will be helpful for doctors to detect abnormalities in patients much sooner than they would otherwise.

TEAM 22

Ethan Caya
Michaela Felipe
Jonah Leventhal
Anusha Nagella
Harold Suquillo

ADVISOR

Seung-Hyun Hong

SPONSOR

DIAMETER
HEALTH™

Diameter Health FHIR API Documentation Website

We've created a website which hosts documentation for Diameter Health's Fusion API. Besides serving as a new centralized user-facing source of documentation, the website allows users to test the API's functionality through its built in sandbox feature. The Fusion API (application programming interface) cleans and de-duplicates healthcare information such as patient records. The purpose of which is to allow interoperability between different healthcare IT systems which may not all structure their data the same way.

TEAM 23

Brendan Henriques
Tristen Lawrence
Alex Le
Zhongqi Luo
Anas Rajeh

ADVISOR

SPONSOR

UCONN
SCHOOL OF ENGINEERING
COMPUTER SCIENCE &
ENGINEERING

This team's project description could not be published for privacy reasons.

TEAM 24

Brett Abarle
Wilfredo Canelo
Nicholas Shpetner
Kyle Stubbs
Zizhou Xu

ADVISORS

Ashley Egan
Bing Wang

SPONSOR

AcceleratED
LEARNING

AcceleratED Learning

AcceleratED Learning LLC. is a web application that features an on-line reading intervention platform that supports students struggling with reading by providing a community of trained tutors that provide virtual research-based instruction during school. We are focused on creating a kid-friendly video teleconferencing platform that will be able to support students during school.

TEAM 25

Jacob Benedetti
Adam Cooper
Ethan Mann
Linda Phung
Sadik Suny

ADVISORS

Seung-Hyun Hong
Rick Ryan

SPONSOR

pitney bowes

Gamification of Data Capture and Analysis from Physical Objects

Pitney Bowes is a global technology company providing commerce solutions that power billions of transactions. Clients around the world, including 90 percent of the Fortune 500, rely on the accuracy and precision delivered by Pitney Bowes solutions, analytics, and APIs in all aspects of shipping, from eccomerce fulfillment to international shipping. As commerce has evolved information about a package or mail piece has become almost important as the item itself. The USPS has continued to place more and more data within barcodes on envelopes and packages. This data can be used to gain insights into the behaviors of the shippers, carriers and technology providers. Pitney Bowes has initiated several programs to encourage employees to send images of the mail and packages they receive to a central location for analysis, but each one quickly lost steam and engagement dropped. Our goal is to gamify the process of scanning labels on mail and packages to increase user engagement and provide crucial data for Pitney Bowes to use to improve their services. The platform will be an app on users phones with a cloud-hosted backend that keeps track of teams and points as well as decoding and parsing the images submitted.

TEAM 26

Nicholas Durkin
Allan Feng
Maximilian Kessler
Bude Su

ADVISORS

Timothy Gifford
Nabavi Sheida

SPONSOR

MOVIA

Shared Environmental Layout Data Structure of Human Position and Posture Representation for Human Robotic Interaction Control

The purpose of the project is to create a system that can take video data from two input devices and combine the data into one global environment. This will allow MOVIA to supplement their Kebbi Air Robot Platform with data from additional devices, improving the ability of the system to interact with subjects. The project will be implemented using Unity and Microsoft's world locking tools. The system will have a module that is responsible for tracking subjects' positions and locations using fixed real-world objects (glyphs). This module will be installed on multiple devices and will feed all the data to a second module. The second module will combine that information using coordinate transformations and create a unified global coordinate space. The global coordinate space will check for duplicate data or errors and will create a single representation of each subject in the environment. These virtual representations will be displayed as the output on a laptop. This document outlines the exact details and design decisions for the system described above, and will also present the action plan for completing the project.

TEAM 27

Benjamin Amar
Harold Carvajal
James Maniscalco
Raymond Pantalena
Niraj Patel

ADVISORS

Wei Wei
Kenneth Lemieux

SPONSOR

Whelen Engineering UConn Senior Project

Whelen Engineering produces lighting and control systems for police and emergency vehicles. With Whelen's control system, customers are able to track the location and status of various functions of their vehicles. The goal of our project was to expand Whelen's platform to handle new signals sent from vehicles. To do this, we updated Whelen's platform to receive the additional signals from the vehicles. Having sent the signals from the vehicles to the cloud, we added functionality to Whelen's live map on their web platform to reflect these signals on the vehicle icons.

TEAM 28

Tharun Jagannathan
Jesmarie Hernandez
 Mendez
Katelyn Nguyen
Kushaal Patel
Ashely Tang

ADVISORS

Suining He
Douglas Vargo

SPONSOR

Wearables in Healthcare

Using public API our team will compile health data and personal wearable device data to make determinations on health status and display this on an application dashboard. Our specific direction for the project was to research the idea of how financial status might affect one's health status in the USA. To do this we will examine the gross income of people in different states, then analyze the number of reported hospitalizations/illnesses/covid patients there are with respect to the total population.

TEAM 29

Tugrul Durdu

ADVISORS

Bing Wang
Chris Allinson

SPONSOR

AEROSPACE
ALLOYS, INC.

Value Stream Mapping

Value Stream Mapping is a project sponsored by Aerospace Alloys, Inc (AAI). Value Stream Mapping or VSM is a visual tool which allows a company to visualize their production for current and future capacity depending on the current and forecasted demand from clients. Using Excel, Python, and eVSM, the workflow of value stream mapping for Aerospace Alloys has been optimized so that it only takes a matter of days to complete instead of months. The original raw data is provided through an Excel spreadsheet generated by AAIs ERP system. The Pandas library in Python is used to analyze the raw data which includes sorting through all the data and calculating cycle times, quantities demanded, and other production measurements. The results are written to Excel sheets by their product family. A dashboard is also generated by combining all the important data into one Excel sheet. This Python program automates the data analysis so that it takes seconds or minutes to compute. The resulting data is then used in the eVSM software to produce the value stream. The goal of this project is to allow Aerospace Alloys to optimize their production workflow throughout the year and actively prepare and succeed as demands change and new challenges arise.

Our team collaborated with Management & Engineering for Manufacturing Team 1 on this project.

TEAM 30

Pablo Medero
Dakota Nyborg
Nicole Nguyen
Vinh Nguyen

ADVISOR

SPONSOR

UCONN
SCHOOL OF ENGINEERING
COMPUTER SCIENCE &
ENGINEERING

This team's project description could not be published for privacy reasons.

TEAM 31

Prateek Kapoor
Kelsey Mitchell
Jake McNamara
Matthew Togher
Aikambir Walia

ADVISOR

Dongjin Song

SPONSOR

Anomaly Detection for Internet-of-Things Appliances

Budderfly is an energy management company that uses innovative solutions to help businesses and other institutions save energy. One of these solutions is accomplished through the installation and monitoring of energy efficient appliances through Internet of Things (IoT) devices. Given time series data on freezer and bread oven monitors, the goal of our project was to analyze the power levels of these appliances. We first visualized the data to better understand it, and then pre-processed the data to get rid of noise and outliers. Then, using different machine learning models, we were able to detect anomalies among the freezer and bread oven monitors. One method we used was K-Means clustering with soft DTW as the metric, which grouped monitors into clusters and helped us identify which monitors were behaving irregularly. Finally, we used an alternate LSTM machine learning model to detect anomalies and compared this with the K-means clustering.

TEAM 32

Mohammad Habib
Connor Lynch
Saumya Shah
Qianrui Xia
Xuehuan Zhu

ADVISORS

Jonathan Clark
Suining He

SPONSOR

Cigna Mental Health Social Media

Our task is to develop an application that integrates with an existing and popular social media platform such as Twitter to allow users to monitor and be alerted when one of their friends might be having a mental health challenge. The app would analyze photo images and textual posts in a social media feed to perform sentiment analysis. The sentiment score would be presented to the user and give them potential insights that allow them to be a real "friend" and provide the community support that is needed. This might be done through prioritizing the news feed, proactive alerting, or even giving users the ability to place certain contacts on a their personal watch list. Sentiment scores might also be graphed over time to show the ups and downs of their community of friends and potentially correlate these extremes to personal or public news events.

TEAM 33

Ethan Efobi
Everett Grethel
Michael Zhou

ADVISORS

Karl Berntorp
Seung-Hyun Hong
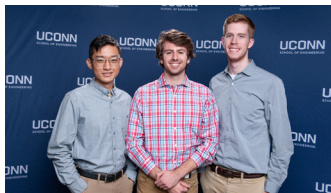
SPONSOR

MITSUBISHI ELECTRIC

MERL path planning with deep neural nets

Autonomous path planning vehicle simulator and RC car using deep learning.

Our team collaborated with Electrical and Computer Engineering Team 7 on this project.

TEAM 1

Zachary DiMeglio
Mitchell Johnson
Stephen Pang

ADVISOR

Sung-Yeul Park

SPONSOR

UCONN
SCHOOL OF ENGINEERING
ELECTRICAL & COMPUTER
ENGINEERING

A Smart, Efficient, and Light Solar Microgrid Inverter

In modern day power engineering, we are seeing the gradual shift away from non-renewable energy sources like coal and petroleum, and towards clean energy. An important component of converting renewable sources like solar into usable electricity is called an inverter. This system controls, regulates, and monitors the power that is generated and delivered to a load. For our design, we specifically implement a microgrid inverter, which is a technology that relies on having many microgrid inverters interconnected on the same network, rather than a single distributed energy source. Thus, it is important to design the inverter to be safe, efficient, modular, and affordable.
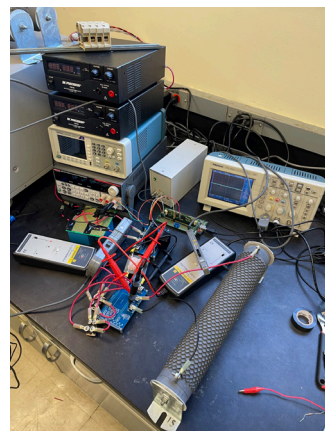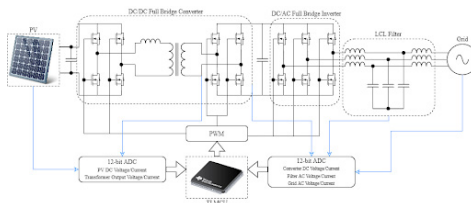
TEAM 2

Kevin Lindstrom
Kaiyuan Liu
Justin Paul

ADVISOR

Shengli Zhou

SPONSOR

UCONN
SCHOOL OF ENGINEERING
ELECTRICAL & COMPUTER
ENGINEERING

Resonant-Beam Based Optical Wireless Data Communication and Charging.

The University of Connecticut's Electrical and Computer Engineering Department has tasked us with developing a resonant beam based wireless power transfer and communication device that uses 1064 nanometer coherent light. This project is a continuation of two years of development performed by two previous senior design teams. We are tasked with finally implementing the extended cavity laser that is this resonant beam and implementing the previous communication work to this extended cavity laser. This task is non-trivial as there are very strong budget constraints being imposed on this project. While the development we are performing is proof of concept based, a company called Wi-Charge already has products that use resonant beam based charging. However, their product does not implement communication over the resonant beam, and this is the task for our team: to make a novel system that does both communication and charging. The development of this new technique could provide alternative communication options to communication standards being used in existing communications bands such as Bluetooth and LoRaWAN.
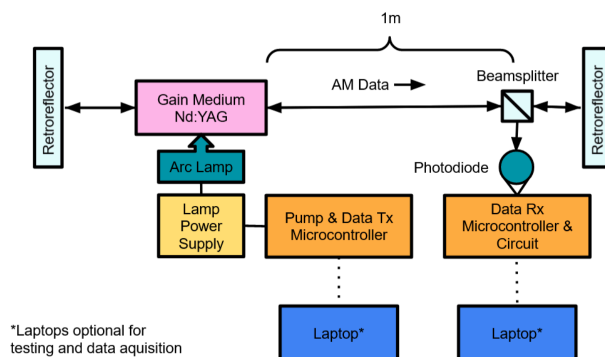
TEAM 3

Rogenry Munoz
Toni Smakaj
Rafael Soliven

ADVISORS

Abhishek Dutta
Alice Nichols

SPONSOR

accelerate**UCONN**
an NSF I-Corps Site

Airborne Virus Extermination Device

With the rise of SARS-CoV-2 as well as its numerous variants, the safe opening of enclosed, shared spaces has once again become a challenge. The Dutta group aims to take this challenge head on through the development of a portable airborne virus extermination device that is capable of continuously removing 99.9% of viral particles in the air. This is made possible through the incorporation of HEPA filters and UV-C lights in the design which are capable of accomplishing this feat. A fan also incorporated in the design pulls unfiltered air in which then passes through a HEPA filter, removing dust or any other small particles which can shield microbes from UV-C light. The air then passes through a UV-C light bulb that eliminates the exposed microbes resulting in clean, pure air to be released at the end of the device.

TEAM 4

Alex Beltran, Jr.
Jayme Palazzo
Kyle Strandson

ADVISOR

Ali Bazzi

SPONSOR

R&D
Dynamics Corporation

Streamline User Interface for a Variable Frequency Drive

Technology adoption is key to a sustainable future but it relies on acceptance by users. Currently programs exist nationwide to encourage installation of Variable Frequency Drives (VFDs) to create more efficient buildings and reduce energy usage. Most commercial VFD software presents a large complex list of parameters to the end user with a structure that requires training to learn and understand. Often, the learning involves memorizing parameter names and location simply to be able to achieve any functionality beyond basic functions. This crude method of presenting complex information represents a barrier to adoption of energy efficient technology. Therefore, finding the most cost effective way to reliably observe and accurately report drive output current when operating high speed motors with sensorless vector control becomes necessary.

TEAM 5

Yongqi Ni
Alexander Parsell
Cindy Torres

ADVISOR

Ali Bazzi

SPONSOR

Hardware Optimization for High Speed Variable Frequency Drive

Reduction of energy use through the adoption of new more efficient technologies is key to a sustainable future. There are a number of advantages to using high speed machinery in certain applications, however wide adoption of more efficient technology is hindered by cost. Therefore optimal hardware selections are needed in order to create a high speed variable frequency drive which can facilitate adoption of more efficient solutions.

TEAM 6

Kevin Joshy
Duy Le
Nathanael Metke
Terry Zhao

ADVISORS

Ashwin Dani
Jason Thibodeau

SPONSOR

Autonomous Search and Rescue Helicopter System Design

In this project, students will utilize the open-source flight control software PX4 to run an autonomous search and and rescue mission. This mission will be implemented utilizing OpenCV image processing library and model-based control system design engineering practices within the Simulink software package. Using an onboard camera, a quadcopter will search an area within a 30ft radius for the rescuee. Upon locating the rescuee, the quadcopter will perform a controlled approach to achieve a stable hover above the target point. At this stage, a retractable rescue hoist will be dropped to pull the victim to safety.

TEAM 7

Dennis Leung
David Nizzardo
Matthew Piotrowski

ADVISORS

Karl Berntorp
Shalabh Gupta

SPONSOR

Path Planning with Deep Neural Networks

Self-driving cars are decision-making systems whose complexity scales with the level of autonomy. In the highest level of autonomy, Level 5, the self-driving car should be able to provide full-time operation of all aspects of driving under different roadway and environmental conditions. The control architecture and its components can be designed and interconnected in different ways, but, at high level, the system structure of a vehicle with at least partial self-driving capabilities consists of a sensing module, a motion planning module, and a control module. The sensing and mapping module uses various sensor information, such as radar, Lidar, camera, and global positioning system (GPS), together with prior map information, to estimate the parts of the surrounding environment relevant to the driving scenario. The motion planner takes sensor input and determines a trajectory that the car should follow. Usually this task is accomplished using a model of the vehicle and the environment, which has limitations in its flexibility to adapt to uncertain sensor information. With the breakthrough of advanced data-driven machine-learning techniques, there are new opportunities in how to be able to design more robust and efficient algorithms for realizing self-driving cars. As an expansion to MERL's set of techniques for autonomous vehicle design, we would like the UConn senior design team to setup a miniature-scale testbed, collect training datasets for a vehicle maneuvering on a road, and test or develop a deep neural network that uses the sensor data to determine a suitable vehicle trajectory.

Our team collaborated with Computer Science & Engineering Team 33 on this project.

TEAM 8

Bryan Cruz-Cintron
Owen Kratowicz
Nabeel Mian
Yuhong Yao

ADVISORS

Pu Wang
Shengli Zhou

SPONSOR

Integrated Wi-Fi Communication and Sensing

Wi-Fi environmental sensing is a relatively new and unresearched technology. Expanding the potential of this field of study, Team 2208, in a project sponsored by Mitsubishi Electric Research Laboratories, is seeking to develop a Wi-Fi simulation platform capable of object detection, tracking, and environmental sensing. This simulation is seeking to expand on current technologies by attempting to capture biometric measurements and detect more delicate body and object movements through the disruption created on the path of surrounding Wi-Fi signals. The goal of this project is to then develop a technology that is capable of emulating radar functionality or environmental imaging. Research was done into the feasibility of the project, as well as a survey of available software tools. The software explored included a deep examination of MATLAB's WLAN toolbox and open-source WiGig tools. Future plans for this project will involve the development of a software-based simulation environment. Successful completion of this simulation could lead to the creation of a physical prototype demonstration.

TEAM 9

Ruowang Jian
Edith Palomino
Drew Riffle
Evan Wielachowski

ADVISORS

Yang Cao
Derek Leahy

SPONSOR

GENERAL DYNAMICS
Electric Boat

Electric Machine Voltage Insulation System

The insulation system of an electric machine has to be carefully designed and implemented in order for the machine to have optimal performance, low size and weight, reduced component cost, and machine longevity. Recently, UConn researchers have developed a new nano-structured insulation material, with hopes of it providing benefits to electric machinery. Tasked by General Dynamics Electric Boat, we will be modeling different marine propulsion motors to test and compare the performance benefits that the nano-structured insulator provides compared to the current industry standard insulator. Multiple motors will be modeled using Ansys RMxprt and Maxwell, and then tested to see their thermal performances. Additionally, we will be observing the effect that different motor cooling methods (air, direct liquid, indirect water) have on the performance of the insulated propulsion motors. The primary objective of this project is to obtain data on how well the nano-structured insulation outperforms the current industry standard insulation, depending on the motor and the type of cooling method used.
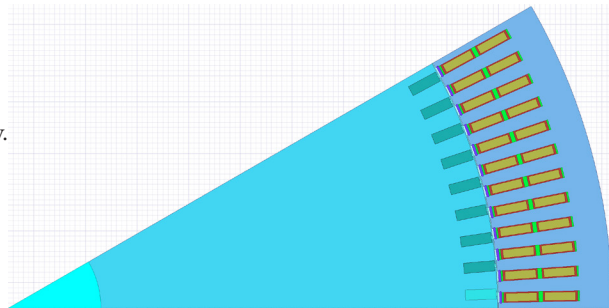
TEAM 10

Jose Grullon
Blake Fulton
Quincy Heinrich

ADVISORS

Necmi Biyikli
Rob Scala

SPONSOR

GENERAL DYNAMICS
Electric Boat

MEMs Magnetometer

Team 2210 has been tasked by Electric Boat to design and build a MEMs magnetometer capable of detecting magnetic fields with intensities as small as 0.1 nT in 3 Axis of direction. This project involves designing and developing three orthogonal fluxgates to detect all the cartesian coordinates. The fluxgate requires a driving circuit capable of supplying a square wave signal around 1.1 amps to the drive coil. The drive coil is wrapped around and through a toroidal ferrite core. The purpose of this coil is to saturate the core in the clockwise direction and then counterclockwise direction very quickly. When no external magnetic field is present, both core halves will saturate simultaneously, leaving a net-zero flux within the system. However, when an external magnetic field is present, the halves of the core will begin to saturate at slightly different times, leaving a nonzero magnetic flux within the core. By wrapping a sense coil entirely around the core, we can induce a current in this coil that is proportional to the external magnetic field. This signal will be processed in MATLAB with a bandpass filter and lock-in amplifier to extract the noise within the system. This device will be inserted into a metal container created by the joint ME team.
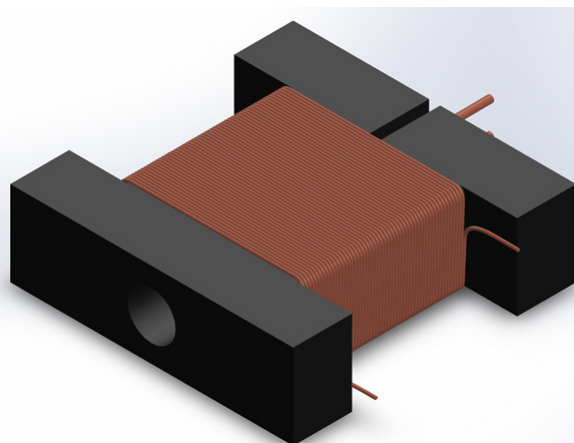
Our team collaborated with Mechanical Engineering Team 21 on this project.

TEAM 11

Abraham Feldman
Joshua Matthias
Christopher Shaffer
Garrett Zeilinger

ADVISOR

Sung-Yeul Park

SPONSOR

NEWPORT

Contactless Underwater Discharge/Recharge of a Vehicle Battery

Our assigned project requires the development and demonstration of the concept of bi-directional power transfer with application to unmanned underwater vehicles (UUVs). We will need to prove the ability to both recharge and discharge battery systems while submerged underwater. This project requires us to develop a system to meet the needs of wireless charging. Included within this is the need for data communication, so as to measure the battery capacity and charging status of the system, as well as notify the transmitter and receiver to change their mode of operation (switch between charging and discharging).
This project focuses on the command and control of bi-directional charging across a water gap, with the demonstration of a prototype design. Our constraints for this project include transmitting between 100 and 200 Watts of power, and maintaining a water gap of approximately 0.25 inches. Demonstration of our system proves the concept of bi-directional power transfer, done so wirelessly while submerged underwater.
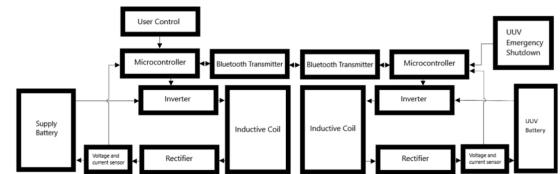
TEAM 12

Joseph DiBenedetto
Justin Maramo
Daisy Megnath

ADVISORS

Abhishek Dutta
James LeBlanc

SPONSOR

NEWPORT

Electromagnetic Expulsion of a Cylindrical Body from an Outer Tube

Team 2212's project is a joint project with ME team 34. The goal of this project is to expel a projectile underwater using electromagnetic fields. The Naval Undersea Warfare Center (NUWC) is interested in this because of the silence and efficiency of an electromagnetic launcher, as opposed to traditional mechanical means. To accomplish this, current is passed through a coil of wire in order to produce a strong magnetic field. This magnetic field interacts with an iron slug in the back of the projectile sled such that the sled gets pulled towards the center of the coil. If the timings of the coils are carefully controlled, a large exit velocity can be obtained. To control the project, an ESP32 microcontroller is used to provide a simple web interface to monitor the status of the device and perform the launch sequence. This allows for simple single-user control of the system.

Our team collaborated with Mechanical Engineering Team 34 on this project.

62

TEAM 13

Jeremy Amoro
Michael Benvenuto
Diego Vilca

ADVISORS

John Chandy
William Villano

SPONSOR

Collins Aerospace

Compact and Robust Data Logger

Collins Aerospace has requested that the team create a compact and robust data logger that can withstand extreme environmental temperatures for long periods for use in testing aircraft parts in simulated real-life settings. The data offer will sample signals of +/- 15V at a frequency of 1MHz and store them on a removable storage device. The data logger enclosure will be constructed to ensure that it can withstand outside temperatures of -40°C to 85°C in an environmental chamber and act as a Faraday cage to provide electromagnetic shielding for the electronics. The electrical and computer engineering team has designed a six-layer printed circuit board for the data logger. The requirements for the circuit board are that it should be compact, be able to sample four differential inputs at 1MHz frequency, be able to withstand temperatures of -40°C to 85°C, store the digitized version of the signals on a removable storage device, read user input settings, and have status indicators. Our PCB design includes four Twin BNC connectors for the four differential inputs, two-stage instrumentation amplifiers with programmable gain to step down the input signal to an acceptable range for the high sample rate analog to digital converters, a Xilinx FPGA/CPU, USB-C input to power the onboard voltage regulators, three LED status indicators, and a microSD card slot to store the signals and read user settings.

Our team collaborated with Mechanical Engineering Team 15 and Systems Engineering Team 2 on this project.

TEAM 14

Sofia Abdari
Jacques Goosen

ADVISOR

Mehdi Anwar

SPONSOR

UCONN
SCHOOL OF ENGINEERING
ELECTRICAL & COMPUTER
ENGINEERING

Ultra-Wide Bandgap HFETs for High Power, High Temperature, and High-Frequency Applications

Ultra-Wide Bandgap (UWBG) materials have paved the way for high power, temperature, and frequency applications, bringing forth a growing research niche and becoming the industry standard. With a wider range of flexibility, UWBG materials are addressing 5G/6G spectrum challenges and improving commercial/defense electronics. Up until now, device designers/researchers did not have access to a resource that specifies performance advantages. This project aims to bridge that gap of knowledge between UWBG materials and advanced communications. Through extensive literature review and TCAD simulation, data has been extracted and verified to construct a well-informed recommendation of the best-qualified materials. Through literature review, a master table has been provided, comparing physical properties and the figures of merits of these materials. Simulations have been conducted using Synopsys Sentaurus to configure a 2D model of a UWBG based CAVET and record the joule heat power distribution. From these methods, the project has contributed a clear resource and recommendation to device designers/researchers, as well as suggesting future areas of research.

Comparison of the Physical Properties/FOMs of Researched Materials Relative to Si

Units		Si [1]	β-Ga₂O₃ [1]	h-BN	Diamond [1]
eV	Bandgap E_g	1.1	4.8	5.9 [2]	5.5
W/cm·K	Thermal conductivity λ	1.5	0.1-0.3	17-20 [2]	20
cm²/V·s	Electron mobility μ_n	1480	250-300	35,000-70,000 [2]	2000
10⁷ cm/s	Saturation velocity v_{sat}	1	1.8-2	2.5 [3]	1
$E_c^2 \cdot V_{sat}^2 / 4\pi^2$	Johnson figure of merit (JFOM)	1	2844	≈2500-7000	1110
$\varepsilon \cdot \mu_n \cdot E_c^3$	Baliga figure of merit (BFOM)	1	3214	≈450,000-925,000	24660

*E_c is the breakdown electric field (MV/cm), ε is the dielectric constant.

