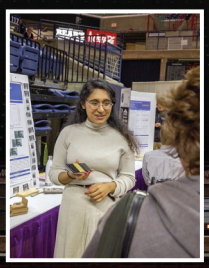
ANNUAL SENIOR DESIGN DEMONSTRATION DAY

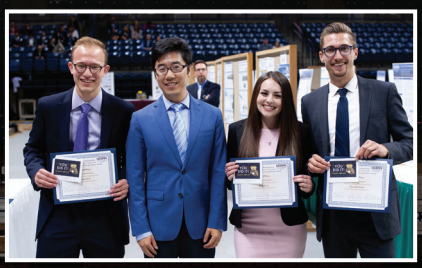
UCONN | SCHOOL OF ENGINEERING

INNOVATION DESIGN INSPIRATION CREATIVITY

HARRY A. GAMPEL PAVILION, STORRS, CT
MAY 1, 2020 12:30PM - 4:30PM

SHARING IDEAS





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:

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Greetings and Welcome to Our Senior Design Demonstration Day!

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.

The Senior Design Project 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.

As you walk among the exhibits displayed here, which are summarized within this booklet, talk to our students. Learn about how they applied the knowledge they have worked so hard to gain. Share in their excitement for the discipline that has dominated their undergraduate career. Their experiences will afford you a deep understanding of the issues they encountered, the creativity and ingenuity they applied to their project, and the exceptional quality of their engineering skills.

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.

Kazem Kazerounian, Dean


NCAA CHAMPIONSHIP
SEC 122
SEC 122

BIOMEDICAL ENGINEERING

TEAM 1

Sree Kolli
Derek Pang
Bryanna Samolyk
Elizabeth Schiesser
Ryan Stack
Hunter Stuart

ADVISOR

Yupeng Chen

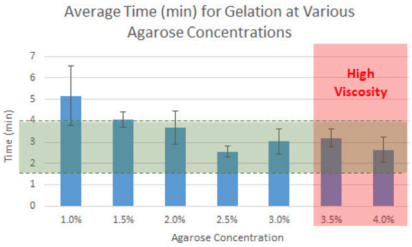
SPONSOR

UCONN
SCHOOL OF ENGINEERING
BIOMEDICAL ENGINEERING

Design of an Injectable Nanomaterial Drug Delivery System for Optimized Tissue Regeneration

3D Design of Femoral Head Type I Growth Plate Fracture

Often times in the case of pediatric growth plate fractures, bone tissue will form within the growth plate, preventing normal growth from occurring. No method currently exists to prevent bone tissue formation, the only current solution being to remove the bony bridge after it has formed. The aim of this project is to develop an ex-vivo, 3D printed bone model that simulates various types of pediatric growth plate fractures and a biocompatible hydrogel that has the capability to seal therapeutic agents into this modeled fracture. The bone model and hydrogel will be utilized in the design of an injection system that can administer the treatment components directly to the injury site. These treatment components, janus-base nanotubes (JBNTs) encapsulating the protein-coding gene MATN3, promote the regeneration of cartilage tissue within the growth plate - preventing bone tissue formation and allowing normal growth to resume upon healing. This injection system offers a minimally invasive alternative for growth plate fracture healing.



BIOMEDICAL ENGINEERING

TEAM 2

Nathan Friday
Vidyalaxmi V. Kandarpa
Morgan McNamara

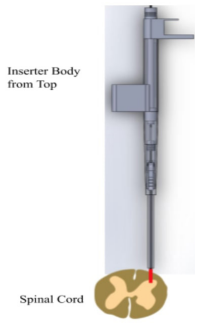
ADVISOR

Martin Han

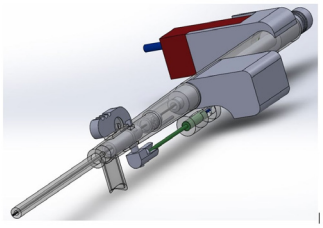
SPONSOR

UConn Neural Prostheses Lab

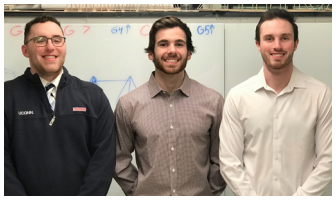
Building 3D-Printed Surgical Inserters to Deliver Microelectrodes to the Spinal Cord for Severe Spinal Cord Injuries



The main goal of this project is to construct an insertion device that will allow us to insert microelectrodes into the gray matter of the spinal cord that are connected to the bladder that patients no longer have control of. Our motivation for the completion of this project is primarily to enhance the daily lives of patients who suffer from spinal cord injuries and chronic pain all located to the lower appendicular of their body systems. The insertion device will utilize sensors which allow the operator to better understand the location of the implantation. This will take place through the use of a force and displacement sensor to measure the speed of the insertion and distance at which the microelectrode is implanted. We plan on utilizing SolidWorks and tissue design to create prototypes of our insertion design as well as a gelatin-agarose model of the spinal cord to test the device. We also used SolidWorks to design and prototype the device in order to test the compatibility with the holding frame, insertion rods, and force and displacement sensors. This prototype will then be used in conjunction with the instrumentation circuitry and the spinal cord model to test its performance and generate data for continuous improvement.



BIOMEDICAL ENGINEERING



TEAM 3

Daniel Barry
Connor McLaughlin
Matthew Tomei

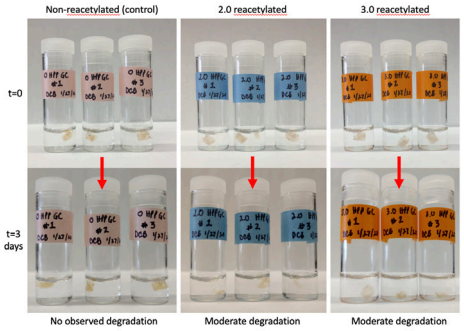
ADVISOR

Lakshmi Nair

SPONSOR

UCONN HEALTH

Chitosan-Based Degradable Hydrogel for Localized Drug Delivery



The goal of this project was to create an HPP-modified reacetylated glycol chitosan-based degradable hydrogel for localized drug delivery. This device allows the administration of drugs/molecules to specific sights in the body at a controlled rate through a degradation-mediated release. The HPP-modified reacetylated glycol chitosan-based hydrogel (HPP-GC) will be loaded with a payload during the cross-linking process, which is achieved using horseradish peroxidase (HRP) and hydrogen peroxide solutions. The HPP-GC is degradable by lysozyme, which is naturally occuring in the body. The degradation of the hydrogel is easily modified by its degree of reacetylation and the concentration of lysozyme coadministered with it. The payload can differ depending on the application at hand. The payload will be primarily released as the hydrogel degrades. The hydrogel will be completely degraded inside the body via lysozyme within a 2 week period. The hydrogel will be biocompatible and should have no adverse effects on the surrounding tissues. Thus far, a hydrogel has been designed that degrades within five days. A formal degradation study will be conducted to adjust this degradation rate. Furthermore, a drug release study will be conducted to observe the release of Curcumin from the hydrogel.

BIOMEDICAL ENGINEERING

TEAM 4

Andrew Lioio
Madison Nadolny
Aya Okada
Cassandra Rossetti