[1] R. Zhang et al., "Progress of Ultra Wide Bandgap Ga2O3 Semiconductor Materials in Power MOSFETs," in IEEE Transactions on Power Electronics, vol. 35, no. 5, pp. 5157-5179, May 2020, doi: 10.1109/TPEL.2019.2946367.
[2] Bhimnathwala, G. R., et al. "2D Boron Nitride," Semiconductors and Semimetals, 2016, pp. 101–47, https://doi.org/10.1016/bs.semsem.2016.04.004.
[3] "High-Velocity Saturation in Graphene Encapsulated by Hexagonal Boron Nitride." ACS Publications, 2017, pubs.acs.org/doi/10.1021/acsnano.7b03878.

TEAM 15

Chelsea Anthony
Yuzhong Guo
Darrel McDowell

ADVISOR

Joseph Mortimer
Amy Thompson
Bryan Weber
Liang Zhang

SPONSOR

Collins Aerospace

Combined Heat and Power System Assessment and Optimization

The Collins Aerospace Windsor Locks site seeks to improve the energy use, sustainability, operation, and reliability of its Combined Heat and Power system (CHP). The CHP plant generates electricity and steam used for process and space heating. It is a critical asset that reduces operational cost, improves the site's reliability and capacity to operate during outages, increases the energy efficiency of the site, and decreases total greenhouse gas emissions. The primary mover is a combustion gas turbine, and a heat recovery steam generator. The UConn student team will evaluate the system from a thermodynamic perspective to assess the efficiency and performance of the plant. Controls and operation practices will be reviewed and examined for improvement opportunities. Current and emerging technologies will be evaluated for feasibility, cost- effectiveness, and efficacy in reducing energy consumption, GHG emissions, and/or water usage. In brief, the Combined Heat and Power System Assessment and Optimization project will examine existing systems and investigate opportunities to meet the energy and emission goals of the site.

Our team is a collaboration between Mechanical Engineering Team 17 and Systems Engineering Team 5 on this project.

TEAM 16

Kenneth Foss
Sam Nguyen
Zachary Stone

ADVISORS

Joe Mortimer
Liang Zhang

SPONSOR

Collins Aerospace

Onsite Wind Power Generation Assessment

As part of their commitment to reducing greenhouse gas emissions, Collins Aerospace is maximizing their production of renewable energy onsite. In pursuit of this goal, this project proposes a wind farm tailored to their site and specific needs. This proposal has been developed following a full wind resource assessment, and is delivered in the form of mechanical, civil, and electrical design packages.

Our team collaborated with Mechanical Engineering Team 14 on this project.
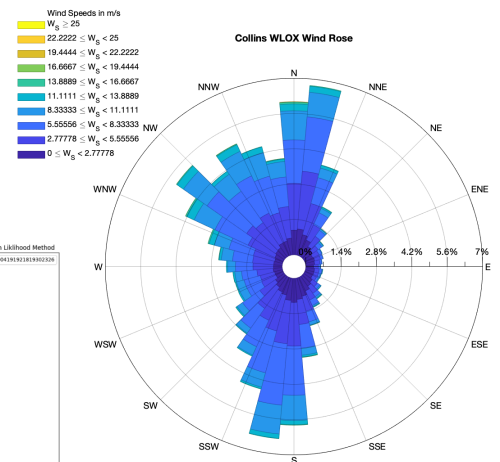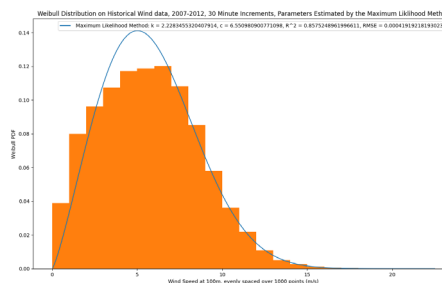
TEAM 17

Jiheng Li
Andrew Osorio

ADVISOR

Liang Zhang

SPONSOR

# Energy Consumption and Efficiency Initiatives for Building 220 and 200

The purpose of our project is to do a comprehensive report identifying energy consumption and opportunities for energy efficiency initiatives within building 220 and 200.

Our team collaborated with Mechanical Engineering Team 39 on this project.

TEAM 18

Alex Clonan
Stephen Duncanson
Tao Liu

ADVISORS

Yaakov Bar-Shalom
Michael Bartosewcz
Richard Davis

SPONSOR

Home
Body

Home Body

The inspiration for Home Body came from our sponsors Richard Davids and Michael Bartosewcz, founder of HOME Shelter. Falls are the leading cause of fatal injuries in older Americans. HOME Shelter envisioned Home Body as a ubiquitous solution to detecting fallen bodies through an IR sensor to mitigate this issue, in a conventional, commercialized application equivalent to that of a smoke detector. We proposed this system to meet the desired need to combat epidemiological issues associated with falling. The senior design group's task was to implement this system: A commercialized infrared, thermal camera, connected over I2c to a microcontroller board running a digital signal processing algorithm to detect falls. Providing a low-cost, portable, ambient environment sensor system that detects the presence of a fallen stationary human body using InfraRed (IR) technology and/or sound at floor level, and is capable of transmitting an alert to a family or medical personnel. The project incorporates the design of the sensor and integration in a contemporary household based on epidemiological data associated with household falls. This project is joint with MEM Senior Design Group 13. Thus, the product additionally incorporates risk, cost, marketing, and manufacturing plans, to make the sensor system a commercial product.
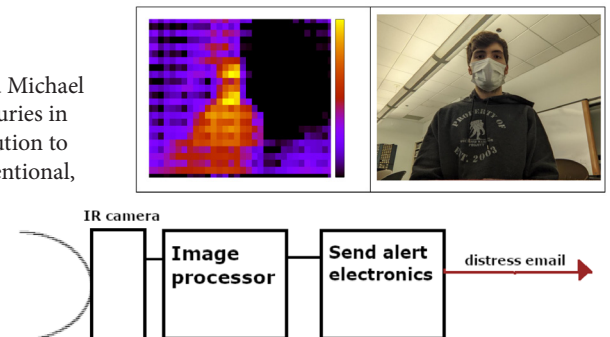
Our team collaborated with Management & Engineering for Manufacturing Team 13 on this project.

TEAM 19

Michael Davis
Nicholas Fortunato
Luigi Matira

ADVISOR

Abhishek Dutta

SPONSOR

AROMAKIT, LLC

Personal Aromatherapy Device

The current climate surrounding the COVID-19 pandemic and many other events that exist within the world has caused a notable unrest and uneasiness within our everyday lives. A remedy most commonly used to calm one's self can be connected through the many years of therapeutic scents that cause a reaction within your system and ease one's tension. From AROMAKIT, our team comprising of electrical and mechanical engineers have come together in creating a device that will allow a dispersion of aromatherapy oils found within a contained system that can be located on the back of one's smartphone. This device will be connected to a bluetooth module that will provide a connection with our device to the phone for easy access and modular adjustability. The user may be able to change these scents using oil soaked pads that can be inserted into the device for quick and safe heating. We hope to provide our users with a device capable of bringing their soothing needs in an easy-to-use and safe capacity to bring their lives back to a calming state.

Our team collaborated with Mechanical Engineering Team 7 on this project.
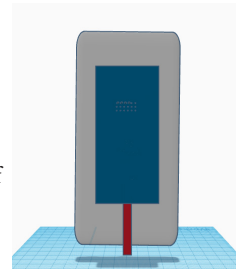
TEAM 20

Christopher Morse
Matthew Owczarczyk
Deep Patel

ADVISORS

Lindsay Altschuler
Tony Cacace
Paul Costello
Lei Wang

SPONSOR

Feasibility of Robotic Welding of Complex Aluminum Panels

Aerospace manufacturing continuously holds rigorous standards in both production quality and project deadlines. The use of robotic arms is becoming more common in the industry as a way of speeding up repetitive tasks while still maintaining high standards. This project demonstrates the feasibility and capabilities of an ABB robot equipped with a TIG (tungsten inert gas) welding apparatus to join complex aluminum panels. The successful implementation of this machine into a manufacturing setting would decrease production time and costs while maintaining the high standards necessary to operate within the aerospace industry. One of the many challenges to overcome in this project included pinpointing the precise movements and timing for the heating and cooling of each unique part. Once those unknowns are solved and proper fixturing is made for each piece to be joined, an ABB robot equipped with a TIG welding apparatus can become a pivotal element of any manufacturing process.

Our team collaborated with Mechanical Engineering Team 1 on this project.
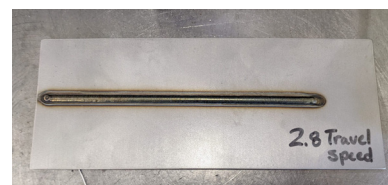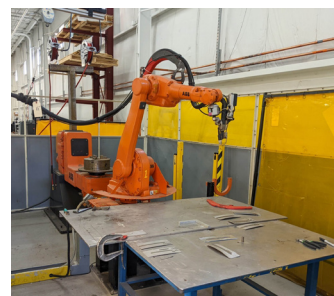
TEAM 21

Maximilian Daignault
Jacob Hayes
Tianbo Huang
Kesong Mi
Brett Muni
Cal Pitruzzello
Elijah Taitel

ADVISOR

Shalabh Gupta

SPONSOR

Fastcorp and Chapco

Fastcorp Vending Design for Manufacturing

The aim of this project is to update Fastcorp DIVI Vending Machine.

Our team collaborated with Management & Engineering for Manufacturing Team 5 and Mechanical Engineering Team 23 on this project.

TEAM 22

Tyler Albanese
Luke Dabek
Elizabeth Downey
Paige Lombardi
Kyle Moriarty
Brandon Tyndale

ADVISORS

Necmi Biyikli
Constantine Demos

SPONSOR

Soldering Iron Documentation and Research

This semester we have been working with the company Chapco to help update documentation, engineer a new product, and make improvements to their manufacturing process. Chapco is an engineering, manufacturing and assembly company based in Chester, Connecticut. They specialize in metal fabrication, prototype to production, product assembly, welding and finishing and also the engineering and development of products for customers worldwide. The engineering challenges for the ECE team this semester are mainly related to the new product design which specifically entails designing a 12V or 24V battery operated soldering iron. The other objectives either don't require much engineering or are mainly being handled by the MEM portion of the group. The main engineering challenge associated with designing the battery powered iron has been designing a heating element that can be manufactured using their current process that will meet the desired voltage requirements.

Our team collaborated with Management & Engineering for Manufacturing Team 4 on this project.

TEAM 23

Howard Ding
Jiankai Hua
Jakob Maranzano

ADVISOR

Shalabh Gupta

SPONSOR

Automatic Rail Alignment

In real world, the rails have wear condition, which means the rail height, weight and railhead shape can change over time. The sponsor's railway inspection device seeks to determine the condition of a railway. This project seeks to provide a methodology to align the device to the rails automatically.

TEAM 24

Lucien Binette
Anthony Bolic
Jake DiMauro

ADVISORS

Adrian Becker
Lei Wang

SPONSOR

Solenoid Test Bench

Our team is designing a Solenoid Test Bench that is capable of meeting Jacobs Vehicle Systems requirements to accurately test their solenoid designs. Jacobs Vehicle Systems requires that the test stand be able to monitor oil supply pressure, return pressure and temperature to maintain testing consistency and have full range of control over the solenoid's operating frequency, duty cycle, voltage and current. This test stand will also be capable of testing multiple solenoids at the same time, be easy to use, and adapt to any location within their facility. Our test stand load tests solenoids by supplying a specified oil pressure and temperature to each of the solenoids and then switches the solenoids at a specified frequency with monitors looking at the current, voltage, and differential pressure for each solenoid being tested. In regards to overall safety we have implemented an Emergency Stop feature within the test stand to maintain a safe working environment and prevent injuries. This feature when activated will turn off all features of the test stand like the oil pump, solenoids, and heater while keeping the data acquisition software online and notifying the operator of an error.

Our team collaborated with Mechanical Engineering Team 27 on this project.

TEAM 25

Steven Allaby
Sushant Raj

ADVISORS

Ashwin Dani
Tim Keiser

SPONSOR

BELIMO®

Assembly Process Improvement with Co-bot

Belimo is a Swiss-based manufacturer and distributor of actuators, sensors, and control valves, for HVAC systems. Their North American headquarters is located in Danbury, Connecticut. The goal of our project is to continue to the work of previous senior design teams from 2019-2021 and implement a collaborative robot work cell into their customization department. We are specifically tasked with working to automate the assembly of their rack-bearing subassembly. The subassembly consists of a bent sheet metal bracket and plastic part that are screwed together using self-tapping screws. The addition of screws introduces the added complexity of automating a screwdriving process. The benefits of automating this fully manual assembly process are that it will allow for shorter customization lead times and allow operators to focus on parallel tasks while decreasing assembly costs.

Our team collaborated with Management & Engineering for Manufacturing Team 2 and Mechanical Engineering Team 11 on this project.

TEAM 26

Emilie Alber
Carlos Lachos
  Olivares
Joshua Mirolyuz

ADVISORS

Rodger Williams
Susan Zuo

SPONSOR

Airbornway

Eagle Mobile Robotic Character

This project involved us designing a power distribution system for the Eagle Mobile Robotic carrier, as well as advising our sponsor on the power requirements necessary for the ERMC, as well as any changes that can be made or additions that could improve the project's overall design and functionality. The ERMC is a gondola-esque shuttle that is designed to propel its passengers throughout a city as a more cost-effective and greener alternative to cars, buses, etc. For our power distribution system, we must provide around 7 KW of power to the cabin, an alternating 81 to 89 KW of power to the elevator motor that will allow the carrier to ascend and descend to pick up passengers, and around 2369 KW of power to the drive motor that will allow the carrier to move throughout the city. In order to do this we have implemented a three-phase radial power distribution system, and in order to distribute power to the various components inside the cabin have developed a load center that will pass on the power to each of the required loads in the cabin. Alongside this we have researched methods such as regenerative braking to save power, as well as where to place our distribution system on the carrier so as to comply with all relevant regulations, making sure our design will be feasible at all times.

Figure 1b

Our team collaborated with Mechanical Engineering Team 4 on this project.
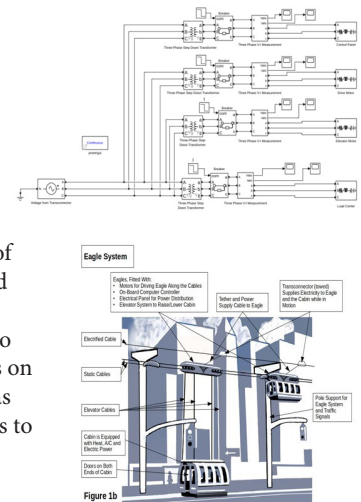
TEAM 27

Alexander Gmuer
Ryan Hendry
Antonio Tran

ADVISORS

Benjamin Bouffard
John Chandy

SPONSOR

Next Generation Bridge PCB Test Fixture Design and Development

Zygo is a metrology company at the forefront of providing high precision metrology solutions to customers dealing with optics, semiconductors, and other high-tech industries. Zygo purchases proprietary PCBs for use in systems through third-party suppliers. In order to interface to the system electronics, a specialized PCB called a bridge translates between Ethernet and CANopen. This includes its own image of Linux with the necessary Zygo-produced programs. Zygo plans on releasing a new version of the bridge PCB. This offers a variety of challenging engineering aspects that require problem solving, including how to image Linux onto the bridge PCB and how to confirm all assembly and programming was successful.

Our team collaborated with Mechanical Engineering Team 64 on this project.

TEAM 28

Sydney Marino
Elijah Malboeuf-Boyd

ADVISOR

Liang Zhang

SPONSOR

UCONN
SCHOOL OF ENGINEERING

ELECTRICAL & COMPUTER
ENGINEERING

Smart Production Line Testbed

With the rapid development of Industry 4.0 computation and communication technologies, more seamless data collection, transmission, and utilization are allowed, which has created enormous opportunities to greatly enhance the efficacy of the decisions and controls made in manufacturing. Because of this, constructing high-quality mathematical models for production systems becomes an important topic to ensure validity of any subsequent model-based analysis. The ECE Department here at UCONN has tasked us with the goal to build a hardware/software testbed to act as surrogate of the physical manufacturing systems in a lab environment to understand the efficacy of the theoretical results in real-life situations.
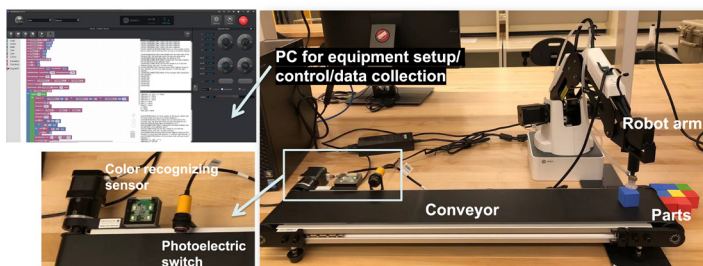
TEAM 29

Bolivar Baez
Jan Feyen
James Hipsky
Jacob Parent

ADVISORS

Joe Borrelli
Duane James
Lou Pannullo
Sung-Yeul Park

SPONSOR

Triumph Group

1500W Brushless DC Motor Controller

Triumph Group Systems and Support is currently developing a family of Brushless DC (BLDC) Motor Controllers that are adaptable, reconfigurable, allow for rapid upgrades, and will meet the needs of current and future customers in the aerospace industry. The goal of the project is to design, procure, and test a 1.5 kW brushless DC motor controller. This controller should be capable of handling up to 40A of current and capable of operating at a maximum of 48V. The design will also be able to operate with or without motor sensor feedback. Our designed controller is split into two sections, a driver stage, and a power stage. The power stage consists of a three-phase MOSFET bridge, shunt resistor current sensing, and its accompanying protection circuits. This stage resides on a single-layer IMS PCB. The driver stage consists of a Texas Instruments smart driver integrated circuit, local power conditioning, and connectors for a microcontroller. This stage is on a four-layer FR4 PCB. The smart driver can be controlled using any microcontroller with sufficient PWM and analog-to-digital capabilities. Inclusively, this design supports the MSP-EXP430F5529LP processor board from Texas Instruments and implements modified TI software to interface with the controller. This is a joint project with the mechanical engineering department; their responsibility is to design and manufacture a motor stand for the selected motor, as well as the motor controller housing. Project deliverables include the finished motor controller, motor controller housing, accompanying motor, and all the design files with their respective artifacts.
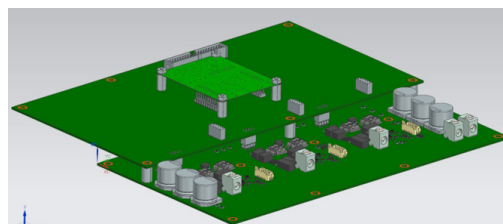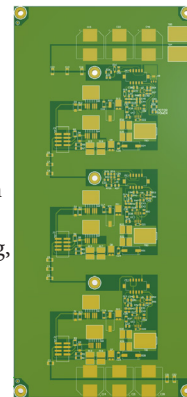
Our team collaborated with Mechanical Engineering Team 54 on this project.

TEAM 1

Hope Dymond
Kyla Drewry

ADVISORS

Alexander Agrios
Erik V. Freidenfelds
Eric Watters

SPONSOR

Pfizer

Condensate Collection and Treatment

The Pfizer Facility in Groton, Connecticut is the global center for the development of pharmaceutical candidates in the Pfizer Research & Development Pipeline. Over the course of a given year, the Groton site consumes a significant amount of water that includes approximately 225 Million Gallons per year over the past 5 years to meet site demand for onsite utility demand for steam and chilled water generation as well as laboratory and office uses. Approximately 25% (57 million gallons per year) is used for cooling tower make-up. This significant amount of water use places the Groton site as one of the top consumers in the entire global portfolio of Pfizer facilities. In order to increase the company's sustainability and lower their water consumption, Pfizer commissioned Senior Projects, Inc. to design a system that would allow for the reuse of condensate accumulated in Building 220 for use in the cooling water towers. In order to make this reuse a reality, two main design aspects are required. The first is a mechanical project which will focus on the transport of the water from the penthouse and basement mechanical rooms to the cooling water towers. Thomas and Chandan will focus on this aspect. This will require a pipe design and possibly a pump as well. The second design requirement will be to ensure that the quality of condensate meets the parameters required for cooling water before it reaches the cooling water towers. This will require design work from environmental engineers, Hope and Kyla, to develop a treatment system for the collected condensate.

Our team collaborated with Mechanical Engineering Team 38 on this project.

TEAM 2

Ethan Lo
Kaelie Moran
Zachary Sagendorf
Juanita Toro

ADVISOR

Alexander Agrios

SPONSOR

TOWN OF BOLTON, CONNECTICUT
1720

Bolton Water Connection

The Town of Bolton is a small community with very limited public water utility access. There are a couple of small public water supplies serving limited residential customers which have little ability to expand or serve our business community. Bolton does have a small area along Rte. 44 between Bolton Notch at 384 and the Town of Manchester that is home to several businesses that would benefit from a public water supply. There is also vacant land at the old drive-in theater site and on Cider Mill Road that would have greater opportunity for development if public water were available. This area is currently served by a sewer system connected to the Town of Manchester. Along this stretch are some restaurants, motor vehicle sales and service, two filling stations with some food service, a veterinary hospital, small equipment sales and service, a machine shop and a manufacturer. The manufacturer in particular purchases water by the tanker load to manufacture automobile soaps and waxes. This area is also home to our only aquifer protection area. Some time ago we looked into the idea of bringing public water to this area but the cost at the time was prohibitive. We believe that we may be able to leverage American Rescue Plan funding to construct this project. The project would entail collaborating with the Manchester Water Company to design a way to bring water from the Manchester Town line along RT 44 to 384. Our early research indicated that there was plenty of water volume but pressure would be an issue. It is our hope that UCONN Engineering students might enjoy meeting the challenges of this project and aid us in finding the most cost-effective solutions to resolve them to supply both potable and fire suppression water. In doing so they would aid Bolton by bolstering the economic vitality of our business district, improve the safety of the public water supplies in the area, improve fire safety and help protect the integrity of the aquifer.

TEAM 3

Julia Jackson
Travis Molnar
Grace Pagano
Gregory Roberts

ADVISOR

Alexander Agrios

SPONSOR

Determining Background Concentrations of PFAS in Connecticut Soils

Per- and polyfluoroalkyl substances (PFAS) have become a global issue and require immediate action from all government agencies in order to ensure the protection of public health and the environment. Their manufacture since the mid-twentieth century has resulted in their widespread distribution throughout the world, posing a difficult challenge to environmental professionals. Each state in the United States is moving forward with their own regulations and task forces to address PFAS and its associated compounds in an effort to contain this persistent contaminant. The state of Connecticut has decided to take action through the establishment of an Interagency PFAS Task Force and PFAS Action Plan. Our team has been tasked with aiding in the collection of PFAS background concentrations in order to establish a baseline concentration of this contaminant in Connecticut soils; PFAS has become so widespread, it is present in soils everywhere to some degree. These background concentrations will lead to the establishment of enforceable regulations that manufacturer's must adhere to in an effort to reduce the impact PFAS has and will have on human health and the ecosystem. The team designated overarching milestones for this project that were accomplished throughout the semester. The first milestone consisted of an analysis of the Connecticut Department of Energy and Environmental Protection's (CT DEEP) online ArcGIS database for layers containing features related to potential PFAS sources. Ideal background sampling locations were situated away from these potential sources to get the most accurate measurement. The second milestone involved the identification of exact soil sample locations within CT DEEP property using the information gained from the first milestone. The third milestone involved the execution of the soil sampling plan and collection of results to be combined into a final report analyzing trends in PFAS concentrations across the state.
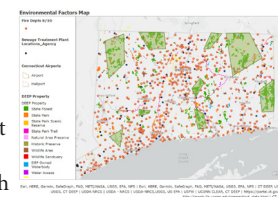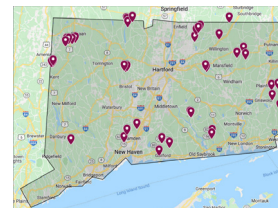
TEAM 4

Scott Ackerman
Madeleine Hasson
Andrew Macklin
Taryn Shannon

ADVISOR

Alexander Agrios

SPONSOR

Centredale Manor Restoration

The Centredale Manor Restoration Project (CMRP), located North Providence, RI, has been assigned a mandated clean-up under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Loureiro Engineering has been tasked to excavate and dispose of any sediment and floodplain soils that are contaminated above regulated levels. Environmental Engineering Team 4 has been tasked with designing a plan for remediation and restoration of the Oxbow wetland area and adjacent floodplain within the CMRP. Due to manufacturing pursuits along the river in the 19th century by Woolen Mill, Metro-Atlantic Inc., and the New England Container Company Inc., there is chemical residue remaining along the river, in groundwater, and in the soil on the site. Along the Woonasquatucket River and Oxbow area there are residential areas, businesses, and a Little League baseball field that are at risk from the contaminants of concern located on site. The main contaminants being looked at are dioxins and furans. The excavation plan was modeled based on the level of the most toxic dioxin, 2,3,7,8 TCDD that, in many areas, is beyond the alternative treatment standard of 10 µg/kg set by the EPA. In addition to the excavation plan, ENVE 4 also created a restoration plan for the wetland. The wetland currently consists of 4 major habitats: upland forest, palustrine forested, palustrine shrub-scrub, and palustrine emergent. The plan was designed to return the wetland to its original construction. The restoration plan includes adding new vegetation, wildlife habitat structures, and erosion control structures.

TEAM 5

Julia Jones
Mia Jordan
Lauren King
Seth Lake

ADVISOR

Alexander Agrios

SPONSOR

WRIGHT-PIERCE
Engineering a Better Environment

Aeration Blower Redesign

Our team of environmental engineers have completed this project in collaboration with Wright-Pierce to redesign the aeration blower system for the town of New Milford CT's wastewater treatment plant. This plant was originally designed with consideration of a new plaza being developed in town, which led them to design for max flow of 4 MGD and peak flow of 7 MGD. The development never happened so now the plant only averages 0.8 MGD, resulting in the plant's infrastructure and process design being oversized. We have redesigned the blower configuration that supplies oxygen to the aeration tank to use less power for lower than expected average intake while still being capable of servicing the maximum and peak flows. We believe this work has high value for the plant because the aeration process typically consumes greater than 50% of a wastewater treatment plant's total energy consumption. We provided options considering positive displacement blowers and high-speed turbo blowers, since both include the advantage of a high turndown. We calculated output requirements for different flow and contaminant scenarios to design a new system of 3 blowers that meet regulations and are compatible with the current aeration tank infrastructure. We provided Wright-Pierce with a cost analysis of a few alternatives with our recommendations for a new and more efficient blower system.

ENVIRONMENTAL
ENGINEERING

TEAM 6

Neel Chakravartty
Brennan Cummings
Makayla Iarrapino
Logan Sarge

ADVISOR

Alexander Agrios

SPONSOR

CHA

Tolland Fire Station Septic and Stormwater Design

Our group was tasked with designing a Septic and Stormwater System Design for a Fire Station in Tolland, Connecticut that is undergoing renovations. The goal of the septic system is to transport the daily discharge from the station and disperse the effluent to a leaching field which will treat the contaminants properly. The goal of the stormwater design is to effectively decrease peak flow and treat contaminants in stormwater. The Septic Design involved many steps to get to our final result. Our first task was determining a location for our system based on separation distances and other limiting parameters. We also had to set piping dimensions and materials as well choosing the correct septic tank for our site. Due to our sites high groundwater table, we deduced that we would need a pump system to distribute effluent into our leaching field. The pump involved many design calculations and special requirements. Finally, we sized our leaching field based on geological and hydrological characteristics of our site as well as effluent properties. We gathered an effective leaching area which was used to determine how many distribution pipes were necessary and their lengths. This area needed to be backfilled with stone aggregate which was one of our last mathematical elements to solve. For our Stormwater Design we had a pretty good idea we were going to extend the existing grass swale on the site to account for the increase in impermeable surface of the new site. We had to do Water Quality Volume calculations to determine the exact amount of effluent that needed to be handled and then equate that to sizing of the swale. To treat contaminants, we also considered Bioretention Basins, Permeable Pavement, and/or Rain Gardens but they were deemed infeasible due to the infiltration rate of the site. The last part of the process was cost analysis which we completed using various software available for material and labor pricing.

ENVIRONMENTAL ENGINEERING

TEAM 7

Gracey Boman
Daniel Chiburis
Kelsey George
Lauryn Patterson

ADVISORS

Manish Roy
Andrew White,
PE, ENV SP

SPONSOR

Tighe&Bond

Design of Replacement Culvert under Park Street in Trumbull, CT

The culvert routing the flow of Belden Brook underneath Park Street in Trumbull, CT has fallen into disrepair over time. The metal culvert and concrete headwalls that are currently in place have structural issues such as spalling, delamination, and corrosion damage. Moreover, the culvert is undersized and cannot handle the flow levels demanded by the site, which has caused immense flooding in the past. The UConn team performed relevant calculations to determine the size of the replacement culvert needed to withstand a 50-year flooding event. The culvert was also designed to disturb less than 5,000 square feet of wetland, and meet the 1.2 times the bank full width and openness requirements as per the United States Army Corps of Engineers and Connecticut Department of Energy and Environmental Protection stream crossing guidance.
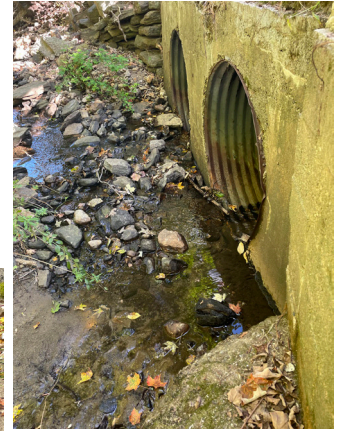
ENVIRONMENTAL ENGINEERING

TEAM 8

Samuel Hamad
Smriti Hamal
Besart Hoxha
Lauren McCard

ADVISORS

Nick Keenan, PE
Manish Roy

SPONSOR

KLEINFELDER
Bright People. Right Solutions.

Design of Sewer and Water Extension to a Community Ski Resort in Pittsfield, MA

Bousquet Mountain and the city of Pittsfield, MA seek to extend the current sewer and water infrastructure in place in order to accommodate future development. The potential future development was evaluated based on the zoning use and probable future construction in the area surrounding Bousquet Mountain. The proposed systems, including the pipes, were sized in accordance with the likely flow rate. The proposed design ties in to existing utilities located on the northwest and southeast ends of the project site by running beneath the roads. The group was tasked with incorporating new gravity, pump station, and a force main for the sewer system design. The group has designed the pump station and utilities and determined their location. The design was based on the city regulations as well as the requirements from the design manuals. The water extension has been designed based on the pressure head and hydrants were placed accordingly. Slopes and alignments for pipes were determined to obtain favorable velocities and avoid interference with existing utilities while minimizing costs. Freezing depth as well as imposed load were considered when choosing the depth of pipes below the surface. Plan and profile views have been developed utilizing a computer aided design software. Furthermore, a construction cost has been estimated based on the cost of materials, labor, equipment, and other indirect costs.
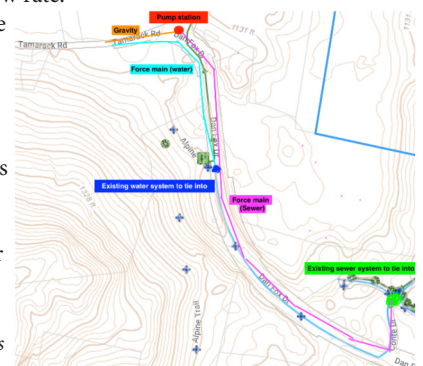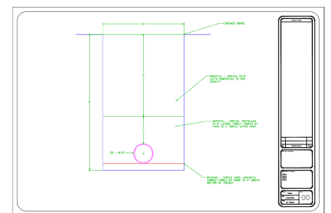
Proposed Water and Sewer Additions

TEAM 9

Stone Brown
Jessica Canty
Caroline Sabo

ADVISORS

Chuck Eaton
Pete Parent
Manish Roy

SPONSOR

CHA

ENVIRONMENTAL ENGINEERING

Design of New Stormwater Management and Septic System in Fire Station 140 in Tolland, CT

Our senior design project is centered around the redevelopment of Fire Station 140, a municipal fire station in Tolland, CT, which will involve an extension onto the South side of the building. The extension of the building will introduce an increase in the overall impervious area on the site. In response to this, our team is tasked with designing a new stormwater management system that effectively meets Connecticut's current stormwater regulations for water quality treatment and peak flow control. Our team chose to explore three different Stormwater BMPs that could be implemented on the Fire Station 140 site: Bioswales, Bioretention Basins, and Stormwater Ponds. The purpose of installing a BMP for this site is to treat and reduce the runoff from the new addition, and further assist the Town of Tolland in its goals to maintain compliance with the current state-wide stormwater standards. We decided the most appropriate BMP to implement on our site is a vegetated swale based on the guidance provided by the 2004 CT Stormwater Manual and the Town of Tolland's MS4 Permit. In addition, the larger capacity of the fire station creates an increased demand for the septic system, requiring a replacement septic system to be implemented. In addition to meeting all the specifications defined by the Connecticut Department of Public Health Technical Standards, we determined the most appropriate septic system design for the site in terms of safety, cost, size, and environmental impacts.
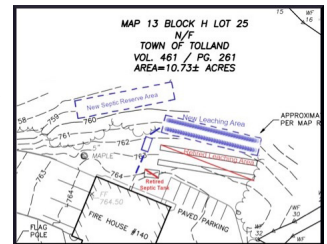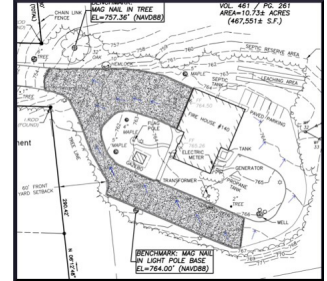
TEAM 1

Bastian Amstutz
Lena Proietti
Jonathan Rucinski

ADVISORS

Chris Allinson
Craig Calvert
Frank Cunha

SPONSORS

AEROSPACE ALLOYS, INC.

Value Stream Mapping

Value Stream Mapping is a project sponsored by Aerospace Alloys, Inc (AAI). Value Stream Mapping or VSM is a visual tool which allows a company to visualize their production for current and future capacity depending on the current and forecasted demand from clients. Using Excel, Python, and eVSM, the workflow of value stream mapping for Aerospace Alloys has been optimized so that it only takes a matter of days to complete instead of months. The original raw data is provided through an Excel spreadsheet generated by AAIs ERP system. The Pandas library in Python is used to analyze the raw data which includes sorting through all the data and calculating cycle times, quantities demanded, and other production measurements.

The results are written to Excel sheets by their product family. A dashboard is also generated by combining all the important data into one Excel sheet. This Python program automates the data analysis so that it takes seconds or minutes to compute. The resulting data is then used in the eVSM software to produce the value stream. The goal of this project is to allow Aerospace Alloys to optimize their production workflow throughout the year and actively prepare and succeed as demands change and new challenges arise.

Our team collaborated with Computer Science & Engineering Team 29 on this project.

Aerospace Alloys - All Product Families - VSM Dashboard

Product Family	1 OS	2 SKI / SEK1	3 SKI2 / SEK2	4 - Ext 4a	4 - Ext 4b	4 - Ext 4c	5 - W	6 - F	7 - C	8 - R	9 - SPB	10 - SP
Demand												
Per Day	1	0	8	13	-	-	1	1.5	-	46.1	-	9.0	-
Per Month	21	120	184	288	-	-	25	32	-	1,002	-	196	-
Inventory Qty (Pcs)												
Raw		295,272	3,297	5,939,652	1,233,817	225,133	326,324		11	-	2,023,470	-
WIP	94	1,805	2,133	18,201	3,000	5,626	121,568	2,050	8,064	-	18,601	1,037
Finished	112	1,027	171	6,594	1,490	376	9,470	397	4,024	-	2,454	230
Total	206	298,104	5,601	5,964,526	1,238,307	220,135	457,362	2,447	12,099	-	2,044,531	1,267
Inventory (Days of Inv.)												
Raw		53,320	389	447,636	#DIV/0!	191,257	220,821	#DIV/0!	0	#DIV/0!	224,664	#DIV/0!
WIP	96	326	239	1,379	#DIV/0!	4,822	92,264	#DIV/0!	175	#DIV/0!	2,065	#DIV/0!
Finished	114	185	20	497	#DIV/0!	322	6,408	#DIV/0!	87	#DIV/0!	272	#DIV/0!
Total	210	53,831	668	449,512	#DIV/0!	196,401	309,493	#DIV/0!	262	#DIV/0!	227,002	#DIV/0!
Cycle Time Average (Min)												
A1	0.4	0.8	0.1	0.5	-	-	-	-	-	-	1.8	-
A2	7.1	5.5	4.1	0.0	-	-	0.4	-	-	-	2.3	-
A3	0.6	-	-	-		94.4	-	-	-	-	-	-
A4	-	6.0	5.0	-	-	-	1.9	-	-	-	3.3	-
A5	1.9	2.0	4.6	1.2	-	16.1	0.9	-	1.2	-	2.2	-
A6	-	0.1	0.6	-	-	-	0.1	-	-	-	0.1	-
A7	1.9	-	9.9	-	-	-	-	-	-	-	2.7	-
Total	11.8	15.0	25.3	2.3	-	110.4	3.4	-	1.2	-	12.4	

TEAM 2

Wilfredo Dolores
Andrew Liew
Jay Warner

ADVISORS

Craig Calvert
Frank Cunha
Tim Keiser

SPONSORS

BELIMO®

Assembly Process Improvement with Cobot

Belimo is a Swiss-based manufacturer and distributor of actuators, sensors, and control valves, for HVAC systems located in Danbury, Connecticut. The goal of our project is to continue to the work of previous senior design teams from 2019-2021 and implement a collaborative robot work cell into their customization department. We are specifically tasked with working to automate the assembly of their rack-bearing subassembly. The subassembly consists of a bent sheet metal bracket and plastic part that are screwed together using self-tapping screws. The addition of screws introduces the added complexity of automating a screwdriving process. The benefits of automating this fully manual assembly process are that it will allow for shorter customization lead times and allow operators to focus on parallel tasks while decreasing assembly costs.

TEAM 3

William Smith
Chaokai Zhang
Yiyi Zheng

ADVISORS

Craig Calvert
Frank Cunha
Eriks Surmanis

SPONSORS

Design a Device for Neck Security Labeling on Alcohol Bottles

Waypoint Spirits currently has a production line that integrates canning, cleaning and labeling. However, only one person can complete the labeling, so the efficiency is low. The main purpose of this project is to design a device for neck security labeling on a glass bottle to increase efficiency. Cost control is critical to ensuring that all expenses are justified by the return on investment. We utilized SolidWorks to create a device that combines human and automatic labeling based on the specifications stated. The team needs to design a device that can automatically label the bottle with lower cost and constant. To properly complete the project, the team must carefully examine modeling approaches, cost control, and project management.

Our team collaborated with Mechanical Engineering Team 12 on this project.

TEAM 4

Luke Dabek
Elizabeth Downey
Paige Lombardi

ADVISORS

Craig Calvert
Frank Cunha

SPONSORS

Soldering Iron Documentation and Design

Chapco is a metal fabrication company in Chester, Connecticut. Chapco has four different business units, with this project falling under the Esico-Triton brand. Esico-Triton develops and manufactures soldering irons for industrial settings. This Soldering Iron Documentation & Design project can be broken down into 3 separate parts. The first objective is to ensure that the certified UL requirements are being adhered to. We added UL requirements to their corresponding drawings and components in the form of visual aids after reviewing UL reports. Secondly, we will document the soldering iron element winding process, and identify process improvements to be done. The third part of this project is to conduct market research on wireless soldering irons, deliver a 12V soldering iron product design, and provide a roadmap of how to implement this.

Our team collaborated with Electrical and Computer Engineering Team 22 on this project.

TEAM 5

Maximilian Daignault
Brett Muni
Elijah Taitel

ADVISORS

Craig Calvert
Frank Cunha
Costantine Demos

SPONSORS

CHAPCO
Metal Fabrication | Assembly | Product Engineering

Vending Machine Design for Manufacturing

Fastcorp produces high end vending machines under parent company Chapco. Fastcorp's Dream It Vend It (DIVI) vending machine is one of their top selling products, but improving this vending machine has been a low priority over the past few years. Over these years, opportunities to decrease cost and improve integration of electronics with the handling and dispensing system have accumulated. The aim of this project is to investigate the potential areas of improvement, identify the most addressable, design a solution to those issues, and execute that design. The selected areas of the project are redesigning the hood lift assembly and building a better material database which will be used to identify potential cost saving measures. The hoodlift is being redesigned with a linear actuator instead of the over-engineered rack and pinion. The current redesign will incorporate a sheet metal assembly inside the freezer container which will lend itself to a more integrated solution. The linear actuator will reduce costs, improve manufacturing time and be more reliable in the field than the existing rack and pinion system. Alongside the redesign, a business analysis to streamline future product development into a more organized and usable system will provide great value to Chapco. This information is important to consider with the state of the overarching industry and the markets Fastcorp operates in. The vending machine industry is in decline as a whole, but there is a large growth in technologically advanced vending machines world wide. It is important to understand how the individual projects will affect the product's position in the marketplace. Vending machines need to be cheap enough to make fiscal sense for their owners while also integrating an enhanced customer experience.

**Our team collaborated with Electrical and Computer Engineering Team 21
and Mechanical Engineering Team 23 on this project.**

TEAM 6

Arthur Lihar
Matt Lozito
Alex Palvinski
Zachary Parker

ADVISORS

Craig Calvert
Frank Cunha
James DeVoe

SPONSORS

Collins Aerospace

Designing and Prototyping an Electromechanical Tool Prototype to Automate Fuel Controls and Increase Efficiency

The Automated Fuel Control Calibration project is a joint project between Collins Aerospace and students from the Mechanical Engineering department and the MEM department in the UConn School of Engineering. The team is designing and prototyping an automated torque tool that will automate the calibration of the fuel flow on Pratt and Whitney's PurePower jet engines. The first step in this process is for our tool to untorque a locknut. Then, the tool switches over to the adjustment screw and based on the fuel flow readings, adjusts the adjustment screw to properly calibrate the fuel controls. Next, while holding the adjustment screw in place, the tool then retorques the locknut in place. The tool must be able to produce desired values for torque, provide repeatable measurements and be intrinsically safe. This current process is currently done manually but with our tool it will be automated saving the company both time and money.

Our team collaborated with Mechanical Engineering Team 19 on this project.

TEAM 7

Jocelyn Bohlman
Vu Linh
Miles Martin
Ngoc Nguyen
James Zieminski

ADVISORS

Kelly Buffum
Craig Calvert
Frank Cunha

SPONSORS

Collins Aerospace

Automation of Silver Paint Application to Heat Exchangers

Collins Aerospace is researching improved methods for applying silver paint to a heat exchanger assembly. Of interest to the company is improved quality of the coating and automation of the process. The senior design team is responsible for simulating, testing and reporting on an improved paint application process, and recommending a course of action to Collins based on existing robotics technology.

Our team collaborated with Mechanical Engineering Team 73 on this project.
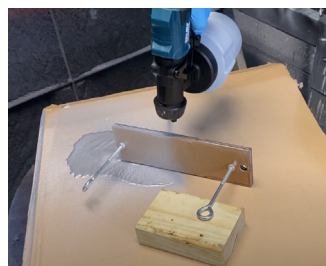
TEAM 8

Louis Dang
Mansi Dhond
Kenneth Malin

ADVISORS

Craig Calvert
Frank Cunha
Bill O'Connor

SPONSORS

BOMAR

Modeling Mixing Dynamics Across Multiple Stirred Batch Reactors

Bomar, a supplier of oligomeric materials for coating and adhesive applications, utilizes a variety of production-scale and lab-scale continuously stirred batch reactors for the synthesis of these oligomeric products. During the operation of these reactors, controlling the impeller speed is critical to maintaining repeatable reaction dynamics, ensuring product quality, and achieving desired batch cycle times. The mixing dynamics in the reactors are not uniform between reactors, and mixing speeds are currently set using empirical guidelines instead of being theoretically modeled. This may be contributing to unnecessary increases in production times, utility costs, and first-pass yield issues. The goal of our project is to develop a model-backed approach to characterize the mixing dynamics and determine the minimum agitator setting to achieve thorough and consistent mixing when scaling across reactors. To solve this problem, we first modeled the Bomar reactor and impeller geometries using SOLIDWORKS. Using these designs, we performed simulations of mixing dynamics in COMSOL for a variety of reactor geometries, baffle and agitator designs, and product viscosities. Based on the results of these simulations, we created a database for each reactor that specified the minimum agitator setting necessary for each product viscosity. This guide will ensure consistent reaction conditions, reduce utility costs, and aid in a more repeatable scale-up process from the laboratory scale to the production floor.

Our team collaborated with Chemical and Biomolecular Engineering Team 3 on this project.

TEAM 9

Josiah Chery
Ryan Cyr
Randy Malak
Rayne Santiago
Samantha Stofflet
Bradley Stutzman

ADVISORS

Craig Calvert
Frank Cunha
Bill O'Connor

SPONSORS

Temperature System Controls and Piping Design to Meet Industry Standards and Increase Product Accuracy

The completion of this project will involve adapting PID modules to create a closed loop system to heat the product temperature inside the reactors. This will also include plans and ideas to connect to the current Delta V system and the creation of a new piping system. By the completion of this project, Dymax will benefit from a more efficient and accurate temperature control system that meets the industry standard. As well as giving Dymax the opportunity to update their piping system and connect their PID modules to Delta V if they choose to do so later on. The project will be completed in three phases to achieve all three of these goals. The first phase will require a MATLAB simulation that models the entire system that we are performing this project on. This will allow us to develop the proper parameters for the heat exchanger to adjust the jacket temperature and create a closed loop system. Next, the PID modules will be specced out to work within the new system that will allow for the heat exchanger to adjust its output temperature simply based on a singular input temperature being put.

Our team collaborated with Chemical and Biomolecular Engineering Team 15 on this project.

TEAM 10

Ryan Schmidt
Jonathan Milovic
Yikun Mu

ADVISORS

Craig Calvert
Frank Cunha
Mark Lamoureaux
Steve Rood

SPONSORS

Business Plan and Product Design for Automation of Small Molded Cylinders

The project's objective is to develop an automated process for molded cylinder products under 5" OD that allows Enflo to penetrate the market for small molded cylinders by maximizing output per man-hour of this product family. The project involves developing a concept from business planning target through to actual completion of a working cell that accomplishes the desirable outcomes. This begins with documenting process flow steps as well as key variables and controls needed to achieve the high level of product quality currently maintained and finalize the project scope. A proposed molding system is then drawn up and fully designed using CAD software. Operating instructions are created for the designed equipment. A budget and bill of materials is developed to project the cost of manufacturing the equipment. The final step is to fabricate the working model and test and document the process results to compare to previous data.

TEAM 11

Harrison Cao
Isabella Donadio
Katrina Granovskiy
Mitchell Hornak

ADVISORS

Craig Calvert
Frank Cunha
Andrew Fujiyoshi

SPONSORS

Since 1868
FLETCHER
Material Cutting & Finishing

Redesign of Auto Frame Robot to Improve Clamping Stability

The purpose of this project is to redesign the clamping system on a framing robot, called the AutoFrame 500 (AF500), in order to improve the corner joining consistency on a variety of frames this company produces. It currently is ineffective when it comes to frames that have curved edges, causing gaps in the frames and making the edges not flushed. This issue makes the frames unappealing to customers, who can look to competitors for their frame joining needs. Given that the picture frame industry is booming and is very successful, this results in a direct profit loss for the company. The solution lies in decoupling the clamp and the nailer and maintaining a lever to be able to maintain the amount of force of the current design. We will do this by redesigning the system as well as creating a new clamp foot prototype to better assist the joining of frame corners.

Our team collaborated with Mechanical Engineering Team 24 on this project.

TEAM 12

Sarah Brown
Marc Federici
Luca Mastrogiacomo

ADVISOR

Craig Calvert

SPONSORS

FritoLay
Good fun!

Parts Inventory Optimization

Our project was to organize the Frito-Lay parts inventory crib with engineered solutions to reduce machine downtime and increase space utilization. With the announcement of the new expansion to the Killingly Site there will be a future need to manage inventory for new equipment that will be coming in the following years. The Maintenance and Engineering Department is looking to optimize the space that it currently utilizes for parts inventory, and streamline the workflow for inventory management through the use of Lean Six Sigma process improvement to position ourselves for the changes coming to the site.

TEAM 13

John Gallagher
Grant Moxham

ADVISORS

Craig Calvert
Frank Cunha

SPONSORS

UCONN
SCHOOL OF ENGINEERING
MANAGEMENT AND ENGINEERING
FOR MANUFACTURING

This team's project description could not be published for privacy reasons.

TEAM 14

John Henry Breen

ADVISORS

Craig Calvert
Frank Cunha

SPONSORS

UCONN
SCHOOL OF ENGINEERING
MANAGEMENT AND ENGINEERING
FOR MANUFACTURING

This team's project description could not be published for privacy reasons.

TEAM 15

Asher Iglesia
Kim Vu

ADVISORS

Craig Calvert
Frank Cunha
Jon Evans
Ryan Vernlund

SPONSORS

NORGREN

Optimization of the Acrylic PMMA Annealing Cycle

In many machining industries today, the build-up of internal residual stresses within acrylic structures often result in engineering failures. These failures can be attributed to poor heat treatments and other poor machining processes. Norgren has tasked the students in UConn's Senior Design to study this issue of residual stress in the company's PMMA acrylic material blocks. In this study, the team should develop a new annealing process and observe the development of stress through a birefringence color system.

Our team collaborated with Materials Science & Engineering Team 3 on this project.

TEAM 16

Stoney Brooks
Nathaniel Grogan
Vahidin Kandic
Rahul Raman
George Fuller Walker

ADVISORS

Craig Calvert
Frank Cunha

SPONSORS

Pfizer

Pharmaceutical Manufacturing Maintenance, Care, and Calibration Downtime Analysis

To keep up with rising global demand in the pharmaceutical industry, UConn's Senior Design students paired with Pfizer's Portable Continuous Miniature Modular (PCMM) facility in Groton, CT to analyze and reduce the scheduled manufacturing maintenance, calibration, and care downtime. Using Pfizer's historical preventative maintenance records, the senior design students can assess the efficiency of the existing annual and/or semi-annual maintenance schedule for each piece of equipment. To accurately determine how to modify a maintenance schedule, the team will analyze the health and performance of equipment alongside the measured runtime extracted from Pfizer's database, looking for trends between runtime and recorded wear. Equipment with superfluous maintenance will receive modified maintenance schedules, while equipment that saw significant wear between maintenance will either receive shorter spells between maintenance checks or a reevaluation of lubricants, belts, seals, or bearings. As some equipment will likely have insufficient data to make a decision, these will be reevaluated when there is more data available.

Our team collaborated with Chemical and Biomolecular Engineering Team 1 on this project.

TEAM 17

Wayne Hatch, III
Andrew Jon
Jackie Zheng

ADVISORS

Craig Calvert
Frank Cunha
Bill Luchon
Natiya Washer

SPONSORS

Prysmian Group

Scrap Room Improvement

All of the scrap wire product needs to be removed from the reels that they are on and shipped out to scrap vendor. All of the material are stored, processed, and removed from a separate "scrap" area. Currently this is a very inefficient process and is done by one person daily. The objective of this project is to reduce cycle time in the scrap area, improve safety of process and personnel, improve overall throughput and reduce labor required.

TEAM 18

Conor Gallagher
Aiyane Mattoso
Ankit Saini

ADVISORS

Craig Calvert
Frank Cunha

SPONSORS

SIKORSKY
A LOCKHEED MARTIN COMPANY

Digital Transformation of Manufacturing through Augmented Reality

This project is sponsored by Sikorsky Aircraft Corporation, a company that supplies helicopters and technology to the United States Department of Defense and customers around the world. The goal of this project is to allow manufacturing engineers to have a better control over their machine outputs and operations. This will be done by integrating augmented reality visualization into manufacturing processes. Technical data given by a machine and its environment will be transferred to an information databank using various sensors. The user will access the databank through a phone or tablet using a QR code trigger. This will display the technical data and update the interface in real time. This version of augmented reality will offer a mobile display for engineers to monitor their manufacturing processes. Displaying data in real time will offer engineers greater understanding of how their machines are operating and decrease time consuming practices. The data will allow corrective action to be made before defective parts are produced and eliminating improper function will decrease machine degradation. Augmented reality is already in practice in many companies around the world, and this project will expand Sikorsky's capability to utilize the technology.

TEAM 19

Alex Rizza
Daniel Schumann
Brian Toole

ADVISORS

Craig Calvert
Frank Cunha
Greg Labbe

SPONSORS

TOMZ corporation

Automating the Pressing Process in the Assembly of Spinal Screws with a Failure Detection System to Decrease Human Error

The goal of this project is to automate the pressing process and detect failure within the assembly of spinal screws. Currently a manual press is being used to swage three parts together, the case, cap, and screw itself. Our plan is to use a pneumatic press that only requires the operator to load the parts and press a button. Sensors will be attached to the top plate of the pressing block and measure the distance between the top plate and the bottom plate during the press. The screen attached to the sensor will then print if the press completed a full stroke, indicating a failure or a pass. The main goal for this project was to decrease the human error by eliminating human judgement on whether the press failed as well as the human force applied on a manual press.

TEAM 20

Sara Armas Barrientos
Vania De La Cruz
Charis Nyarko

ADVISORS

Craig Calvert
Frank Cunha
John Simmons

SPONSORS

Whitcraft

Construction of Automated Seam Resistance Welder to Increase Productivity and Reduce Operator Fatigue

The main goal of this project is to maximize insulation and seal edges of spot-resistance welding as it is a requirement for the construction of heat shields for turbine engines. One of the major issues that the company has with the current way they are being constructed, is that the process time exceeds takt time and does not always get a proper seal on the first weld forcing be re-welded. This then leads to the company not being able to meet demand in time.The current process makes about 500 hundred manual spot resistance welds in a given year and leads to operator fatigue as it is a very mundane task. The solution that the company was able to come up with is to replace the handmade spot resistance welding process with an automated seam welding machine. This would not only meet the direct need of the operators, but the indirect need of the company as a whole. Using the budget we have been given $10,000, to construct the most efficient and cost-effective automated seam welding machine by May 2022. We have taken into account the risks we may encounter and assessed each of them while also developing a schedule for the project to ensure we stay on track to achieve our goal in time. The most important aspect that our sponsor has requested we take into account is to oversee the quality of weld happening and decreasing the cycle time. Weld quality will need to be monitored very closely because this causes the largest increase in takt time.

Our team collaborated with Mechanical Engineering Team 63 on this project.

MATERIALS SCIENCE ENGINEERING

TEAM 1

Yu Pei
Laura Lee
Ethan Shan

ADVISORS

Jasna Jankovic
Kienan Tierney

SPONSOR

CORROSION PROBE, INC.
THE COMPLETE ENGINEERING APPROACH – FROM DETECTION TO CORRECTION
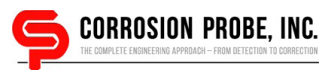
Ultrasonic Thickness Measurements of In-Situ Cast Iron Piping

Throughout the United States, there are cast iron water pipelines located underground that face corrosion. The oxides that form are quite detrimental to the mechanical stability of the cast iron. Thus, usable material diminishes and the pipes thin out. Corrosion Probe Inc. uses ultrasonic testing (UT) to measure the thickness of these pipelines, therefore allowing them to predict how long they will continue to be in service. Although ultrasonic testing is reliable on materials such as stainless steel, readings done on cast-iron pipes are very inaccurate due to the heterogeneous microstructure present. In our work, we are testing several variables on cast iron samples, such as graphite size, shape, concentration, and microstructure, to determine how to improve the accuracy of readings via UT gauges. This involves creating relationships between microstructural components and correlating how each variable impacts the UT error.

MATERIALS SCIENCE ENGINEERING

TEAM 2

Jack Gibbons
Theresa Nosel
Thomas Greene

ADVISORS

Vincent Palumbo
Yuanyuan Zhu

SPONSOR

mott
MISSION CRITICAL PRECISION

Determining the Sintering Condition of Porous Metal Media Through Non-Microscopy Based Techniques

This project's focus is to determine an alternative technique to scanning electron microscopy (SEM) that can quantitively verify if 316L stainless steel porous media has been sintered correctly. The team is investigating a parallel between sintering condition and acoustic resonance spectroscopy (ARS). With a promising correlation, investigating the sintering condition will be shortened from 30 minutes (SEM) to less than two minutes with ARS.

TEAM 3

Cole Accardi
Liam Gerety
Camille Martinez
Robert Williams

ADVISORS

Jon Evans
Ryan Vernlund
Xueju "Sophie" Wang

SPONSOR

NORGREN

Optimization of the PMMA Acrylic- Annealing Cycle

A major concern in machining industries today are the build- up of internal residual stresses within acrylic structures that often result in engineering failures. Such failures are frequently caused by heat treatments or other poor machining processes. Norgren has tasked students in UConn's Senior Design to further study this phenomenon of residual stress in the company's Poly(methyl-methacrylate), or PMMA acrylic material blocks by developing new heat- annealing parameters and observing the development of stress through a birefringence color system.

Our team collaborated with Management & Engineering for Manufacturing Team 15 on this project.

TEAM 4

Taylor Houghton
Elise Bessette
Ian Krasnow

ADVISORS

Jesse Boyer
Rainer Hebert

SPONSOR

PRATT & WHITNEY
DEPENDABLE ENGINES
GO BEYOND

Automated Powder Bed Apparatus

The objective of this year's project is to determine a method to automatically characterize various powders and develop one or more methods to measure flowability and printability to ultimately develop a relationship between the two.

Our team collaborated with Mechanical Engineering Team 46 on this project.

TEAM 5

Nicholas Villandry
Brianna Westenfield
Alexander Sutherland

ADVISORS

Ernest Boratgis
Shadd Bradshaw
Volkan Ortalan

SPONSOR

GO BEYOND

Material and Structural Response Under Dynamic Loading

Fan blade out is when a fan blade breaks off in a plane turbine engine while it is running. This puts a lot of stress on the remaining engine components, due to the rotational asymmetry at very high angular velocities. This stress is applied at a very high strain rate, stretching the components in very little time. Engines are currently designed to accommodate stress applied statically, at very low strain rates; however, materials can absorb more energy before fracturing at dynamic, high strain rates. Therefore, engine components are stronger than they need to be and are unnecessarily heavy. The aim of this project is to produce stress-strain curves at high strain rates that can be compared to static curves in the redesigning of lighter engine components. The major objectives of the project include performing static and dynamic tensile tests, at various strain rates, on samples of a low ductility Aluminum alloy. The ADMET Expert 3901 is being used to evaluate the response of Aluminum 3003-H14 and Aluminum 6061-T6 to several different strain rates. It is expected that the higher strain rates will have higher yield strengths, ultimate tensile strengths, and ductility; that is, the alloys will appear tougher at higher strain rates. The mechanical engineering team members will use the data generated for modelling.

Our team collaborated with Mechanical Engineering Team 44 on this project.

TEAM 6

Gavin Foley
Ryan Gordon
Sana Qureshi
Peiyuan Zhang

ADVISORS

Mark Aindow
Keith Grayeb
Sean Ketchum

SPONSOR

Ulbrich

High Temperature Strain Ageing of Cold Worked Austenitic Stainless Steel

301 stainless steel is a commonly used steel alloy belonging to the 300-series of stainless steel alloys, being the alloy with the lowest amount of nickel content. This project involved the strain ageing and mechanical treatment of a 301 stainless steel strip, turned into dog-bones for mechanical testing. The primary objective of this research project was to increase the ultimate tensile strength (UTS) of the 301 stainless steel strip samples by 10-15 ksi, which would be tested via tensile testing or 3-point bending. 301 stainless steel strip samples were procured from Ulbrich, which had been cold worked on site at the Ulbrich Specialty Strip Mill. For testing, a time series and a temperature series have been created to research the effects of heat treatment on the 301 stainless steel samples post-rolling. To characterize the microstructural changes that will be present in the 301 stainless steel as a result of testing, multiple analytical techniques will be employed. These include scanning electron microscopy to analyze fracture mechanics, optical microscopy to observe phase content and surface morphology, electron backscatter diffraction to analyze grain orientation, and a Feritscope to determine the phase content of the steel. Thorough literature analysis on the cold working of stainless steel under similar test conditions has provided great insight regarding anticipated material changes of the 301 stainless steel samples. It is anticipated that the goal of an ultimate tensile strength increase of 10-15 ksi will not only be met but will be exceeded as a result of this research.

TEAM 7

Andrew Christenson
Madeleine Siegel
Hale Tresselt

ADVISORS

Calvette Brown
Jorge Paricio
Victoria Rodriguez
 Minowitz

SPONSOR

National Center for
Disability Entrepreneurship
at The Viscardi Center

The Guider's Shield

COVID changed typical guiding protocols for the blind. The Guider's Shield enables touch guidance in a safer and healthier manner by reducing the transmission of diseases and giving more control to the person being guided. The goal of this project is to optimize The Guider's Shield design to reduce weight, provide adjustability, simplify manufacturing, determine a way to inject an anti-microbial coating, and reduce cost.

Our team collaborated with Mechanical Engineering Team 32 on this project.

TEAM 8

Yirui Xiong
Ria Paranjape
Martin Birnbach

ADVISORS

Pamir Alpay
Lesley Frame
Rob Jensen
Chris Rinderspacher

SPONSOR

DEVCOM
ARMY RESEARCH
LABORATORY

Computational Modeling of Solid Solution Hardening on Aluminum Alloys

The goal of this project is to determine the impact of solute element concentration on the mechanical properties of a single-phase Aluminum alloy, and then compare correlations between computational and experimental data from methods that employ solid solution strengthening and grain boundary refinement. After determining Aluminum alloys with compositions that stay in single phase without precipitating, as well as the maximum solute concentrations to form binary alloys, our main objective is to develop density functional theory (DFT) simulations and compute changes in the elastic/bulk moduli, hydrostatic pressure variations near a solute, and charge distributions. We hope to create a data loop between our DFT models and our experimental data, which will be calculated by characterizing the physical samples of our procured alloy(s) after processing. Going forward, we would like to apply our research on solid solution strengthening of aluminum alloys onto different alloy systems.

TEAM 9

Shane Williams
Quenten Dean
David Roche

ADVISORS

Lesley Frame
Matthew Guziewski
Robert Jensen

SPONSOR

Prediction of Residual Stresses associated with Inclusions in a Matrix

The goal of our project is to be able to accurately predict the residual stresses within a precipitation hardened aluminum alloy. In order to do this, we have heat treated and annealed our samples before conducting various testing methods. By doing so, we can then gather the necessary information to do the residual stress calculations and send this information to Dante. The company will then use the data provided to create a digital twin of each sample and test, in order to run their own simulations. These simulations and data from Dante are then evaluated to see if the process is successful and can be repeated with different alloys.
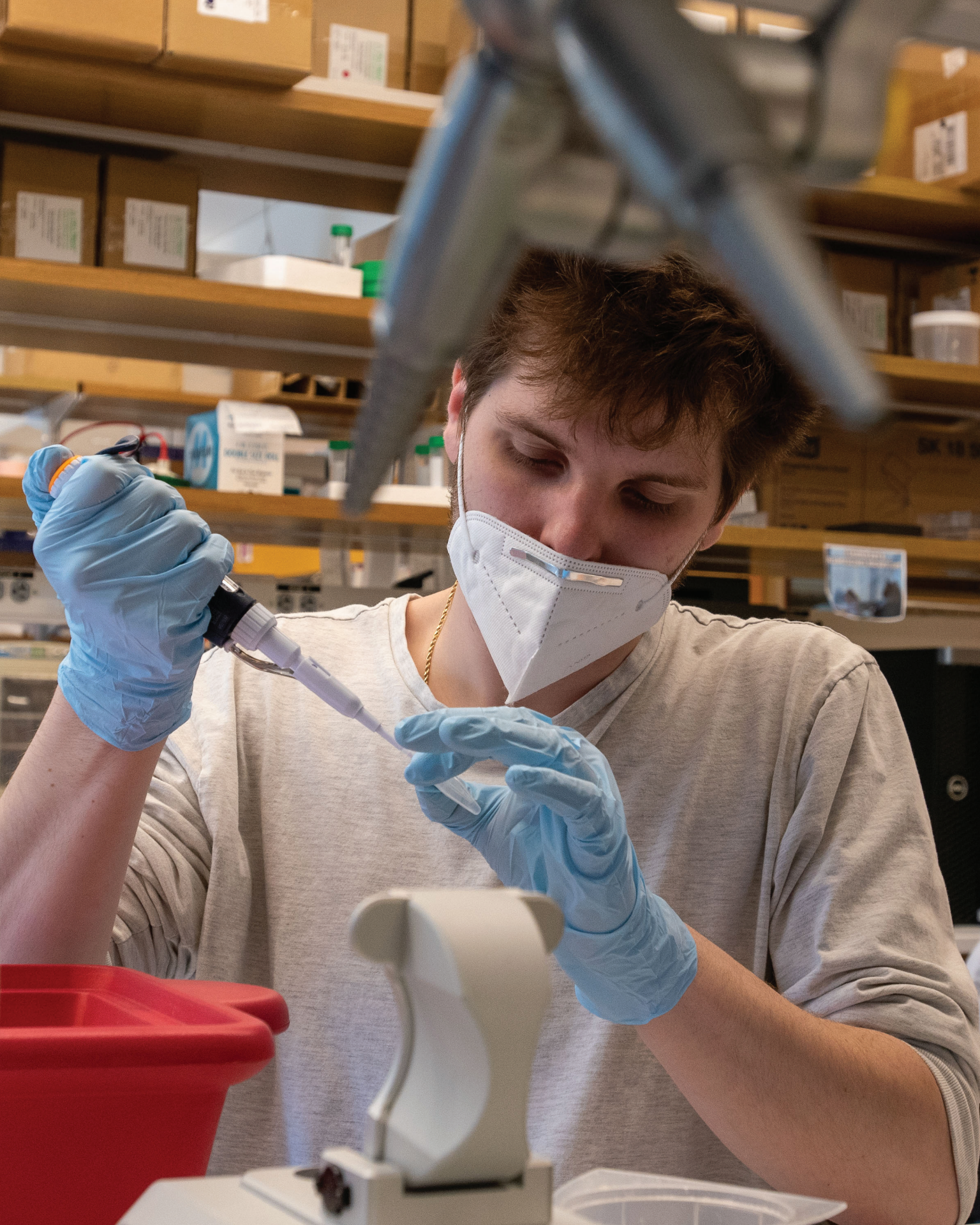
TEAM 1

Jared Amankwah
Jack Herms
Piero Herrera
Emma Westerholm

ADVISORS

Lindsay Altschuler
Vito Moreno

SPONSOR

ACMT

Feasibility of Robotic Welding of Complex Aluminum Panels

This project demonstrates the feasibility and capabilities of an ABB robot equipped with a TIG (tungsten inert gas) welding head to weld complex aluminum panels. Aviation is a volatile industry and companies are constantly looking for ways to improve speed and efficiency in their manufacturing processes. The use of robotic arms are becoming more common in industry as a way of speeding up repetitive tasks while still maintaining high quality products. Companies are also exploring the use of robotic arms for the safety benefits of higher risk tasks such as welding. TIG welding provides a multitude of challenges for the robot arm. It requires precise movements and timing for the heating and cooling of the metals. Variables such as current, voltage, speed, and feed rate will be adjusted to create a quality weld. Specific fixturing and tooling will be required to complete specific tasks. This project explores the robots ability to perform quality welds that are acceptable in the field of aviation where requirements and tolerance are extremely crucial.

Our team collaborated with Electrical and Computer Engineering Team 20 on this project.

TEAM 2

Nicholas Howard
Carmine Muratore

ADVISOR

Ryan Cooper

SPONSOR

AERO GEAR
Insist on Excellence

Gear Residual Stress Measurement

The durability of gears is strongly influenced by surface residual stresses which are dependent on a variety of factors, one of these factors is the gear grinding process. For this project ME02 will work with Aero Gear to measure and develop a relationship between grinding and residual stress on a representative gear tooth geometry. Aero Gear is based in Windsor, CT and produces aerospace precision gears and gearbox assemblies. Gear grinding has several parameters that can affect residual stresses. The parameters that the team will be testing are material removal rate, grinding wheel roughness, and grinding wheel composition. To measure the residual stresses within the gear the team will be working with the material science engineering department using X-ray diffraction. X-ray diffraction works by emitting X-rays at the material and measuring the diffraction angle. From this angle the spacing between the crystal lattices can be determined and from there, residual stress.
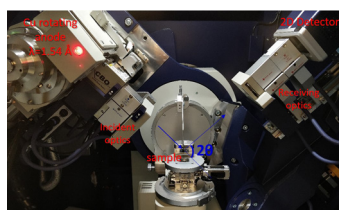
TEAM 3

Alex Szczepaniak
Shenji Zhou
Taylor Kissinger
Shotaro Ishihara

ADVISORS

Chengyu Cao
Richard Fu

SPONSOR

Air Water Generator - Aerius Water

Aerius Water was created in response to the ongoing water crisis and the unremitting demand for clean, sustainable water processes. Due to the continuously developing water crisis out west, and the struggle to distribute water in municipalities and skyscrapers, it is becoming imperative to find a reasonable solution other than desalinization and importing water. Our current prototype design is intended to be able to generate at least 3-4 liters of drinking water in a form factor compact enough to be in the average kitchen. However, we plan to scale our technology to provide a more environmentally friendly and efficient solution to generate water on site wherever it is needed. Our design is based on a absorption desorption cycle using solid desiccant technology, which we have been testing and optimizing over the past year. As of now, we have constructed a modular design that can demonstrate the basic capabilities of the technology.
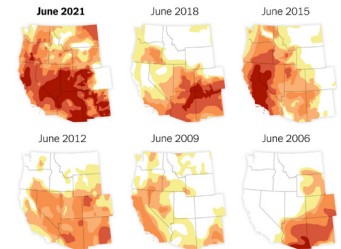
TEAM 4

Ethan Langh
Matthew Chambers

ADVISORS

David J. Giblin
Rodger Gibson

SPONSOR

Eagle Mobile Robotic Carrier System

The Airbornway Eagle Mobile Robotic Carrier System is a self-driving machine that travels on a single cable suspended in the air between towers. Its goal is to act as a energy efficient alternative to modern public transportation. A key element of the Eagle MRC is that passengers are loaded/unloaded at street level. To accomplish this, the system utilizes an elevator subsystem to move the passenger cabin between its loading/unloading and traveling heights. ME Team 04 is investigating and evaluating the current design for the elevator subsystem of the Eagle MRC system using the ASME 17.1 Safety Codes for Elevators with the goal of providing both Airbornway critical feedback on their design's feasible. Furthermore, the ME team is working with the electrical engineering team to redesign the elevator subsystem to improve its energy efficiency using existing technology.

Our team collaborated with Electrical and Computer Engineering Team 26 on this project.

TEAM 5

Alejandro Figueroa
Anthony Mastino
Jared Niedermeyer

ADVISORS

Peter Dacey
Horea Ilies

SPONSOR

amodex®

Design of a 200 Gallon Mixing Tank

Amodex is a company that specializes in ink and stain remover based out of Bridgeport, Connecticut. They have been manufacturing their stain removing product since 1958 and still offer the most effective stain removing technology available on the market. The Amodex team currently employs twin, 100-gallon mixing tanks for production. With increasing product demand, a larger tank must be fabricated with a higher volumetric capacity to keep up with consumer requests. This new tank would need a theoretical volume of 200 gallons to allow for greater, single tank batches to be produced. While we are designing a new tank, the 100-gallon tanks offered great reliability and had desirable mixing characteristics for the Amodex stain removing product. The fluid mechanics set forth by the current tanks were studied and improved upon during the design process of the new mixing tank. Some design considerations for mixing tanks include the tank's shape, the diameter and height of the tank, curvature of the tank bottom, mixing head shape, impeller length, and impeller-to-tank concentricity. With these factors in mind, CAD models of potential tank design candidates, and a CAD model of the current tank, were generated to later be tested in ANSYS, a Computational Fluid Dynamics software. By taking the fluid behavior in the current tank via ANSYS, we were able to quantify the overall mixing in the tank. With this data, we were able to identify the advantageous mixing properties occurring in the current tank, mimic the desired behavior in the new tank, and improve the mixing of the fluid in the new tank. By performing these tasks, the 200-gallon tank should be able to produce larger batch sizes and not hinder the quality of the Amodex stain removing product.
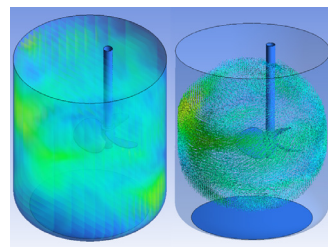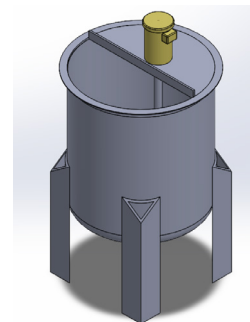
TEAM 7

Allison Camp
Aaron
  Rosenbloom-Snow

ADVISORS

Ying Li
Yusuf Ransome

SPONSOR

AromaKIT LLC

Portable Personal Aromatherapy Device

The objective of this project is to design a functional portable personal aroma therapy device. The complete device will be sold to the general public in order to improve personal wellbeing in daily life. The aroma therapy device will be designed to be attached to a smartphone and disperse aroma from within. The device will be powered by the phone that it is attached to by plugging the device into the phone's charging port. The heating element of the device will be controlled by an app within the phone that can determine both length and power that the device will receive from the phone itself. This device will be able to disperse aroma within a 3 foot radius of the user's phone in order to not disturb others.
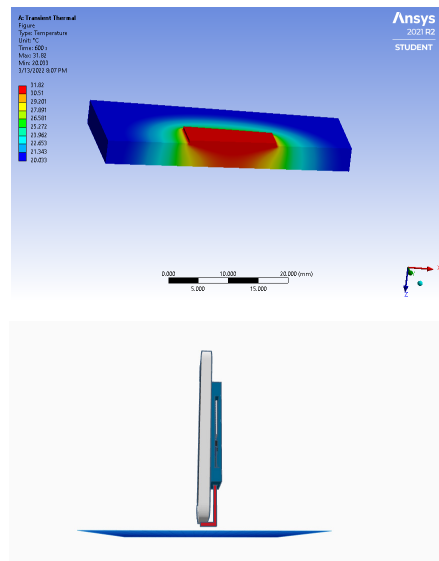
TEAM 8

Xiaoyang Ma
Zachary McCollum

ADVISORS

Andy Judge
Thanh Nguyen

SPONSOR

ASML

Mechatronic Actuated Optics

ASML specializes in semiconductor technology and is one of the world's largest suppliers of lithography systems. With headquarters located in the Netherlands, the company has offices all around the world; utilizing advanced technologies to constantly improve their research and development. ASML uses specialized optic lenses for various applications in its lithography processes. These lenses are rotated by motors to accurately control light. The nature of the lithography process demands motors to perform with high precision, quick response time, and low thermal output among other strict requirements. Piezoelectric motors are well suited for these specifications; however, not cost-effective. Over the course of the past two semesters, the UCONN School of Engineering senior design team, ME08, was tasked with researching more cost-effective alternative technologies with traditional electric motor architecture. The goal was to find a conventional option that is capable of achieving similar performance characteristics to their expensive piezoelectric counterparts. Both off-the-shelf and custom-built options were reviewed. After thorough consideration, the team down-selected a direct-drive BLDC motor for proof-of-concept testing. A test fixture to house the motor, as well as flexure design for optomechanical purposes were designed. The flexure secures a 3D-printed disk to replicate a lens that ASML would use in its real-life applications. Modal, positioning accuracy, and thermal analysis were performed; A proof of concept system was designed, manufactured and tested, although a significant amount of work remains to industrialized this system to meet all performance requirements, the results of this project will nevertheless aid ASML in improving its lithography systems.
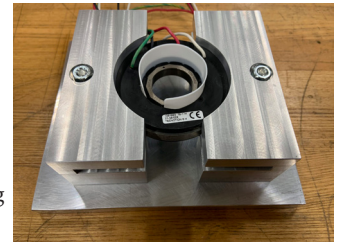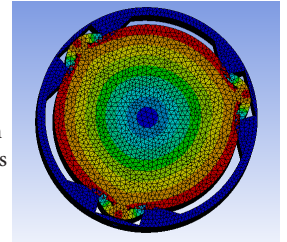
TEAM 9

Elliot Bushman
Justin Gough
Sahil Rentia
Jacob Zukile

ADVISORS

Jason Lee
Mike McGinty
Jason Sicotte

SPONSOR

BARNES

Pickup and Stacking Device for Flat Spring Production

Barnes is a manufacturer of a wide range of springs, with their Connecticut facility handling flat and stamped varieties. One of their products includes the Belleville spring washer which is used in clutches in the automotive industry. As a part of the quality assurance process each spring undergoes a load-deflection test, to make sure that spring rate falls within acceptable industry standard. Currently loading of Belleville washer spring into the test machine is achieved manually, which is labor intensive and time consuming. Barnes is considering the use of a robot arm to automate the testing process, thus reducing labor costs. The objective of this project is to develop end of arm tooling to allow robotic arms to easily pick up and manipulate parts into and out of test fixtures. Due to the size and complex geometry of the Belleville washer, as well as the tight clearances of the test fixtures a universal pickup mechanism would not be sufficient. By designing and building custom end of arm tooling we will be able to increase the function and reliability of the robotic arm, increasing capacity and decreasing operator intervention. Our tooling has two components, a device to orient a stack of washers to fit into the fixture and another to pick up and manipulate washers.
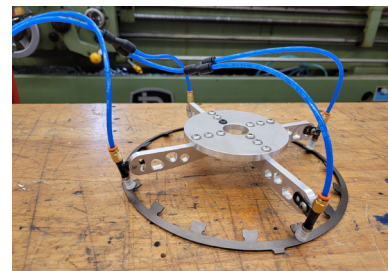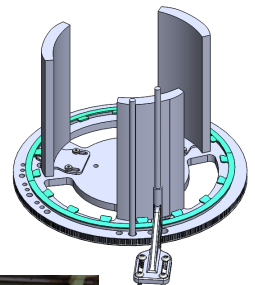
TEAM 10

Michael Calvert
Shijo Thomas

ADVISORS

Tony Abate
Vito Moreno

SPONSOR

Substrate material for Flat Plate Bi-Polar Ionization

AtmosAir Solutions is an air purification system manufacturer that strives to improve air quality in all types of indoor settings. They currently use a plasma generating tube design to conduct the bipolar ionization process, but they are looking to improve their units with the all new flat plate design. Our goal was to determine a dielectric material that will efficiently conduct bipolar ionization for a longer period of time. We tested each of these materials on their ability to conduct ions and their thermal durability. The ion production test used a 110 CFM reference fan blowing through a 3' pipe with a 6" diameter and collected data on the amount of negative ions per cubic centimeter through the ASCI-II ion meter. In order to determine which material best contributed to ion production, we combined identical anodic and cathodic components to each dielectric forming test pieces. These test pieces were placed into our test rig and run for 5 min after a warm-up period for a total of three times to best collect the average ion production. The thermal durability test determined which material would best handle the high temperatures of bipolar ionization. The material should function for two or more years in temperatures between 750°F-1500°F. To achieve similar thermal stresses, we used an aggressive approach of cyclically heating and cooling the materials 50-100 times to observe any material changes. Our testing will give AtmosAir information on which material will allow them to produce efficient flat plate ionization devices.
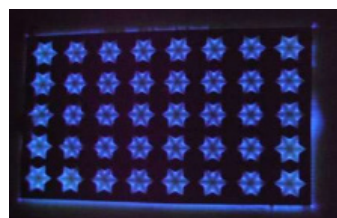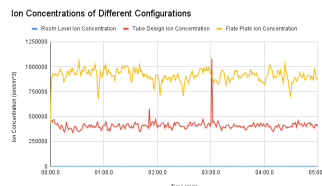
TEAM 11

Robert Foley
Ryan McKenna
Andy Vu

ADVISORS

Farhad Imani
Tim Keiser

SPONSOR

Assembly Process Improvement with Co-Bot

Belimo is a Swiss-based manufacturer and distributor of actuators, sensors, and control valves, for HVAC systems. Their North American headquarters is located in Danbury, Connecticut. The goal of our project is to continue to the work of previous senior design teams from 2019-2021 and implement a collaborative robot work cell into their customization department. We are specifically tasked with working to automate the assembly of their rack-bearing subassembly. The subassembly consists of a bent sheet metal bracket and plastic part that are screwed together using self-tapping screws. The addition of screws introduces the added complexity of automating a screwdriving process. The benefits of automating this fully manual assembly process are that it will allow for shorter customization lead times and allow operators to focus on parallel tasks while decreasing assembly costs. After researching and evaluating the different options for automating the rack-bearing assembly our team decided that an off-the-shelf screwdriver integrated with the crobot's current grippers would be the ideal solution. Our team installed the screwdriver and grippers on a dual mounting plate at a 45-degree angle. The dual mounting plate allows for the screwdrivers and grippers to be used during the same process without needing a tool change. Part feeders and assembly fixturing were designed and 3D-printed for the workstation. The robot was programmed to build the assembly and drop it in a finished goods bin. The robot will run for an hour before any operator intervention.
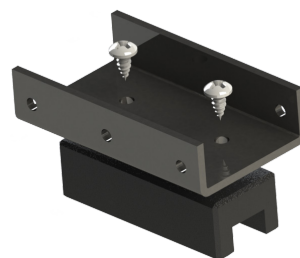
Our team collaborated with Electrical and Computer Engineering Team 25 and Management & Engineering for Manufacturing Team 2 on this project.
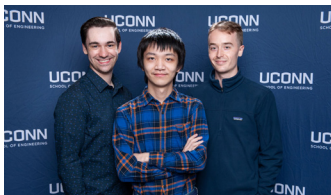
TEAM 12

Chenrui Liu
Camden Johnson
Brendan Parsons

ADVISORS

Frank Cunha
Eriks Surmanis

SPONSOR

Label Application Device

Waypoint Spirits is a distillery located in Bloomfield, CT that was established in 2015. Their main products are vodka and gin which are made and bottled in house. The goal of this project is to design, prototype and fabricate a device that can apply a safety seal to the top and neck of bottles. A successful device would be able to consistently apply seals to bottles while applying them straight and in line with the label to be visually appealing. Applying the safety seal is the last step in the production process but takes the most amount of time due to it being applied by hand. Buying an automated machine isn't justifiable for Waypoint currently since it would exceed the capacities of the other processes and would have a large initial cost.

Our team collaborated with Management & Engineering for Manufacturing Team 3 on this project.

TEAM 13

Matthew Donlon
Doni Lopez
Douglas Vilaysom

ADVISORS

Tracy Camassar
Thomas Mealy

SPONSOR

Torque Capability Test Fixture Design

Chapman Manufacturing has tasked Mechanical Engineering Team 13 with redesigning their torque capability test fixture. The purpose of this project is to design and optimize a new testing fixture for Chapman Manufacturing with improved accuracy, ease of use, and efficiency when testing and switching between different slotted screwdriver bits. Our objective is to develop a practical and ergonomic fixture that will provide accurate and reliable results with less human observation required. The testing process should be replicable and routine in its set up, with consistent readings between different operators and testers. The most important criteria our team focused on throughout the design process were reliability, safety, and ease-of-use/ergonomics. During preliminary torque tests with the previous Chapman fixture, there were readily apparent issues the team had to focus on. These issues included both the concentric and orthogonal positioning of the bit with regards to where torque was being applied as well as how each bit was secured, respectively. These issues were addressed by using a sliding plate with fasteners to secure each bit orthogonally to a respective slot height setting in tandem with a concentric plate positionally mounted above each height setting, ensuring that the bit holder has minimal angle deviation when torque is applied. Five height settings were chosen to sufficiently account for the varying contact areas of individual bits. Another issue found during testing was the cam out forces present when applying torque. A loaded spring mechanism was incorporated into the bit holder component to counteract these forces.
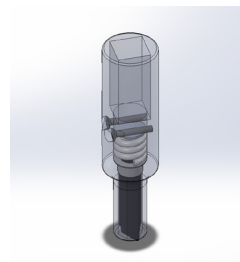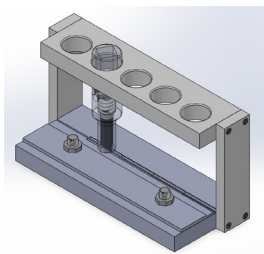
TEAM 14

Dalia Clarke
Afreen Vahora

ADVISORS

Tianfeng Lu
Joseph Mortimer

SPONSOR

Collins Aerospace

Site Wind Renewable Energy Evaluation

The Windsor Locks branch of Collins Aerospace is dedicated to power and control systems. As part of the growing commitment to environmental stewardship, Collins Aerospace has pursued opportunities to integrate renewable energy systems into their grid. Both solar and geothermal evaluations have already been performed, and a solar photovoltaic installation will commence at the Windsor Locks site in the coming years. These energy sources will be used to lower the company's carbon footprint, import from Eversource, and overall electricity costs. As the next step in this process, the objective of our senior design project is to assess the feasibility of implementing wind energy at Collins Aerospace's Windsor Locks site by designing a 500 kW rated wind farm. Our procedure first involved research into how wind power works and using historical data to determine wind speeds over the site. In modeling the wind resource through a Weibull distribution, we then determined the best turbines to fit our parameters. We then created a wind farm layout that optimizes energy production, adheres to Federal Aviation Administration regulations, and creates convenience in interconnecting the turbines to the current power grid. Finally, we highlighted how the power generation of this wind farm will benefit Collins Aerospace both financially and in reaching its sustainability goals.

Our team collaborated with Electrical and Computer Engineering Team 16 on this project.

TEAM 15

Jeremy Amoro
Michael Benvenuto
Diego Vilca
Rigel Wachtmann

ADVISORS

Chris Soumakis
Chih-Jen Sung
William Villano

SPONSOR

Collins Aerospace

Compact and Robust Data Logger

Collins Aerospace has requested that the team create a compact and robust data logger that can withstand extreme environmental temperatures for long periods of time for use in testing their aircraft parts in simulated real life settings. The data logger will sample signals of +/- 15V at a frequency of 1MHz and store them on a removable storage device. The data logger enclosure will be constructed to ensure that the data logger can withstand outside temperatures of -40°C to 85°C in an environmental chamber. The enclosure must also act as a complete Faraday cage, providing electromagnetic shielding for the interior electronic components.

Our team collaborated with Electrical and Computer Engineering Team 13 on this project.
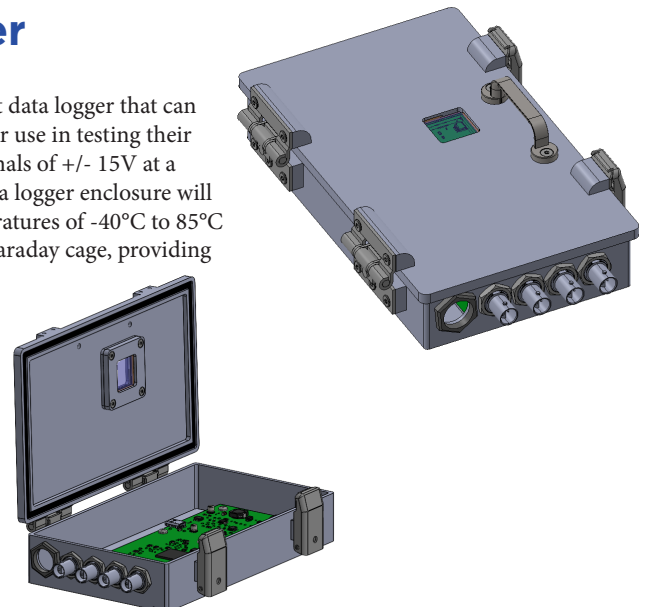
TEAM 16

John Meszaros
Jacob Schneider
Logan Wojnarowski

ADVISORS

Jeremy Strange
Bryan Weber
Mark Zaffetti

SPONSOR

Collins Aerospace

The Design and Testing of a 3D-Printed Plastic Cold Plate

In the space industry, cold plates are a common form of heat exchanger used to cool down avionics equipment. These cold plates are currently manufactured out of 6061-T6 Aluminum, which is a well tested and effective material for this application. However, these aluminum cold plates are heavy, expensive, difficult to fabricate, and must be treated for corrosion prevention. With the recent widespread adoption of additive manufacturing technology, the purpose of this project is to see if a thermally conductive 3D printed plastic can serve as a comparable replacement to the traditional aluminum material. The 3D printed plastic used in this project is known for being more thermally conductive than other 3D printed plastic materials, is lighter than aluminum, and would require no corrosion treatment or machining, only the time it takes to be grown. By comparing two identical cold plate models, one machined from solid aluminum and the other grown through additive manufacturing, our goal is to see if the steady state thermal performance of the 3D printed plastic cold plate can be reasonably compared to that of an aluminum counterpart. This project includes forming an analytical model, performing simulations in ANSYS Fluent, and conducting experiments using a constructed test rig. The results of our project come in the form of a series of normalized temperature relations which Collins Aerospace can use to determine whether or not the use of a thermally conductive 3D printed plastic can effectively replace aluminum in their cold plate applications.
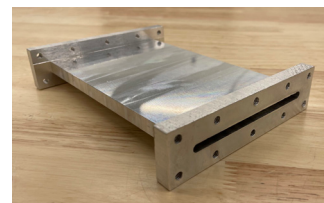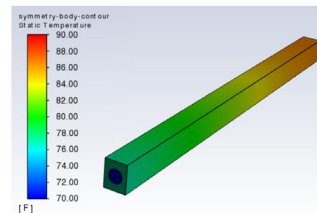
TEAM 17

Julia De Oliveira
Michael Ruffino

ADVISORS

Joseph Mortimer
Amy Thompson
Bryan Weber
Liang Zhang

SPONSOR

Collins Aerospace

Combined Heat and Power System Assessment and Optimization

The Collins Aerospace Windsor Locks site seeks to improve the energy use, sustainability, operation, and reliability of its Combined Heat and Power system (CHP). The CHP plant generates electricity and steam used for process and space heating. It is a critical asset that reduces operational cost, improves the site's reliability and capacity to operate during outages, increases the energy efficiency of the site, and decreases total greenhouse gas emissions. The primary mover is a combustion gas turbine, and a heat recovery steam generator.

The UConn student team will evaluate the system from a thermodynamic perspective to assess the efficiency and performance of the plant. Controls and operation practices will be reviewed and examined for improvement opportunities. Current and emerging technologies will be evaluated for feasibility, cost- effectiveness, and efficacy in reducing energy consumption, GHG emissions, and/or water usage. In brief, the Combined Heat and Power System Assessment and Optimization project will examine existing systems and investigate opportunities to meet the energy and emission goals of the site.

Our team is a collaboration between Electrical and Computer Engineering Team 15 and Mechanical Engineering Team 17 on this project.

TEAM 18

Rachel Greenman
Jimith James

ADVISORS
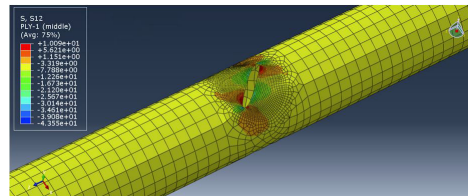
Jeongho Kim
Rajiv Naik

SPONSOR

Collins Aerospace

Design of Aircraft Composite Structures with Service Damages

This project focuses on advanced fiber-reinforced polymer-matrix composite structures, providing significant weight efficiency for aircraft and rotorcraft applications. The goal of this project was to work with Collins Aerospace to enhance the design process for aircraft composite structures assuming risks of random service damages through systematic FEA-based modeling. The team worked with Power and Controls Division of Collins Aerospace to model a representative aircraft tubular structure using FEA to account for the random nature of potential service damages. Representative service damages in the composite were considered as functions of their random sizes and locations. Design characteristics (geometry of the structure, composite layup) and loading parameters were also considered as variables. ABAQUS-based FEA modeling was performed according to the suggested computational test-matrix to analyze the strength of the structure. Generated results allowed us to understand conditions of the worst-case damage and made recommendations for design optimization under such random service conditions. The results can also be useful for efficient and accelerated certification of Collins composite structures for multiple aircraft and rotorcraft systems.

Representative dimensionless stress distribution in the vicinity of a typical service damage, highlighting the effect of such damages on strength performance.

TEAM 19

Arthur Lihar
Matthew Lozito

ADVISORS

James DeVoe
Alexei Poludnenko

SPONSOR

Collins Aerospace

Automated Fuel Control Calibration

Collins Aerospace is an aerospace company owned by Raytheon Technologies and is one of the world's largest suppliers of aerospace and defense products. The Mechanical Engines Systems group at Collins Aerospace currently creates the fuel control units that are implemented into Pratt and Whitney's PurePower Engines. A high pressure relief valve inside these units contains a spring seat adjustment screw and a lock nut mechanism that controls the fuel flow throughout the device. These fuel control units currently undergo a tedious manual calibration process to verify that the unit is within acceptable limits. Collins Aerospace is looking for ways to improve the quality and reduce the cost of this calibration process. The goal of this project is to design and test the feasibility of an autonomous, electromechanical tool that will read results from the test flow rig, interface with the spring seat adjustment screw and the lock nut, and apply the correct amount of torque in in-lbs to properly calibrate the fuel control unit. Gaining inspiration from a manual car transmission, the gearing system was designed such that one gear would hold one component in place while another gear would turn the other component. Utilizing preliminary research and Pugh Charts, the most optimal gear ratios, gear sizes, motors, and solenoids were selected and later implemented into the final design. To test the final design, a random number generator was used to create a random pressure value that the tool would read and then make the proper adjustments to the spring seat adjustment screw until acceptable pressure values were outputted.

Automated Torque Tool

High Pressure Relief Valve
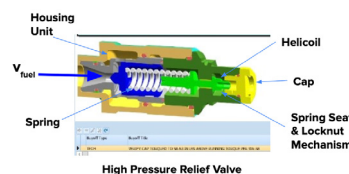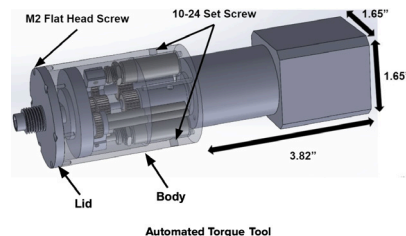
Our team collaborated with Management & Engineering for Manufacturing Team 6 on this project.

TEAM 20

Joseph Andrews
Ben Ruben
Dan Simmons
Max Veilleux

ADVISOR

Reza Sheikhi

SPONSOR

DIVE
TECHNOLOGIES

Low-Logistics Autonomous Underwater Vehicle Transport and Deployment System

Our project is sponsored by DIVE Technologies which designs and uses custom autonomous underwater vehicles (AUV) for specialized missions. These missions include littoral and deep water surveys, inspection, and ISR. For our project, our team is tasked with designing a system which can carry a 6,000 pound, 19 foot long, 4 foot diameter AUV across public roads and launch it at a typical boat launch. This system needs to adequately dampen vibrations so the sensors on board the AUV are not damaged due to transportation. The system also needs to be submerged during the launch and recovery process so that the AUV can float off. Lastly, the system needs to be corrosion resistant in order to go into salt water frequently without damage. Our team based the initial design off of the typical aluminum boat trailer to save weight. We then modified the design to include an extendable trailer head and a ramp so that the length of the trailer would be able to be adjusted to adequately meet the needs of the launch and recovery process, while being able to remain shorter during transport for ease of maneuverability. This design includes wire rope isolators between the trailer and AUV in order to provide high frequency vibration protection along with a typical trailer spring and damper system. For extra structural support, this design includes galvanized steel I-beams around the frame of the trailer. We used the simulation program Ansys to validate our design's strength and vibration mitigation.
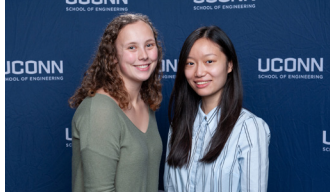
TEAM 21

Annchi Li
Maya Waldron

ADVISORS

Chengyu Cao
Robert Scala

SPONSOR

GENERAL DYNAMICS
Electric Boat

MEMS Magnetometer

General Dynamics Electric Boat (EB), founded in 1899 and headquartered in Groton, CT, is the primary shipbuilder for the United States Navy. A magnetometer is a device which measures the direction and strength of a magnetic field at a location. The military utilizes magnetometers to determine heading for navigation. As part of their mission to advance naval technology, EB sought to create a MEMS magnetometer with enough accuracy to measure approximately a 0.1 Nanotesla change in the Earth's magnetic field. Our team focused on developing the enclosure that will house the circuitry of the device. The device will be mounted externally to an autonomous underwater vehicle (AUV), and therefore, will need to be watertight and able to withstand a range of ambient pressures and temperatures that are typically experienced by an AUV in operation. The team chose Stainless Steel 316 as the material for the enclosure based on low magnetic permittivity, corrosion resistance, and thermal conductivity. Our design is a cylinder consisting of two lids on the top and bottom of the device. The lids have grooves which allow for the installation of two O-rings on each lid. Six holes through each lid allow for screws. The body of the enclosure will house the magnetometer circuitry. Steady state thermal and static structural simulations were conducted via ANSYS to validate the enclosure's ability to withstand the pressure and temperature conditions. The design was 3D-printed to ensure the components functioned cohesively. From here, the device was fabricated in the machine shop at UConn and brought to EB for pressure testing. The enclosure was placed inside a pressure tank where it was tested for one hour at approximately 560 psi. Visual inspection as well as measuring the amount of water that leaked into the device determined if the device met specifications.
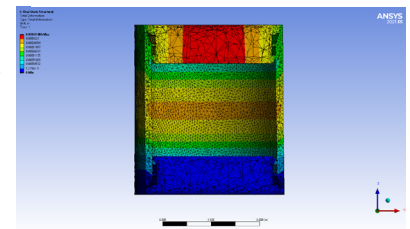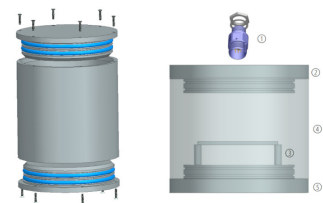
Our team collaborated with Electrical and Computer Engineering Team 10 on this project.

TEAM 22

Johnathan O'Neill
Nicholas Porte

ADVISORS

Richard Christenson
Jiong Tang

SPONSOR

NATIONAL INSTITUTE FOR
UNDERSEA VEHICLE TECHNOLOGY

Digital Twinning Test Bed Development

In this project, leveraging on-going naval research, the plan is to synthesize an experimental testbed consisting of motor with gear transmission, heat exchanger and notional pumps and pipes, equipment cabinet and isolation devices that will be used as the benchmark for a digital twinning algorithm investigation. The testbed will be connected with data acquisition systems as well as controlled ambient excitation sources. Various failure modes will be injected into the testbed system. Preliminary data analysis will be conducted for modeling validation and fault analysis. The main deliverable is to show that the test bed is able to gather usable data from the system in real time.

TEAM 23

Kesong Mi
Cal Pitruzzello

ADVISORS

Peter Boyle
Constantine Demos
David Giblin

SPONSOR

CHAPCO
Metal Fabrication | Assembly | Product Engineering

Fastcorp Vending Machine Design for Cost Reduction and Functional Improvement

The objective of this project is to reduce the cost of the freezer door lift system for Chapco and Fastcorp's Dream-It-Vend-It (DIVI) vending machine by reducing the assembly time required. The team is providing Chapco and Fastcorp with a new assembly to lift the freezer to replace the existing system. The freezer is inside the vending machine where the products are stored in bins. The freezer door has to automatically open to let a suctioning system pick up the product and place it in the bin for the customer to take. The existing system that automatically opens and closes the door on the freezer has a great number of parts, fasteners, and often requires troubleshooting to get it working before being sold. The team designed a new system that takes advantage of a commercialized linear actuator to reduce the number of fastening operations from 16 to 3, the number of in house made parts from 5 to 3, and to eliminate all outsourced machined parts. This reduces the assembly time and simplifies the process to build the system while not increasing the cost of parts. The team utilized Matlab to calculate the dynamics of the mechanism to optimize the force exerted onto the door and the time required to lift the door. After selecting an actuator that met the requirements given from the simulation, and was in budget, the team prototyped with the actuator to get a working system. Brackets to mount the actuator were designed in Solidworks and validated structurally using ANSYS Static Structural. The team designed and programmed an electronic control system prototyped with Arduino to implement into the vending machines control board. The code will then be programmed into the vending machine's control board. The DIVI XL, a larger version of the DIVI, uses a custom designed control board so the new system will be first implemented into the DIVI XL. The original DIVI will use the new system once it's main control board updates to the DIVI XL's control board.

**Our team collaborated with Electrical and Computer Engineering Team 21
Management & Engineering for Manufacturing Team 5 on this project.**

TEAM 24

Harrison Cao
Isabella Donadio
Katrina Granovskiy
Mitchell Hornak

ADVISORS

Horea Ilies
Andrew Fujiyoshi

SPONSOR

FLETCHER
®
The Fletcher-Terry Company, LLC

Redesign Auto Frame Robot to Improve Clamping Stability

The objective of this report is to develop an alternative clamping mechanism and custom clamping foot for Fletcher-Terry's automated framing robot to improve joining at the corners of wooden picture frames. Fletcher-Terry sells the AF500, a state-of-the-art automated framing robot that can produce a wooden picture frame of any size in under eight seconds. The AF500 was designed for high volume, automatic frame joining. It outputs the same number of frames as eight manual joiners while only requiring one operator to load the frame edges into a vertical feeder. Currently, the robot automatically positions the four sides of the frame using pneumatic locators. It then clamps down on top of the frame corners with flat plastic feet and rapidly inserts V-Nails in multiple locations along the corner specified by the operator on the control panel. Currently, for each nail driven into the frame corners, the robot needs to clamp and unclamp the frame because the clamp and the nailer are coupled. This constant motion, accompanied by the rigid clamp feet, creates gaps in the corners of the frame when the nails are driven. This problem is exacerbated with more ornate frames that have features causing the face of the frame to be non-flat because now the flat clamp foot is applying uneven pressure upon a curved surface. The new design must maintain the current manufacturing throughput and clamp a variety of frame shapes.
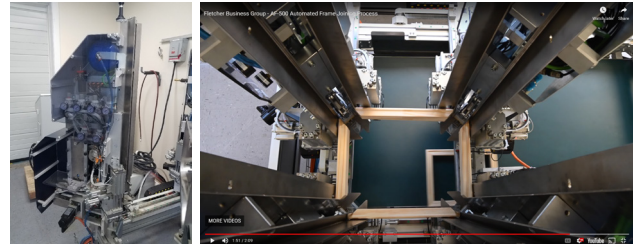
Our team collaborated with Management & Engineering for Manufacturing Team 11 on this project.

TEAM 25

Justin Boissonneault
Matt Shembri

ADVISORS

William Bailey
Richard Donais
Rory Eastman
John Harmon
John Lewis
Romman Semyanko
Bryan Weber

SPONSOR

Coal Nozzle Tip - Increase Operational Life

This project was focused around extending the operational life of a coal nozzle tip of a commercial sized power generation plant. General Electric has tasked us with identifying and eliminating warpage in the external wrapper plate caused by extreme temperatures. The nozzle is responsible for delivering two separate streams, fuel (coal) and combustion air to the furnace. The current operational life of this part is 2-3 years and then requires replacement per request of the consumer. A static temperature analysis yielded an incredible temperature gradient of the plate and was deemed the source of the problem. Through further evaluation using ANSYS Fluent we created multiple design variations utilizing the combustion air flow to reduce the temperature gradient.. The current design is strictly a smooth flat plate with no interior or exterior features to modify the flow of the secondary air stream. The redesigned plates feature drilled holes through the plate at various angles. The goal of the drilled holes is to create vacuum sucking the external stagnant air in the furnace chamber into the nozzle and heat the inside boundary of the wrapper plate. In increasing the temperature on the interior of the plate we can reduce the overall gradient and keep the plate at a more uniform temperature reducing the probability of warpage.
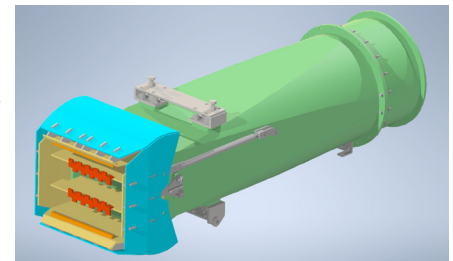
TEAM 26

Zafir Jamil
Pamela Nguyen
Tony Wang

ADVISORS

Rusty Heise
Julian Norato

SPONSOR

Heise Industries

Optimization of Blow Mold Cooling Designs

To model and simulate the cooling process of a specific mold. Analyze it, and study the results in order to redesign the mold and make it more efficient by reducing cycle time.

TEAM 27

Theodore
  Dombroski, Jr.
Nicholas Morgan
Delain Varesio

ADVISOR

Chih-Jen Sung

SPONSOR

Solenoid Durability Test Stand

Jacobs Vehicle Systems specializes in engine braking systems and works with companies such as Caterpillar, Volvo, and Hyundai to name a few. An integral part of their success is the prototyping, development and testing of their braking solenoids to ensure a long-life cycle. The project delegated was to develop a solenoid durability test stand to accommodate ten interchangeable and easily serviceable testing blocks for their solenoids on a durable rig. The frame was designed using 80-20 aluminum extrusions and incorporates an emergency stop feature as well as a safety switch built into the lid. The hydraulic system is powered by a 5 HP AC motor coupled to a gear pump pumping 45 gal/min. The oil is heated by a 4.5kW immersion heater capable of reaching and maintaining up to 300° F. The basin was custom designed to accommodate 3 drain ports and bulkhead fittings to feed in the electrical and inlet plumbing. The testing blocks include a single main manifold with a temperature probe, feeding 10 separate testing blocks that each have a manually set pressure regulator and pressure transducer fed from the manifold, and another set of transducers and regulators to regulate back pressure, before oil is exhausted into the basin and drained into the 15-gallon oil tank. This ensures that each solenoid in the testing blocks will be fed the appropriate flow and pressure requirement as the solenoids are actuated in testing. Testing is user controlled through a LabVIEW interface designed and implemented by our ECE teammates.

Our team collaborated with Electrical and Computer Engineering Team 24 on this project.

TEAM 28

Hannah Aseltine
Melanie Keogh

ADVISORS

Haley Strassner
Anna Tarakanova

SPONSOR

Medtronic

Esophageal Testing Model for Orvil Deployment

Medtronic is the world's largest medical technology company that manufactures cardiac devices, cranial and spine robotics, surgical tools, patient monitoring systems, and more. ME 28 was tasked with fabricating an esophageal testing model for the development of their surgical staplers. The project focused on the modeling and development of a physical esophageal model with accurate human anatomy since one does not currently exist. ME 28 designed a CAD model of the region and its necessary components with anatomically correct dimensions provided by Medtronic. All components were 3-D printed except the esophagus which is composed of replaceable LifeLike BioTissue bowels. To validate the bowel selection, the mechanical properties of LifeLike BioTissue were recorded and compared to porcine esophagi through tensile testing and inflation testing. The assembled model was validated with a successful passing of a 25 mm anvil through the model. This project is a joint project with BME.

Our team collaborated with Biomedical Engineering Team 17 on this project.

TEAM 29

Christopher Annino
Paul Spanoudakis

ADVISOR

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

This team's project description could not be published for privacy reasons.

TEAM 30

Joseph Lee
Peter Stokes
Allison Tewksbury

ADVISOR

Jason Lee

SPONSOR

Reduced Gravity Simulator for Field Environments: Drone-Augmented System

Astronauts go through extensive training on Earth before heading into space, and the more accurate the analogue, the better prepared they will be. NASA currently trains astronauts in simulated lower gravity environments in the Neutral Buoyancy Laboratory and the Active Response Gravity Offload System (ARGOS), but neither of these systems allow for testing outdoors in field environments. In partnership with NASA and Aquiline Drones, the Mechanical Engineering, Biomedical Engineering, and the Krenicki Arts and Engineering Institute seeks to develop a gravity offload device compatible with testing in field environments such as Desert Research and Technology Studies (Desert RATS). Using a weather balloon to passively offload the user's weight and a drone to dynamically respond to changes using a system of sensors creates a consistent and well balanced offloading force. The weather balloon and drone system is connected to a harness system to comfortably lift the user at their center of gravity while providing attachment points for the sensors. In the Spring Semester, we are putting together our first scale tests at lower offload weights and iterating to make improvements as we scale up to our goal of an offload of 25 pounds. Our final design will be presented with a comprehensive plan on how NASA can scale our design up to their desired offload of 100 pound.
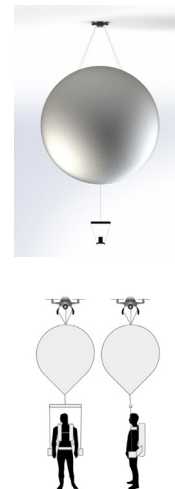
Our team collaborated with Biomedical Engineering Team 10 on this project.

TEAM 31

Taiyaba Batool
Lunar Fukami
Matthew Giorgio
Daniel Yang

ADVISOR

Vito Moreno
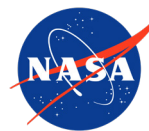
SPONSOR

Reduced-Gravity Simulator for Field Environments — Mobile Frame System

NASA seeks to advance its astronaut training programs by integrating reduced gravity simulation in field environments to better prepare their astronauts for the exploration of Lunar or Martian terrains. Currently, NASA's most advanced reduced gravity offloading system is the ARGOS, which is a 41' x 24' x 25' fixed frame structure that is able to offload a portion of an astronaut's weight to simulate any given gravitational condition. However, its static nature does not allow for in-field training at geographical locations on Earth that resemble Lunar or Martian terrains. We provide a solution through this project by demonstrating a proof-of-concept design for a mobile offloading system that maintains a constant ⅚ G offloading force on an astronaut and is able to move as the astronaut moves. For simplicity, we are focusing only on simulation of Lunar gravity which is equivalent to approximately ⅙ G. This project combines the knowledge and skills from three different departments: Mechanical Engineering, Biomedical Engineering, and Dramatic Arts. Due to the complexity, budget constraints, and safety risks associated with developing a full-scale, mobile structure, we decided to split the project into two major components: A static, large-scale, frame structure (similar to ARGOS) that demonstrates the offloading capabilities and a dynamic, small-scale, chassis-wheel structure that demonstrates mobility through the integration of motion sensors with mecanum wheels and maintains stability on rough terrains and slopes through the integration of a simple suspension system.
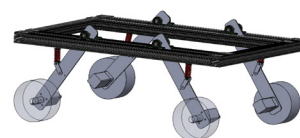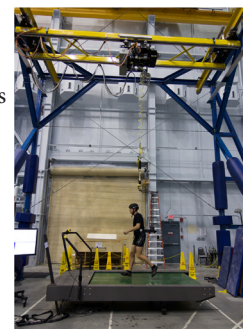
Our team collaborated with Biomedical Engineering Team 13 on this project.

TEAM 32

Andrew Christenson
Madeleine Siegel
Hale Tresselt

ADVISORS

Calvette Brown
Jorge Paricio
Victoria Rodriguez
 Minowitz

SPONSOR

National Center for
Disability Entrepreneurship
at The Viscardi Center

The Guider's Shield

COVID changed typical guiding protocols for the blind. During the pandemic, guiders switched to verbal directions which made those being guided feel unsafe. The Guider's Shield enables touch guidance in a safer and healthier manner by reducing the transmission of diseases and giving more control to the person being guided. This product has the potential to eliminate the inefficiency of verbal directions, mitigate viral exchange, and combat sexual hassassment. The shield has many avenues to consider including usage for the blind and disabled, use in hospitals to guide the elderly, for first responders to guide victims out of disasters, and for children to follow each other safely. The goal of this project is to optimize The Guider's Shield design to reduce weight, provide adjustability, simplify manufacturing, determine a way to inject an anti-microbial coating, and reduce cost.

Our team collaborated with Materials Science & Engineering Team 7 on this project.

TEAM 33

Michael Aisevbonaye
Ian Cooke
Muhammad Khan

ADVISORS

Ryan Cooper
Raymond Mostowy

SPONSOR

NAVSEA
WARFARE CENTERS
NEWPORT

Hydraulic Pressure Trace Analysis for Bearing Degradation Detection

Many complex mechanical systems that operate in the ocean use hydraulic actuators. Due to this harsh environment, the complex mechanical systems have to handle ever increasing friction from sea growth build up, calcareous deposits, and other environmental impacts. Typically the hydraulic actuator is located in a dry space and the hydraulic operating pressures can be monitored. However, the mechanical operating linkage is often times located in seawater and inaccessible. Normally, troubleshooting can only be accomplished by determining if the mechanical linkage is moving or not. Slow degradation of the system may not be seen until there is a stall condition at maximum hydraulic operating pressure. Monitoring of the hydraulic pressures might be able help determine alert values to pinpoint specific bearing degradation prior to stall. The objectives of this project are to develop a dynamic model of a hydraulically operated mechanical linkage to determine hydraulic pressure traces for normal operation and for troubleshooting of bearing failure modes.

Our team collaborated with Management & Engineering for Manufacturing Team 14 on this project.

TEAM 34

Jason Clark
Jeremy Lucien
Nathan Wetherell

ADVISORS

James LeBlanc
Alexei Poludnenko

SPONSOR

NEWPORT

Electromagnetic Expulsion of a Cylindrical Body from an Outer Tube

Current technologies to accomplish the submerged launch of torpedoes and unmanned underwater vehicles (UUVs) consist of water ram systems that use high-pressure water slugs to push the projectile out of an enclosed tube. However, this solution is not ideal for environments where the reduction of detectable noise is a priority. This design examines the feasibility of replacing this water ram system with a less mechanically complex and less detectable electromagnetic launcher. In this design, a sequence of high current pulses is passed through a series of coils, electromagnetically attracting a ferrous sled, propelling it down the tube, and pushing the projectile out in the process. This project was first presented as a small-scale model at the 2019 Demonstration Day, and since then, several improvements have been made to the launch system. The physical design was improved this year to include motor-controlled muzzle and breech hatches to facilitate automated submerged testing. The sled and payload were also modified to ensure consistent submerged launch behavior. In addition to the physical design, a custom discrete time step simulation program was created within Python to interface with a Finite Element Method Magnetics (FEMM) package to quickly and repeatably determine the optimal timings of the current pulses through the three-coil system. The result of this project is a functioning launcher and an experimentally determined relationship between the voltage of the capacitor bank, the launched mass, and the exit velocity of the projectile.
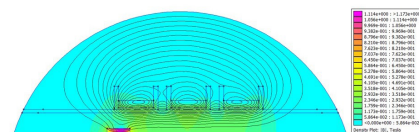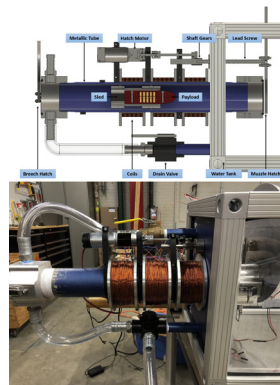
Our team collaborated with Electrical and Computer Engineering Team 12 on this project.

TEAM 35

Nathan Grabbe
Nathaniel Larsen
Tithi Patel

ADVISORS

Michael Ansay
Tianfeng Lu

SPONSOR

NEWPORT

Optimal Design and Modeling of Towed Underwater Vehicles

In partnership with the Naval Undersea Warfare Center (NUWC), our project examines how the optimal design of a towed underwater vehicle or several vehicles is achieved through Ansys Fluent simulations and fluid mechanics theory. Ansys Fluent is a program that uses finite element analysis to calculate expected flow solutions. A typical underwater vehicle is shaped like a cylinder with rounded edges, comparable to a pill. To reduce the complexity of generating the simulations, we assumed any accessories such as the fins and propellers would be neglected. Our group used several 2D and 3D simulations to fully comprehend the software and understand how theory was used in practice. We created numerous CAD models of the vehicle shape that varied in length and diameter, as well as created several models where more than one vehicle were towed. These were simulated in Ansys Fluent to determine their respective drag force and velocity profile. With these simulations, we can narrow down our models to determine the best towing design. To ensure our results are legitimate, our group has spent the majority of the time validating our Ansys Fluent models against known shapes. We have iterated the simulations to reach grid convergence, the practice of using smaller and smaller mesh pieces in the finite element analysis solver to find a solution that should match the previous iteration, in order to further lend credibility to our simulations.
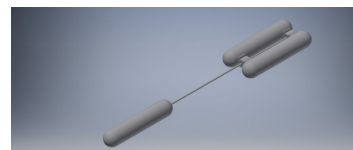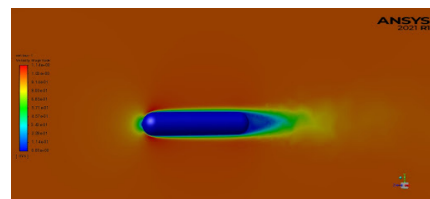
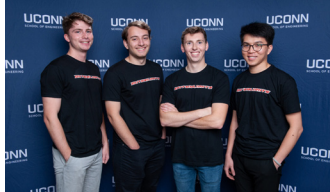**TEAM 36**

Alexander Holley
Justin Hult
Reineer Valenzuela

ADVISOR

This team's project description could not be published for privacy reasons.

TEAM 37

Jonathan Denman
Ryan McCarthy
My Nguyen
Sean Quinlan

ADVISORS

Vito Moreno
Dan Kleitz
Ken Kleitz

Wind Control Device on a High Performance Power Boat

Outerlimits Offshore Powerboats is a manufacturer of high performance luxury racing boats. They are based in Bristol, Rhode Island and have been an industry leader since their inception in 1993. They manufacture both catamaran and deep-vee hull vessels. The boat in question for the project is the SC-37 Catamaran style boat with a top speed of 125 MPH. This boat has an open top design and seats 6 passengers. The company tasked us with designing, fabricating, and demonstrating a device that would reduce the wind buffeting felt by rear-seat passengers when cruising at high speeds, without affecting the overall drag coefficient or top speed of the vessel. They also asked us to ensure that the wind control device was transparent and either retractable or detachable with the ability to easily store it within the rear lockers that are already on the boat. We brainstormed a handful of possible wind control devices and ran our ideas by the sponsor. They gave us feedback on our designs and we were able to eliminate a few of them from consideration and move forward with the refinement and development of the others. We then took our design considerations and made CAD models so that we would run CFD analysis in ANSYS as well as 3D-print the wind control devices so that we would attach them to our scale 3D-printed boat model and compare our analytical results with our experimental results. We compared velocity and pressure differentials with and without the devices present. From here, we selected the best wind control devices and passed our ideas on to the sponsor to pursue.
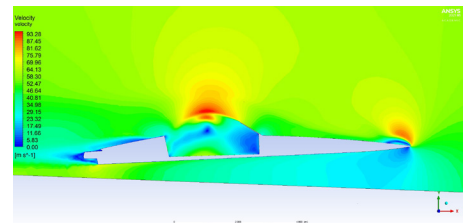
TEAM 38

Chandan Bhandari
Thomas Masayda

ADVISOR

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

This team's project description could not be published for privacy reasons.
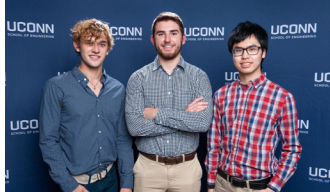
TEAM 39

Joshua Desjardins
Rio Chi
Ethan Maclelland

ADVISOR

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

This team's project description could not be published for privacy reasons.
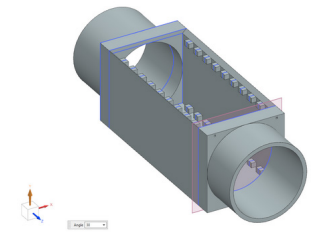
TEAM 40

Brandon Baker
Alexander Ferrari

ADVISORS

Ugur Pasaogullari
Jeffrey Weissman

SPONSOR

PCI
Precision Combustion, Inc.

Heat Transfer Characteristics of a Catalytic Layered Screen

This project aims to define the heat transfer characteristics of Precision Combustion Inc.'s Microlith® mesh. This primary goal includes design and fabrication of a test rig that will be used to experimentally collect heat transfer data through both conduction and convection in both axial and radial directions, and to determine how the heat transfer properties determine temperature distributions across a variety of mesh configurations. In the design of the test rig we also hope to refine the process for the setup of resistive heating system for the mesh, as this would allow for a more even;y distributed temperature distribution, which is important for a variety of applications. Ultimately, the data we collect will be analyzed and then utilized in further simulations to extrapolate the temperature distributions in alternative designs.

Mesh Spacer Casing

TEAM 41

Althea Paynter
Collin Poore
Alex Thatcher

ADVISORS

Valeriy Krutiy
David Pierce
John Tirone

SPONSOR

PRATT & WHITNEY
DEPENDABLE ENGINES

Experimental and Analytical Investigation of Bolted Joint Loosening Due to Vibration

This project explores the phenomenon of self loosening bolted joints. This refers to when bolts wiggle loose in an assembly. We use the term wiggle here to simplify and illustrate the effects of plate vibrations on a bolted joint connection. The object of this project is to identify key parameters of amplitude that would predict the potential for bolted joint loosening. This is judged by a decrease in preload. Bolted joint loosening is most commonly due to transverse cyclic loading. We test a Grade M6 bolt by laying two steel plates with 0.25" holes on top of one another, and transversely moving the top plate. An analytical model is first created to determine the relationship between the force the motor must give out and the force needed to displace the bolt with our predetermined preload and amplitude. With this relationship, we can validate that our experimentation methods will work. The M6 bolt's shaft diameter is about 1 mm less than the 0.25" hole, and this clearance allows the plate to move under the head without shearing the bolt. A 3D FEA model is also created to determine the weak points on the rig. From the results of the baseline FEA, we created multiple FEA reports for different methods of support and judged them based on simplicity and durability. The test rig is designed to simulate vibrations. The frequency is held constant at 1725 rpm and the tested amplitudes are 0.2 mm, 0.4 mm, 0.6mm, 0.8mm, and 1mm. The preload data is collected by a compression load cell, which is situated between the nut and the bottom plate. The load cell sends signals through an amplifier which is connected to a computer. Once the preload data is collected on the computer, we are able to create tables and graphs that show a trend for preload.
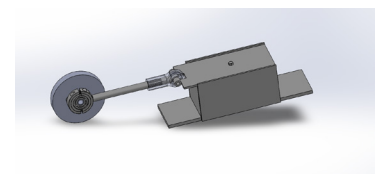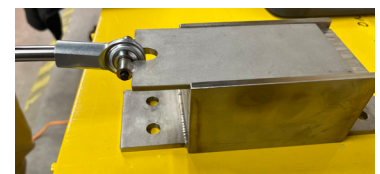
TEAM 42

Grant Berube
Irish Esperida
John Mosley
Jared Olson

ADVISORS

Joseph Colucci
Vito Moreno

SPONSOR

Thermal and Vibration Testing of Static Carbon Flange Seals

The scope of this project is to expose Thermafoil graphite seals to heat and vibration simultaneously, and determine the impact on sealing capabilities. The parameters for testing include vibration testing for 150 hours at 2000 Hz and 3000 thermal cycles from 100F to 500F, all at the same time. 1000 pressure cycles from 0-100 psi will be conducted before and after heat and vibration exposure to determine whether the tests have negative effects on the capabilities of the seal. Microscopic imaging will also be conducted to compare surface integrity prior and post exposure and will provide an alternate form of validation. ME42's activities included design, analysis, ANSYS simulation, and fabrication of a test rig, internal and external cooling systems, and a mount used to conduct simultaneous thermal and vibration testing. ME42 also had to troubleshoot and repair the pre-existing pressure test system to operate properly so baseline and validation tests could be executed. Test equipment including the vibration table, induction heater, water cooler and all cooling components had to be ordered, assembled, and set up to achieve desired testing parameters. Following testing, ME42 is tasked to determine whether the sealing capabilities after exposure to heat and vibration are satisfactory to replace current spiral wound compression seals in aircraft engine bearing compartments. The advantage of replacing the spiral wound seals is less required crush force to make a proper seal, since there is no metal wound inside the seal. Less required crush force results in lighter components and a lighter, more efficient aircraft.

TEAM 43

Justin Corres
Zachary Ryan
John Grady Shea

ADVISOR

Nejat Olgac

SPONSOR

Experimental and Analytical Demonstration of Coupled Disk-Shaft Vibration

Experimentally, analytically, and numerically find the natural frequencies (or modes) of the rig with minimal percent errors. This must be done in a static and rotational reference frame in order to determine the critical speeds of the rotating disk-shaft system (the rotational velocity of a system when it rotates at a frequency exciting one of its natural frequencies). Maintaining a constant disk mass of 1.12 kg, determine and analyze the effects that varying disk geometries have on the mode shapes and corresponding frequencies of the rig. Make calculated predictions about how different disk shapes affect the behavior of the rig. Determine safe ranges of operational rotation for rotors with similar disk geometries and effective shaft lengths.
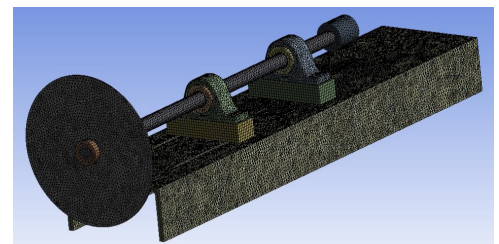
TEAM 44

Pujan Patadia
Alexander
 Sutherland
Stephanie Torres
Nicholas Villandry
Brianna Westenfield

ADVISOR

Vito Moreno

SPONSOR

Material and Structural Response Under Dynamic Loading

The objective of this project is to run tensile tests on aluminum alloys that used as structural components of turbine engines at varying strain rates to understand the relationship between strain rates and mechanical properties. During flight, gas turbine engines are subjected to mechanical stresses. In certain situations fan blade failure can occur, where the fan blade will break off, causing the turbine to be subjected to large impact loads. Fan blade out is a highly dynamic and transient event with complex loading and system-level effects. During this event, deformation will occur to the structural components of the turbine with very high strain rates. When metals deform with a very high strain rate, it is known that their mechanical properties, such as ultimate tensile strength and ductility, increase. Currently, in the aerospace industry, the mechanical design of turbine supporting structures is done by using data obtained from tensile tests using a static, or very low, strain rate. We are tasked to quantify and understand the difference in strain behavior of a material and component loaded with the same magnitude of force but varying the time under loading. The preferred material to be tested is a low ductility aluminum alloy because of its common use in aerospace applications.
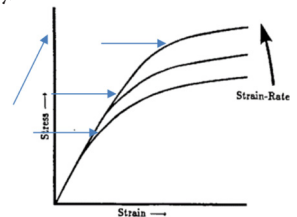
Our team collaborated with Materials Science & Engineering Team 5 on this project.

TEAM 45

Ali Halla
Bryan Plunske

ADVISOR

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

This team's project description could not be published for privacy reasons.

TEAM 46

Elise Bessette
Aakrish Daswani
Taylor Houghton
Ian Krasnow
John Ling

ADVISORS

Jesse Boyer
Ying Li

SPONSOR

Automated Powder Bed Apparatus

The objective of this year's project is to determine a method to automatically characterize various powders and develop one or more methods to measure flowability to ultimately develop a relationship between the two.

Our team collaborated with Materials Science & Engineering Team 4 on this project.

TEAM 47

Alejandro
 Carino-Nieves
Kaiyue Wu

ADVISOR

SPONSOR

UCONN
SCHOOL OF ENGINEERING

MECHANICAL ENGINEERING

This team's project description could not be published for privacy reasons.

TEAM 48

Frances Mirabile
Huy Ngo
James Pettit

ADVISOR

This team's project description could not be published for privacy reasons.

TEAM 49

Benjamin Tyszka
Dylan Wu

ADVISORS

Wilson Chiu
John Virtue

Thermocouple Heat Transfer Surface Error

Thermocouples are tiny electrical devices that measure the temperature of a surface or fluid. They are a critical component in the operation and testing of jet engines. Despite their ubiquity, textbook descriptions of thermocouples often neglect that you have to mount the thermocouple to the surface of interest using an adhesive, in our case, a high-temperature adhesive. Those adhesives cause an error in the thermocouple reading from the "true" temperature of the surface of interest. This project aims to quantify and reduce the error associated with our sponsor's surface thermocouple measurements via a test rig. The completed rig can create a flow and heat transfer environment representative of a jet engine component cooled by forced convection, can record a thermocouple temperature measurement of that surface, and can record the actual surface temperature from a thermal camera mounted above the test rig. We then experimented with the size of our adhesive to identify a configuration that minimizes the error. Our team has also developed analytical models and numerical simulations that identify trends in the heat transfer environment that reduce the error and have evaluated the error associated with our sponsor's current method of installing thermocouples. Our project allows our sponsor's engineers to gain greater insight into the trustworthiness of their thermocouple data.
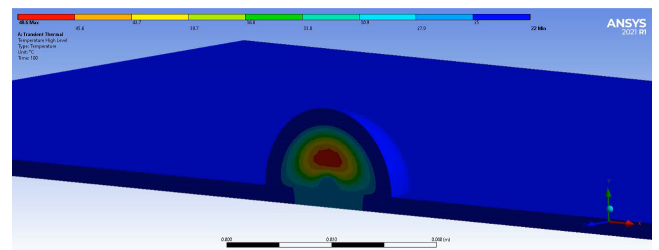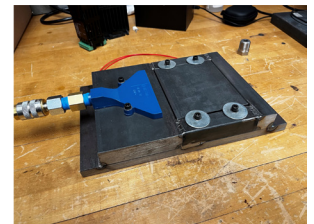
TEAM 50

Andrew Bauer
Michael Hill
Sean Young

ADVISORS

John Cowles
Vito Moreno
Phil Smith

SPONSOR

Bearing Load Measurement

The Bearing Load Measurement project, sponsored by RBC Bearings, measures accurate load values on a cam follower through the utilization of strain gauge technology. Using a cam and cam follower combination to displace springs, a desired industry comparable load is produced. The project includes the reconstruction of a rig capable of not only producing and withstanding industry level loads, but measuring them as well through a strain gauge (placed directly on the cam follower) and a load cell (placed at the top of the test rig). Finite element analysis software is employed to model the behavior of the cam follower being analyzed in order to visualize and support the results concluded from the project. Relating the measured strain values from the strain gauge implementation to the load values provided from the load cell will be able to confirm the accuracy of the results. Calculating load through a measured strain on the cam follower itself can provide a more accurate representation of the true load that the cam follower experiences in industry.

TEAM 51

Alexander Malyk
Cameron Potter
Phillip Tsurkan

ADVISORS

Ulf Jonsson
Nejat Olgac

SPONSOR

Structural Vibration Excitation using Rotating Magnet Arrays

Raytheon Technologies Research Center (RTRC) is Raytheon technologies central research organization. RTRC is located in East Hartford, CT and works in both commercial and government sectors. High cycle fatigue failures is a common issue plaguing jet engines and other aerospace systems. Typically, it requires test duration up towards 10 million load cycles and traditional servo hydraulic load frames operating at 10-20 Hz results in long test durations. It is desirable to develop methods that are capable of operation at 10X or higher frequencies. The team was tasked to design and build a non-contact excitation rig in which a stationary sample can be excited by a rotating magnet array. Magnets will be used as they can provide alternating force, which will provide non-contact excitation. The magnet array needs to be able to induce a vibration with a frequency near the object's resonance to enable high stress in the material. Strain amplitude has to be accurately controlled through the test. The design uses one half of a magnetic coupling and its embedded permanent magnets which serve as the rotating magnet array. This is rotated by an AC electric motor controlled by LabVIEW. Initial testing had been conducted on a plain beam with a thinned out bending section fitted with a strain gage for stain monitoring through LabVIEW. A hall sensor is mounted near the magnetic coupling to record actual frequency. Utilizing this setup, non-contact fatigue and vibration testing is achieved.
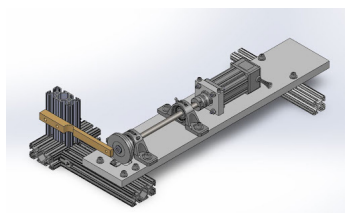
TEAM 52

Austin Huang
Adam Pysk
Karl Siismets
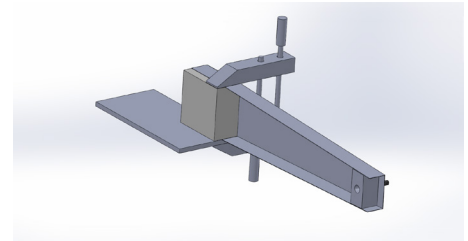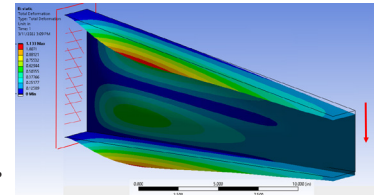
ADVISOR

Rajiv Naik

SPONSOR

SIKORSKY
A LOCKHEED MARTIN COMPANY

Design and Validation of Tapered Composite C-Section Beam Structures

C-Beams are commonplace in engineering structures. This shape is notable because the basic shape can provide high bending stiffness in one direction, but offers a relatively compliant member when subjected to twisting loads along its length. Using composite materials, the disparity between bending stiffness can be increased for a C section. These structures are used in the aerospace industry, for example in helicopter rotor applications. The objectives of this project are to design, analyze, fabricate, and test tapered C-Beams to identify viable design configurations for helicopter rotors. In order to achieve these objectives, different C-Beam structures were analyzed using Finite Element Analysis. Composite C-Beams with varying tapered angles and layups were fabricated and tested to investigate the effects of loading, taper angle, and composite layup on the overall stiffness and compliance. As a result of this research project, the team was able to provide Sikorsky Aircraft Corporation with a validated composite C-Beam design methodology.

TEAM 53

David Chan
Matthew Cruz
Claire Fresher
Maya Rudd

ADVISORS

Vito Moreno
Vinay Patel

SPONSOR

STANLEY.
Access Technologies

ICU Pro-Care 8300 Header Redesign

Stanley Access Technologies, located in Farmington, CT, manufactures, installs, and services various automatic and manual doors. Receiving the world's first automatic door patent 90 years ago, Stanley Access Technologies has led the industry with state-of-the-art manual and automatic door solutions. Our project focuses specifically on Stanley's ProCare 8300 Series, which are human-centric ICU doors deliberately designed with respect for patients and caregivers in sensitive healthcare environments. This specific door is a two-piece aluminum extrusion including the header frame and an external cover; the price of aluminum per pound having increased by 50% since the 2020, these extrusions have increased costs on Stanley's aluminum extrusions. In this project, we have been tasked with the redesign, test, and fabrication of a new aluminum header with the goal of reducing aluminum without sacrificing sufficient strength, stiffness, and sealing. With a newly designed aluminum extrusion, cost analysis was performed to not only account for the aluminum reduction, but the resources saved in production and field installment.
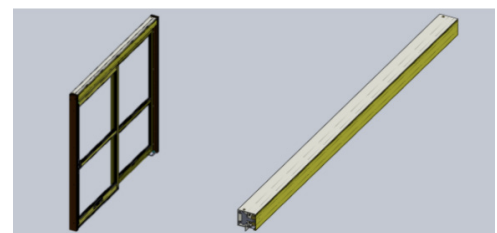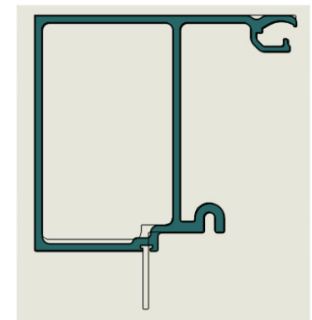
TEAM 54

Alexander Jarrett
Theoharis Puka

ADVISORS

Joe Borrelli
Chengyu Cao
Duane James
Justin Huddy
Lu Pannullo

SPONSOR

Triumph Group

AC-Power Driven Brushless DC (BLDC) Motor Controller

The goal of this project was to research, design and fabricate a BLDC Motor controller. The motor should be capable of driving up to 1.5 kWatts and operate in ambient temperatures of -40C to 85C. It should be mounted in an enclosure that will be air-cooled with no use of fans. The motor was not under the same enclosure as the PCB and thus the team did not need to consider vibrations. The circuit was 90- 95% efficient so estimated internal dissipation was 75W to 150W. The approach of the PCB was to have two boards, an IMS (single layer aluminum plate) and a FR-4 (fiberglass). Three connectors board to board and three hanesses connect the two boards. Additionally, a housing was designed and manufactured, made of aluminum, to host the PCB. The housing has an open top so it can help with the heat dissipation.

Our team collaborated with Electrical and Computer Engineering Team 29 on this project.
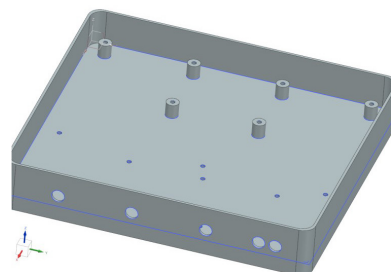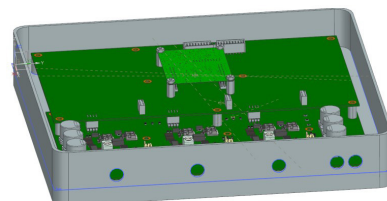
TEAM 56

Akash Binoj
Christopher Case
Ava Zahedi

ADVISOR

George Matheou

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

CloudBots: Autonomous Atmospheric Explorers

The CloudBot is an autonomous weather balloon that operates on the principle of variable buoyancy to ascend and descend in the atmosphere. Sponsored by Dr. George Matheou of UConn's Department of Mechanical Engineering, this project aims to develop a device that can collect atmospheric measurements and communicate them mid-flight with the goal to reduce reaction times to detrimental natural weather disasters. The apparatus consists of a helium-filled balloon, the robotic payload, and an air cell. The fixed-volume helium balloon at the top provides an upwards buoyancy force, while the air cell at the bottom can hold a variable amount of pressure to adjust the density of the CloudBot. This allows the CloudBot to ascend or descend depending on how much air is compressed in the air cell. The robotic payload consists of temperature, pressure, and altitude sensors as well as a GPS module. By interfacing with two solenoid valves, the CloudBot can either direct compressed air from the pump into the air cell or release air into the atmosphere depending on user or computer input. The transceiver modules present in both the payload and ground control allow for communication between the CloudBot and the ground. The CloudBot can hold pre-programmed flight plans for navigation or be manually operated with ground control. Measurements can be collected and displayed via the Arduino Nano on ground control.
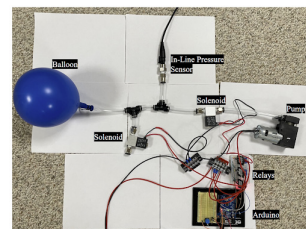
TEAM 57

Jonathan Dos Santos
Anthony
 Mirabilio Mulhall
Sean Russell

ADVISOR

George Lykotrafitis

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

# Design and Build a Mini Autonomous Underwater Vehicle

The underwater capability of human technology is supremely underdeveloped. In an effort to improve these abilities, this group is tasked with designing a 3D printed underwater vehicle that is only a cubic foot in overall volume. Furthermore, it must be capable of using artificial intelligence, through deep reinforcement learning, to self-navigate underwater. In doing so, it will also be able to detect disturbances within its environment, and follow a given target as well using the sensors it has on board.

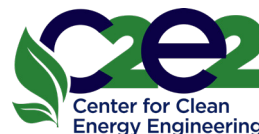**Our team collaborated with Mechanical Engineering Team 57 on this project.**
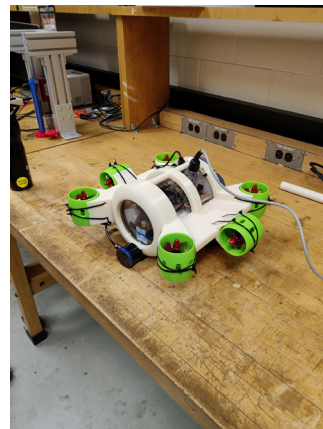
TEAM 58

Jake Kracinovich
Sean Rescsanski
James Sweeney

ADVISOR

Ugur Pasaogullari

SPONSOR

C2E2
Center for Clean
Energy Engineering

Separation of Hydrogen From Hydrogen-Natural Gas Blend

As the United States begins to shift away from fossil fuels, hydrogen continues to be a focus as a potential green energy solution for the future. Using electricity from renewable resources and electrolysis, pure hydrogen can be generated for later use in fuel cell applications such as vehicles. However, transportation infrastructure for hydrogen does not exist on a large scale, preventing hydrogen from being used on a large scale. One potential solution is to blend hydrogen into natural gas pipelines, allowing for hydrogen to be separated out for pure hydrogen applications down the line. Conventional methods of separating hydrogen from natural gas are too expensive and inefficient for this to be a feasible solution, with the cost of hydrogen per kg potentially exceeding $10/kg. Our project explores an alternative method to hydrogen separation from natural gas with the goal of lowering the cost of hydrogen separation, proving the economic feasibility of blending hydrogen into natural gas pipelines. We utilize a hydrogen pump, an electrochemical cell, as the means of purification. As a byproduct of hydrogen purification from natural gas, carbon monoxide is generated which binds to the platinum catalyst, drastically poisoning the cell. As a mitigation technique, our group is testing pulsing the cell periodically to oxidize and clear the carbon monoxide. This procedure incurs a high energy cost, but allows for the cell to maintain an optimal operating performance over long periods of time. Through experimentation, our group will determine the minimum amount of power input required to maintain high cell performance and correlate this power usage to a cost of hydrogen purification. From our findings we hope to be able to economically justify the blending of hydrogen into natural gas pipelines as a means of transitioning away from non-renewable energy sources.

TEAM 59

Timothy C. Foley
Donald Kulowski, III
Rachit
 Kumbalaparambil

ADVISOR

SPONSOR

UCONN
SCHOOL OF ENGINEERING

MECHANICAL ENGINEERING

This team's project description could not be published for privacy reasons.

TEAM 60

Shayne Back
Natalie Connors
Cristiano Da Silva

ADVISOR

David M. Pierce

SPONSOR

im
LABORATORY

Device to Measure the Coefficients of Friction Between Cartilage and Different Materials in Sliding

ME60 designed, built, and tested a device to measure the static and kinetic coefficients of friction as a function of time between surfaces of cartilage. Professor David M. Pierce and his Interdisciplinary Mechanics Laboratory (imLab) at UCONN will use the device to continue understanding articular cartilage. They are researching the development of microcracks in cartilage for patients diagnosed with osteoarthritis. Our new device will aid their mission to quantify changes in cartilage and joint function with progressing microstructural damage. Changes in the coefficient of friction may highlight microstructural damage and indicate potential treatment targets. The device functions like a record player, with a fixed sample of cartilage as the pin and a rotating sample as the record. The fixed sample is 3 mm in diameter. It is held in place by a linear bearing and slotted shaft. Beneath it is the rotating sample 10 mm in diameter and driven by a motor. An acrylic tube isolates the cartilage samples to allow for testing within a saline bath to mimic conditions within joints. We must know the friction and normal forces to determine the coefficient of friction. A load cell integrated in the slotted shaft measures the axial force applied to the fixed sample. The system is constrained in this direction, creating an equal and opposite normal force perpendicular to the intersection of the samples. The fixed sample is offset from the center of rotation such that the friction force between the samples creates a torque. The torque due to friction is measured by a rotary torque sensor. We calculate the friction force from this torque value by measuring the distance between the center of each sample. The torque sensor and load cell are connected to LabVIEW. We process our raw data using MATLAB to quantify the coefficient of friction as a function of time.

121
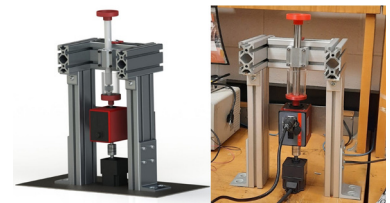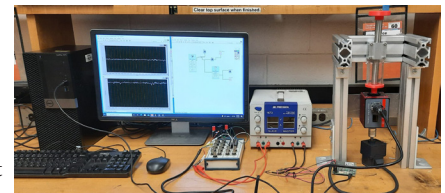
TEAM 62

Christian Bollinger
Bettina Burke

ADVISOR

Wilson Chiu

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

Thermal Fluids Study of Heat Transfer and Pressure Drop of 3D Printable Open-cell Foams

This project is a continuation of the research conducted by Dr. Chiu and his laboratory team on the study of heat transfer and pressure drop of 3-D open-cell foams. Open-cell foams are extremely useful in heat transfer applications due to their porous and lightweight bodies. The objective of this project is to determine the structural stability and printability of several individual open-cell foams, each with slightly different geometric features. The analysis specifically focuses on investigating cells with different binder angles, shell wall thicknesses, and perforation radii. Feasible means to 3-D print the cells were discovered and utilized on cells with binder angles ranging between 30° to 60°. The structural stability of several cells with binder angles ranging from 5° to 25° was determined. Through simulation, it was possible to numerically evaluate which cells are structurally sound enough for printing and handling, as well as determine the minimum binder angle for which 3-D printing was feasible. A plot was developed to demonstrate the relationship between binder angle and maximum Von Mises stress from the analysis. To validate these results, physical compression tests were performed. Furthermore, CFD analysis was performed using COMSOL to simulate wind tunnel conditions and study the fluid flow, velocity, and pressure drop across an open-cell foam. Multiple CFD tests were performed with foams generated using multiple cells and configurations as well as multiple inlet velocities. The relationships between pressure drop, porosity and inlet velocity of the flow were developed. This work was performed in collaboration with Gerardo Maria Mauro at the Università degli Studi del Sannio, and Marcello Iasiello, Nicola Bianco and Vincenzo Naso at the Università degli Studi di Napoli Federico II, with support from an Italian Government MIUR Grant No. PRIN-2017F7KZWS.
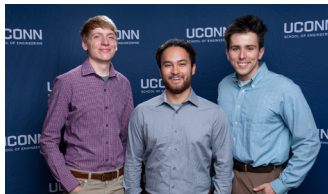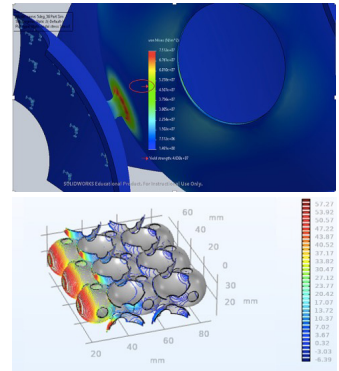
TEAM 63

Sara
 Armas Barrientos
Conrad Baldwin
Vania De La Cruz
Graham Douglass
Charis Nyarko
Zachery Roy

ADVISORS

Frank Cunha
John Simmons

SPONSOR

Whitcraft

Automated Spot Resistance Welder

Whitcraft Group is an aerospace manufacturer located in Eastford Connecticut, where they have been since their founding in 1960. They produce low to medium volume parts with an emphasis on products with complex geometries, particularly engine components. In order to maximize the efficiency of the multiple independent production lines, Whitcraft adheres to the principles of lean manufacturing, aiming for continuous improvement and standardization whenever possible. Whitcraft produces heat blankets for a Pratt and Whitney engine. These heat blankets consist of an insulation sheet nested between two paired pieces of sheet metal. The current process to join the sheet metal involves a couple hundred manual resistance welds. Applying these with a spot-welding gun is labor intensive, prone to variation, and leads to a high scrap rate. To address this, Whitcraft has tasked our team with developing a machine that will complete the welding operation hands free, only requiring the operator to load the components and initiate the process.

Our team collaborated with Management & Engineering for Manufacturing Team 20 on this project.

TEAM 64

Qing Liu
Raymond Ma

ADVISOR

Chengyu Cao

SPONSOR

Bridge Assembly Programming and Screening

This project was focused on designing and developing a test fixture capable of validating the Zygo Corporation's next-generation Bridge printed circuit board. The current test fixture lacks the ability to program the Bridge PCB, and only utilizes cables to interface into the Bridge PCB. Jointly with ECE 24, Zygo has tasked us with the solution of developing a new test fixture to simplify the interfacing and testing procedure for the user. As the test fixture will be utilized in a manufacturing environment, robustness and simplification for the user are emphasized. The main focus of developing a new test fixture for the Bridge PCB is to reduce the number of cable connections, while still confirming the board's functionality. As such, a switch to a "Bed-of-Nails" solution was introduced. Spring-loaded pins will make a physical connection to specified nodes located on the Bridge PCB. The test fixture will push and lock the Bridge PCB into the pins to ensure a connection for the testing to occur.

Our team collaborated with Electrical and Computer Engineering Team 24 on this project.
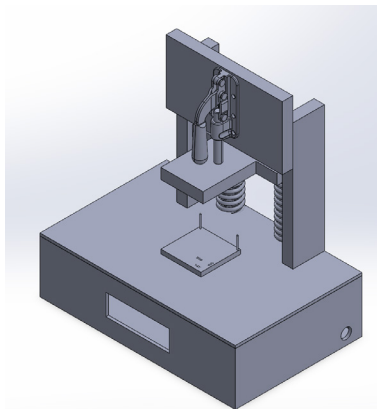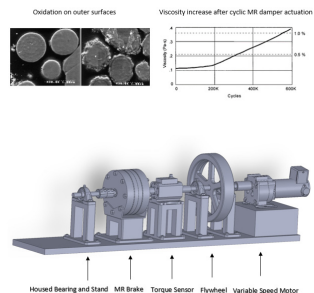
TEAM 65

William M. Cawthra, III

ADVISORS

Richard Christenson
Jiong Tang

SPONSOR

UCONN
SCHOOL OF ENGINEERING

Understanding the Performance of Magnetorheological Fluids Within Smart Dampers

Since the discovery and implementation of Magnetorheological Fluids within industry, little to no research has been compiled regarding the durability and performance characteristics of MR fluids during long term actuation. A MR fluid is generally composed of micron-sized ferrous particles, such as carbonyl iron, suspended within a carrier fluid, such as mineral or silicone oil. When exposed to varying magnetic fields, the polarized particles form chain-like structures in the direction of the magnetic flux. The result of the interparticle-viscous stresses creates a change in apparent fluid viscosity and is directly proportional to the applied magnetic field intensity. This robust principle grants the motivation towards industry practice, allowing for real-time vibration control for applications such as vehicle shock absorbers and base isolation systems. However, qualitative research indicates the potential for a phenomenon known as "In-Use-Thickening" (IUT), the main failure mode of interest in this study. When a MRF is subjected to high interparticle stresses, elevated temperatures, and ambient conditions, initiation of oxidation-redux on the particles' outer surfaces occurs and is propagated during load actuation. This surface layer eventually breaks off, and since this layer holds no value of magnetic permeability, thickening in fluid viscosity during its "off-state" increases over time and eventually leads to both fluid and component failure. The objective of this research is to repeatedly produce such phenomenon, while operating under various load conditions, such as varying shear rates, temperatures, and magnetic field intensities. To accelerate the process, the formulation of a rotary MR test brake is designed in leu of a shear mode damper for continuous actuation. The brake allows for pure shear loading of the fluid while establishing baseline dynamic-failure prediction models. These models will then be used to predict fluid-failure in existing MR devices.

TEAM 66

Celia Chacko

ADVISOR

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

This team's project description could not be published for privacy reasons.

TEAM 67

William
 Hobson-Rhoades

ADVISOR

Hongyi Xu

SPONSOR

NIUVT'S MISSION

Simulating the Lithium-Ion Battery Electrode Calendaring Process

In this project, several simulations needed to be created in order to best simulate the battery electrode calendaring simulation. The first of these is a macroscopic simulation, which is used to determine large-scale properties of the electrode, such as general density distribution before and after the calendaring process. In this simulation, a roller is dropped onto the battery electrode, and then horizontally translated across the surface. Next, a macroscale simulation needed to be created to determine the material properties of the macroscale simulation. This simulation was created by distributing different numbers of particles throughout a cube, and translating one side of the cube inward, in order to compress the particles. This deformation provided a stress-strain curve, which would be applied to the macroscopic model. The other component of the microscale model was to determine the electrochemical properties of the battery. The three analyzed properties were tortuosity, effective conductivity, and active surface area. They could be determined from the model by replicating the morphology of the battery electrode. This model was created by filling x-ray images of the battery electrode with particle centers, and expanding the particles to best fill the material parts of the image. The remaining material parts were filled with particles with properties of binder, replicating the structure of the electrode. These properties could then be used to determine the battery's performance.
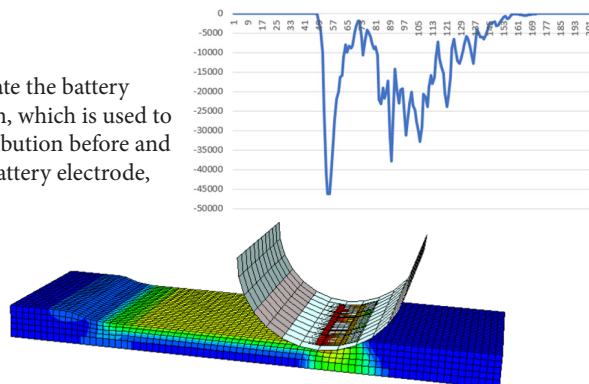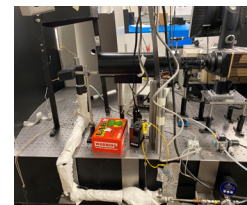
TEAM 68

Andrew Pace

ADVISOR

Baki Cetegen

SPONSOR

Filtered Rayleigh Scattering Analysis of Ethanol, Toluene and n-Dodecane

The Combustion and Gas Dynamics Laboratory uses laser diagnostic techniques to analyze bluff-body stabilized flames. The goal of this project is to determine the filtered Laser Rayleigh Scattering (LRS) signals from liquid fuels as a function of temperature. Current experimental studies are focusing on gaseous fuels utilizing filtered LRS thermometry, Particle Image Velocimetry (PIV), and OH Planar Laser Induced Florescence (OH-PLIF). To extend these studies to flames fueled by pre-vaporized liquid fuels, the filtered LRS signal needs to be calibrated by characterizing filtered LRS signal versus fuel mixture temperature for the selected liquid fuels. This project will enable filtered LRS thermometry studies to be performed in tandem with PIV and OH-PLIF to create simultaneous temperature and velocity maps of the pre-vaporized liquid fuel flames. The purpose of using filtered LRS instead of unfiltered LRS is to filter out Mie scattering from particles introduced into the flow for PIV. A fuel-nitrogen flow is heated to a known temperature and imaged with one Intensified CCD camera. The camera will be positioned behind an iodine cell, which contains iodine vapor to filter out the Mie scatter. A portion of the LRS will be spectrally broadened and fall outside the absorption feature of the iodine, allowing it to be imaged by the camera. The filtered LRS versus temperature relationship for the pre-vaporized liquid fuels can be derived by measuring the filtered LRS signal with the camera at different temperatures. The unfiltered LRS data will also be gathered simultaneously with a second Intensified CCD camera.
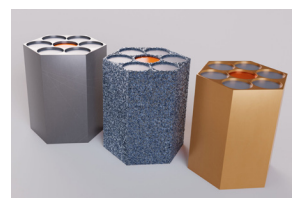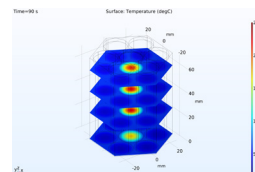
TEAM 69

David Vanasse, III

ADVISOR

SPONSOR

This team's project description could not be published for privacy reasons.

TEAM 70

Chris John

ADVISOR

Wilson Chiu

SPONSOR

UCONN
SCHOOL OF ENGINEERING
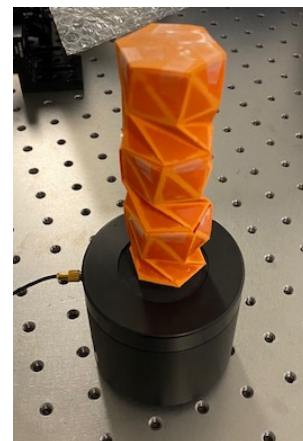MECHANICAL ENGINEERING

Triggering Thermal Runaway in Lithium-Ion Batteries

The proliferation of lithium-ion batteries (LIB) has facilitated the design and production of innumerable technological advances from cell phones to battery-powered vehicles. A latent danger, however, exists in these batteries. Mechanical, thermal, or electrical damage can initiate a phenomenon known as thermal runaway (TR). This damage causes internal short circuits within the battery, releasing heat. This heat triggers additional decomposition reactions, releasing additional heat and further increasing the decomposition reaction rate. The battery will catch fire if rapid cooling is not present. While experimental designs exist for evaluating TR, significant safety hazards and impracticality may impede testing efforts. Finite element analysis, therefore, becomes a vital tool in modeling TR and mitigation techniques. However, there is limited literature regarding modeling and evaluating TR in generalized models with different material properties and conditions. This project works to develop these models and evaluate methods of mitigating TR. A major objective of this project was the creation of a representative battery model, based on an 18650 cell, in which TR can be triggered. Upon successful triggering in this single cell, the next step was inserting the battery into a generalized battery case called the "honeycomb". This honeycomb holds seven total cells, with one cell forced to undergo TR. Multiple studies were then performed to see if certain parameters could prevent TR from propagating to the other cells. Parameters included changing material properties such as varying thermal conductivities, case dimensions, and even porosity of the material. Parametric combinations can be trialed and optimized for weight reduction, cost, and other real-world considerations. The symmetric honeycomb geometry can be linked with other honeycombs, expanding the number of cells indefinitely depending on the application.

TEAM 71

Ashmika Gupta

ADVISOR

Osama Bilal

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

Deployable Origami Based Structures and Their Potential Applications in Engineering

This project explores deployable origami-based structures for vibration control. Origami-based structures have been shown to be effective at attenuating vibrations due to their unique geometry. Their capabilities stem from their unique nonlinear stiffness which is a direct result of their geometry. They are also cost efficient and easy to fabricate as they can be transformed from 2D sheets into 3D configurations. Our lab is called Wave engineering for extreme and intelligent materials (We-xite), where we perform research on metamaterials and meta-structures . These are uniquely designed structures which obtain their unique properties due to their geometry rather than their chemical composition. In this project, I consider an origami design known as the Kresling pattern. The pattern is made out of a 2D flat sheet and can be folded into a three-dimensional column. The stiffness of the studied structure is modeled using a nonlinear finite element method to accurately simulate the nonlinear behavior of the structure. This model was then used to explore the response of the column to vibrational excitation both numerically and experimentally. A numerical tool was created in MATLAB in order to plot dispersion curves and a frequency response function for the purpose of extracting the band gap (range of frequencies that cannot propagate through the structure) of the system. The experimental samples were fabricated using different 2D material sheets (such as thin plastic and construction paper) and the pattern was cut precisely using an automated mechanical cutter. The flat pattern was then folded and assembled into a column with each panel being reinforced with a UV curable resin. This sample was then excited using a mechanical shaker in order to generate an experimental frequency response function. Experimental results were then compared with the numerical results. This project presents the findings from the numerical and experimental vibrational analysis of the
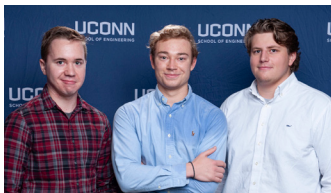
TEAM 72

Christian Falck
Josef Womelsdorf
Kyle Zimmerman

ADVISOR

David Giblin

SPONSOR

EAP
A CAM COMPANY

Tube Wear Sleeve And Braze Foil Pre-Assembly

E.A. Patten is a world leader in custom metal tubing used in aerospace, medical, commercial, sporting, and numerous other applications. Clamps are added along tubes in certain applications to reduce vibrations. Over time, rubbing of the clamps can cause the tube to wear. To prevent this possible damage, wear sleeves are attached to the tubes at the clamping locations. The wear sleeves are brazed to the tubes to prevent them from moving. Currently, the process of cutting the braze foil and placing the wear sleeves is all done by hand. This project creates a solution to automate the cutting and attaching of braze foil to the wear sleeves. A wear sleeve is placed in one end of the device. A dispensing system, similar to that of a printer, feeds the correct length of foil over the wear sleeve. The cutting mechanism then lowers. A razor blade attached to the cutting mechanism is able to cleanly slice through the foil. Meanwhile, the foil gets pushed into the wear sleeve and becomes temporarily tacked. Three major benefits of this automated process can be seen. First, the foil cutting is much more accurate than by hand. The stepper motor dispensing system allows the foil to be dispensed with accuracy of a fraction of an inch. This leads to less failed brazes and significantly less wasted foil. Next, the process allows for the wear sleeve and foil assembly to be made in advance. This means an operator can simply pull the wear sleeves from a premade batch and immediately attach them to the tubes. This leads to the most important benefit which is saving time. The automated process allows operators to significantly reduce the time it takes to attach each wear sleeve. The reduction in time along with the decrease in waste will allow E.A. Patten to continue producing their high-quality products while allowing for more resource allocation elsewhere.
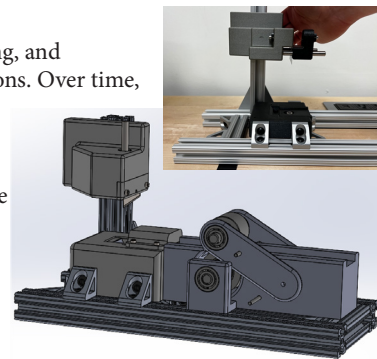
MECHANICAL ENGINEERING

TEAM 73

Jocelyn Bohlman
Miles Martin
Vu Linh Ngoc Nguyen
James Zieminski

ADVISORS

Kelly Buffum
Jason Lee

SPONSOR

Collins Aerospace

Silver Paint Application on Heat Exchangers

Collins Aerospace, a Raytheon Technologies subsidiary, is one of the world's largest providers of aerospace and defense products with more than 30 locations across the country. Their unique industry knowledge and decades of experience enable them to specialize their aerospace systems and services for commercial aircraft. Currently, Collins uses a manual coating process for their heat exchangers from Boeing 787 Dreamliner. The water-silicone based paint (also called silver paint) is pumped out of nozzle through fins to protect plates and fins against corrosion and high temperatures. An operator transfers the heat exchanger to a blowdown rig to remove all excess paint by compressed air, then paint bubbles formed on underside are brushed off. This method is reliant to the operator experience, and time-consuming for transferring exchanger between phases with unidentified outcomes of interior coating. Collins is looking for an automated painting process that is capable of decreasing overall time by at least 40%, reducing operator interaction, increasing consistency and reliability of exchangers. The benefit of this project will not only be insured a better rust preventative and heat conducting coating, but it will greatly aid the shop operators in ergonomics. To accomplish this goal, our team conducted extensive research to determine the best coating method that not only ensured improvement in the painting process, but repeatability as well. From this research, we developed the process using automation to coat the inner fin structure of the heat exchanger. Thus far, two methods were selected and analyzed through the construction of test rigs and experiments to perform three major variable alterations as pressure, angle, and pass speed. These parameters would be used to optimize the automation process while minimizing the operating time as well as the operator interaction.

Our team collaborated with Management & Engineering for Manufacturing Team 7 on this project.

TEAM 74

Maxwell Bartlett

ADVISOR

Wilson Chiu

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

Intelligent Design of Architected Open-Cell Foams

Novel advancements in manufacturing technology allows for greater precision in printing 3D metal structures. This makes the production of metal architected open cell foams possible. Architected open cell foams are comprised of repeating connecting unit cells, are light weight and may have high heat transfer rates for how light they are. These properties are ideal for use in heat exchangers. The optimal geometric configuration of these open cell foams to maximize effective thermal conductivity is currently unknown. The purpose of this project is to use machine learning to discover the optimal foam geometry to maximize effective thermal conductivity. This will be achieved by implementing a Genetic Algorithm within MATLAB. The Genetic Algorithm will start with an initial population of foam geometry configurations. It will then use COMSOL simulations to evaluate the performance of each specific geometric configuration. The performance of each configuration will then be transferred into MATLAB, which will generate a new collection of foam geometries based off the most effective previous configurations. The new geometries will then be reevaluated in COMSOL, and the process will continue until the most optimal foam configuration is discovered This work was performed in collaboration with Gerardo Maria Mauro at the Università degli Studi del Sannio, and Marcello Iasiello, Nicola Bianco and Vincenzo Naso at the Università degli Studi di Napoli Federico II, with support from an Italian Government MIUR Grant No. PRIN-2017F7KZWS.

TEAM 75

Alexander Blagojevic
Toni Moore

ADVISOR

Sina Shahbazmohamadi

SPONSOR

AEROCYONICS
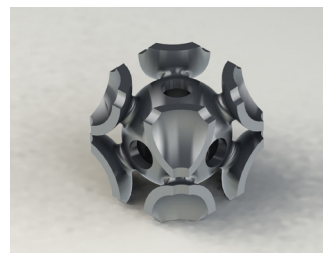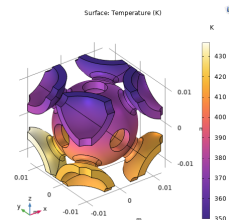
Design and Build of a Precision Polygon Scanning Femtosecond Laser Set-Up

For many micromachining applications that require especially high levels of precision, high-powered ultra-short pulse (USP) lasers have been shown to outperform their continuous or longer pulsed counterparts, in terms of machined surface quality. USPs operate on the principle of high intensity, short pulses of light, in the order of a few dozen femtoseconds to 10 picoseconds. These short pulses allow for more precise machining, by minimizing the amount of heat transferred to the area surrounding the target. Currently, femtosecond lasers are limited in positioning speed due to the acceleration of the galvanometer mirrors that align the laser bottlenecking certain beam parameters. For example, to achieve a 50 percent pulse overlap at 2 MHz the beam would need to move at a velocity of 15 meters per second, while the limit of a typical galvanometer configuration is 11 meters per second. The objective of the project is to design, build, and calibrate a femtosecond laser system that utilizes a polygon scanhead and other optical components to overcome these speed limitations, achieving precise scanning control and greater versatility of beam settings. A polygon scanner replaces one of the galvo mirrors with a rotating polygon whose sides are coated in reflective material. The polygon scanner's maximum angular velocity is 10,000 RPM, which yields a scan speed of at least 180 meters per second. This faster scan speed allows for experimental designs that aren't otherwise possible and achieves a higher quality scan. Existing polygon scan head technology is typically used with larger spot sizes for applications such as laser printing, but has seen limited use in micromachining. Our design is unique, as it utilizes a beam with a small spot size for more precise applications in micromachining, such as laser polishing and thin film removal. This system needs to be high functioning, complete, and repeatable for future marketing and professional use.
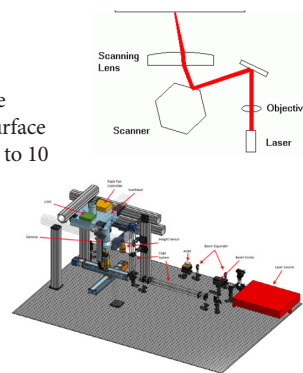
TEAM 76

Will Foschi

ADVISOR

Tom Mealy

SPONSOR

UCONN FSAE Frame Scaffolding Validation

Measure the geometry of the constructed racecar frames from the 2018-2019 and 2019-2020 seasons with in a precise way. Then, assess the accuracy of each frame's construction with respect to the modeled geometry. Finally, analize the validity of the choice to implement the scaffolding across the two seasons.

TEAM 1

Dylan Carzello
Jason Dumont
Daniel Kloyzner

ADVISORS

Matthew Stuber
Thomas Tampone

SPONSOR

Boehringer
Ingelheim

Self-Learning Flow Reactor

It can take many experiments to refine a chemical process when finding the most optimal way to run it. This can make optimization difficult to do by hand in a cost-effective way, especially with the possibility of human error which increases with the number of iterations done with a particular reaction. The goal of this project is to create a system that when given a set of parameters, and a particular measurement to optimize, will use optimization algorithms to adjust a reactor process in real time. This will both remove the element of human error from the process, as well as save time otherwise taken up by continuously stopping the process to adjust different variables before restarting. The project uses Matlab for both the optimization algorithm itself and for the use of a "digital twin" of the system. The digital twin is used to calibrate and test the algorithm to compare with results from using the system in a lab environment. The reactor, when in a physical setting, will give data of the outputs to the ReactIR software. This data is then passed to the algorithm in Matlab, which will then connect to the Labview program to in turn adjust the pumps and heat exchanger of the reactor setup. The changes made will then cause changes in the output data, which will continue to refine and optimize the process. This project will cause increases in lab productivity, while also decreasing costs. In the long term, this can impact the speed of development for life-saving drugs, and can speed the advancement of medical science, as well as development in several other fields of chemistry.

TEAM 2

Jeremy Amoro
Michael Benvenuto
Diego Vilca
Rigel Wachtmann

ADVISORS

John Chandy
Chih-Jen Sung
William Villano

SPONSOR

Collins Aerospace

Compact and Robust Data Logger

Collins Aerospace has requested that the team create a compact and robust data logger that can withstand extreme environmental temperatures for long periods for use in testing aircraft parts in simulated real-life settings. The data offer will sample signals of +/- 15V at a frequency of 1MHz and store them on a removable storage device. The data logger enclosure will be constructed to ensure that it can withstand outside temperatures of -40°C to 85°C in an environmental chamber and act as a Faraday cage to provide electromagnetic shielding for the electronics. This is a joint team with members from the Electrical and Computer Engineering department and the Mechanical Engineering Department.

Our team is a collaboration between Electrical and Computer Engineering Team 13 and Mechanical Engineering Team 15.
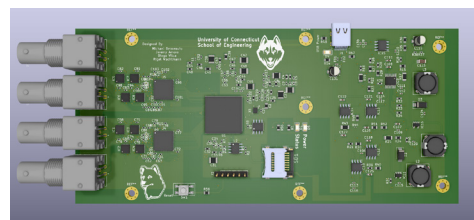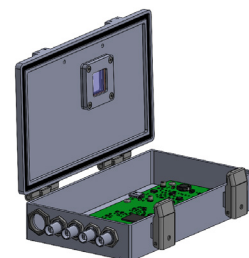
TEAM 3

Aditya Dubey
Daryl D'Souza
Matthew Pluta
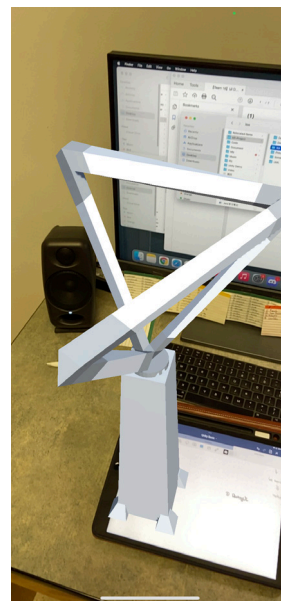Zecheng Wang
Rohit Yerram

ADVISORS

Matthew Ferrier
Jake Scoggin
Amy Thompson

SPONSOR

SONALYSTS

AR Mobile Application for Visualizing Spatially Anchored 3D Models

For this project, Sonalysts would like to have the students design and develop an AR application that interacts with static exhibits. Our project is an augmented reality mobile application that is able to render animated 3D holograms in real-time and geospatially anchor them on physical objects and/or tags in the real world. It is capable of image recognition, object detection, geolocation mapping, marker recognition, and it can support an augmented reality view that contains spatial awareness and AR sessions. In addition to this, our application is able to render animated 3D object models, retrieve and fetch them from a cloud database in real-time, contain a secure user authentication and authorization service, and should have a friendly and interactive user interface.

TEAM 4

Cat Odendahl
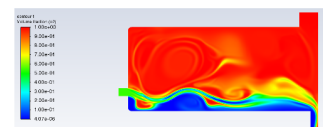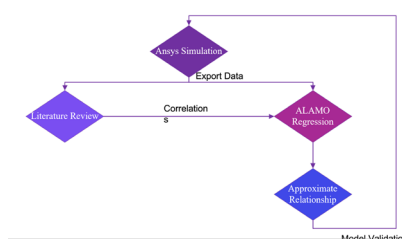Sloane Putnam
Christine Sharabun

ADVISORS

George Bollas
Andy Roemer

SPONSOR

nel

Computational Fluid Dynamics Analysis and Symbolic Regression of a Water-Oxygen Separator in the Hydrogen Production Process

Nel produces hydrogen and innovates its various applications in renewable energy and fuel. Hydrogen is produced via electrolysis which involves splitting water into hydrogen and oxygen. Because this process is not 100 percent efficient, a downstream water-oxygen separator is in place to isolate the unreacted water into a recycle stream back into the electrolyzer. Our project goal is to maximize the efficiency of the separator by manipulating its current design. We used ANSYS Fluent to test different internal and external geometry features to observe their effect on separation efficiency. The team then used ALAMO, a machine learning regression software to obtain a mathematical model of separation efficiency with respect to different geometries, vessel size and other measured variables. Having an efficient separator and an experimentally verified model as a basis for design will allow downstream unit operations to also operate efficiently, minimizing energy and material waste in the process.

TEAM 5

Chelsea Anthony
Julia De Oliveira
Yuzhong Guo
Darrel McDowell
Michael Ruffino

ADVISORS

Joseph Mortimer
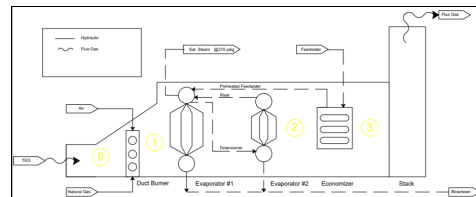Amy Thompson
Bryan Weber
Liang Zhang

SPONSOR

Collins Aerospace

Combined Heat and Power System Assessment and Optimization

The Collins Aerospace Windsor Locks site seeks to improve the energy use, sustainability, operation, and reliability of its Combined Heat and Power system (CHP). The CHP plant generates electricity and steam used for process and space heating. It is a critical asset that reduces operational cost, improves the site's reliability and capacity to operate during outages, increases the energy efficiency of the site, and decreases total greenhouse gas emissions. The primary mover is a combustion gas turbine, and a heat recovery steam generator. The UConn student team will evaluate the system from a thermodynamic perspective to assess the efficiency and performance of the plant. Controls and operation practices will be reviewed and examined for improvement opportunities. Current and emerging technologies will be evaluated for feasibility, cost- effectiveness, and efficacy in reducing energy consumption, GHG emissions, and/or water usage. In brief, the Combined Heat and Power System Assessment and Optimization project will examine existing systems and investigate opportunities to meet the energy and emission goals of the site.

Our team is a collaboration between Electrical and Computer Engineering Team 15 and Mechanical Engineering Team 17 on this project.

TEAM 6

Dalia Clarke
Kenneth Foss
Sam Nguyen
Zachary Stone
Afreen Vahora

ADVISORS

Tianfeng Lu
Joe Mortimer
Liang Zhang

SPONSOR

Collins Aerospace

Onsite Wind Power Generation Assessment

As part of their commitment to reducing greenhouse gas emissions, Collins Aerospace is maximizing their production of renewable energy onsite. In pursuit of this goal, this project proposes a wind farm tailored to their site and specific needs. This proposal has been developed following a full wind resource assessment, and is delivered in the form of mechanical, civil, and electrical design packages.

Our team is a collaboration between Electrical and Computer Engineering Team 16 and Mechanical Engineering Team 14 on this project.
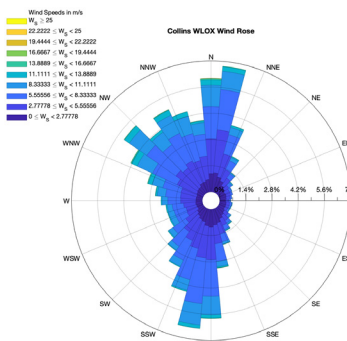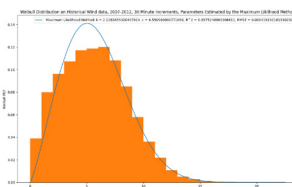
TEAM 7

Emilie Alber
Matthew Chambers
Carlos Lachos
 Olivares
Ethan Langh
Joshua Mirolyuz

ADVISORS

David Giblin
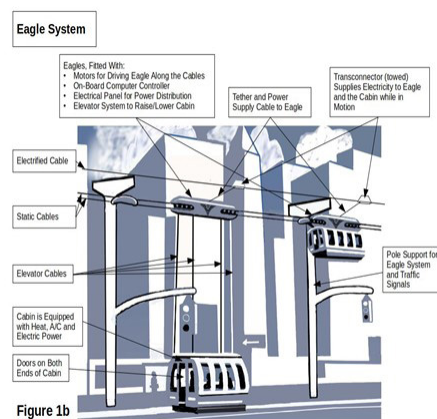Rodger Gibson
Amy Thompson
Susan Zuo

SPONSOR

Airbornway

Eagle Mobile Robotic Character

This project involved a collaboration between the ECE and ME teams in order to help improve the overall design of the Eagle Mobile Robotic Carrier (EMRC) to improve power efficiency, as well as designing a power distribution system for this purpose. For our project, we have research and written design constraints for the system such as the maximum weights, speeds, torque, safety requirements, and other miscellaneous requirements. Furthermore, we have researched which subsystems the system will require, as well as designed some such as the power distribution circuit and the load center, with CAD models in regards to the lifting and elevator systems. We have performed simulations on both the circuitry and CAD models being utilized as well as done calculations regarding mechanical and power requirements and research regarding safety standards to determine technologies that could be used to make the elevator subsystem of the EMRC more efficient. More information on the ECE and ME aspects of the project can be found on the respective ECE and ME Teams webforms (ME team 4 and ECE team 26).

Figure 1b

Our team is a collaboration between Electrical and Computer Engineering Team 26 and Mechanical Engineering Team 4.

TEAM 8

Rachel Greenman
Jimith James

ADVISORS

Jeongho Kim
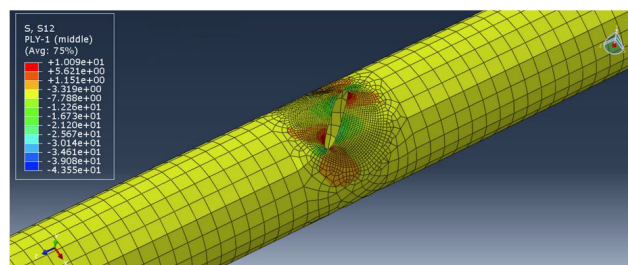Rajiv Naik

SPONSOR

Collins Aerospace

Design of AIrcraft Composite Structures with Service Damages

This project focuses on advanced fiber-reinforced polymer-matrix composite structures, providing significant weight efficiency for aircraft and rotorcraft applications. The goal of this project was to work with Collins Aerospace to enhance the design process for aircraft composite structures assuming risks of random service damages through systematic FEA-based modeling. The team worked with Power and Controls Division of Collins Aerospace to model a representative aircraft tubular structure using FEA to account for the random nature of potential

service damages. Representative service damages in the composite were considered as functions of their random sizes and locations. Design characteristics (geometry of the structure, composite layup) and loading parameters were also considered as variables. ABAQUS-based FEA modeling was performed according to the suggested computational test-matrix to analyze the strength of the structure. Generated results allowed us to understand conditions of the worst-case damage and made recommendations for design optimization under such random service conditions. The results can also be useful for efficient and accelerated certification of Collins composite structures for multiple aircraft and rotorcraft systems.

Representative dimensionless stress distribution in the vicinity of a typical service damage, highlighting the effect of such damages on strength performance.

TEAM 9

Nathaniel Grogan
George Walker
Rahul Raman
Stoney Brooks

ADVISORS

Burcu Beykal
Steven Lathrop

SPONSOR

Pfizer: Transition to Predictive Maintenance

To keep up with rising global demand in the pharmaceutical industry, UConn's Senior Design students paired with Pfizer's Portable Continuous Miniature Modular (PCMM) facility in Groton, CT to analyze and reduce the scheduled manufacturing maintenance, calibration, and care downtime. Using Pfizer's historical preventative maintenance records, the senior design students are able to assess the efficiency of the existing annual and/or semi-annual maintenance schedule for each piece of equipment. To accurately determine how to modify a maintenance schedule, the team analyzed the health and performance of equipment alongside the measured runtime extracted from Pfizer's database, looking for trends between runtime and recorded wear. Equipment with superfluous maintenance received modified maintenance schedules, while equipment that saw significant wear between maintenance either received shorter spells between maintenance checks or a reevaluation of lubricants, belts, seals, or bearings. With the lack of data for some equipment, the results were inconclusive and will be reevaluated when more data is available.

Our team is a collaboration between Chemical and Biomolecular Engineering and Management & Engineering for Manufacturing Team 16.

SENIOR DESIGN CONTACTS

Biomedical Engineering
Ki Chon
Department Head
www.bme.uconn.edu
(860) 486-4767

Chemical and Biomolecular Engineering
Ranjan Srivastava
Department Head
www.cbe.engr.uconn.edu
(860) 486-4019

Civil and Environmental Engineering
Marisa Chrysochoou
Department Head
cee.engr.uconn.edu
(860) 486-2992

Computer Science and Engineering
Sanguthevar Rajasekaran
Department Head
www.cse.uconn.edu
(860) 486-3719

Electrical and Computer Engineering
John Chandy
Department Head
www.ee.uconn.edu
(860) 486-0080

Management and Engineering for Manufacturing
Jiong Tang
Program Co-Director
www.mem.uconn.edu
(860) 486-2221

Materials Science and Engineering
Bryan Huey
Department Head
www.mse.engr.uconn.edu
(860) 486-4620

Mechanical Engineering
Horea Ilies
Department Head
or
Vito Moreno
Professor in Residence
me.engr.uconn.edu
(860) 486-5342

Systems Engineering
George Bollas, Director
george.bollas@uconn.edu
or
Amy Thompson, Associate Director
amy.2.thompson@uconn.edu
(860) 486-8462

For more information:

Charles Maric
Director of Technical Business Development, Senior Design Projects
School of Engineering
University of Connecticut, Storrs, CT 06269-3237

Information Technologies Engineering Building – ITE, BECAT Room A - 03

Mobile: 860.428.2258
Office: 860.486.2297
E-mail: charles.maric@uconn.edu

SPONSORS

1TouchTechnology
Accelerate UConn
AcceleratED Learning LLC
ACMT
ADT Security Services
Aerocyonics Inc. and Department of
    Defense - Defense Microelectronics
Activity
Aerogear
Aerospace Alloys Inc.
Agrivolution LLC
Airbornway
Amodex
Army Research Laboratory
AromaKIT
ASML
AtmosAir
Barnes
Beekley Family Foundation, Connecticut
Breast Health Initiative, Dr. Kuhn
Belimo Americas
Boehringer Ingelheim
Bomar
Budderfly
Burns & McDonnell
Center for Clean Energy Engineering
CGI
CHA Consulting, Inc.
Chapco Inc.
Chapman Manufacturing
Cigna
City of Norwalk
City of Stamford
Collins Aerospace
Connecticut Department of Energy and
    Environmental Protection (CT DEEP)
Connecticut Department of
    Public Health (CT DPH)
Connecticut Department of
    Transportation (CDOT)
Connecticut Transportation Institute
Corrosion Probe Inc.
Connecticut National Guard
Richard Davids
Defibtech
Department of Energy
De-Simone Consulting
Diameter Health
Dive
Dr. Alexandra Hain, Connecticut
    Cooperative Transportation Research
Program (CCTRP) Project 20-02
Dymax
EA Patten
Enflo
Fastcorp and Chapco
Fletcher-Terry Company, LLC

Fuss & O'Neil
GE Power
General Dynamics Electric Boat
GP Musculoskeletal System
    Modeling Lab
Guiding Light Orphans
Heise Industries Inc.
Jeff Holland, Nathaniel Rickles
Hologic, Inc.
HOME Shelter
HomeBody
Hoshino Lab
Jacobs Engineering
Jacobs Vehicle Systems
Kleinfelder
Larsen & Toubro Infotech
Lockheed Martin
Loureiro
Luchs Consulting Engineers, LLC and
    DeCarlo & Doll Architects/Engineers
Medtronic
Mitsubishi Electric Research
    Laboratories (MERL)
Mott Corporation
Movia Robotics
National Aeronautics and Space
    Administration (NASA)
National Center for
    Disability Entrepreneurship at
    The Viscardi Center
National Science Foundation
National Space Grant Foundation
Naval Undersea Warfare Center
Nel Hydrogen
National Institute for Undersea
    Vehicle Technology (NIUVT)
Nordco/Wabtec
Norgren
OuterLimits Offshore Powerboats
PepsiCo Frito-Lay
Pfizer
Pitney Bowes
Pratt & Whitney
Precision Combustion Inc.
PrimeAE Group, Inc
Prysmian Group
R&D Dynamics
RBC Bearings
Robust Product Development LLC
RTRC
Sikorsky Aircraft Corporation
SLR Consulting
Sonalysts
Stanley Access Technologies
Stantec Consulting Services, Inc.
Synchrony
Teradyne

The Fletcher-Terry Company LLC
Tighe & Bond
TOMZ Corporation
Jose Torres and Emanus LLC
Town of Bolton, CT
Town of Hamden, CT
Town of Manchester, CT
Town of Wethersfield, CT
Triax Technologies
Triumph Engine Control Systems
UConn Biomedical Engineering
    Department
UConn Chemical & Biomolecular
    Engineering Department
UConn Computer Science
    & Engineering Department
UConn Computer Science
    & Engineering Department
UConn Health
UConn Electrical & Computer
    Engineering Department
UConn Formula SAE
UConn School of Engineering
UConn School of Engineering
UConn Spring Valley Student Farm
Ulbrich Stainless Steels &
    Specialty Metals
Unilever
University of Connecticut
Vanasse Hangen Brustlin, Inc. (VHB)
Waypoint Spirits
Webquity
Whelen Engineering Company
Whitcraft LLC
Wright-Pierce
WSP
Zygo Corporation

UCONN | SCHOOL OF ENGINEERING

ENGINEERING FOR CONNECTICUT'S FUTURE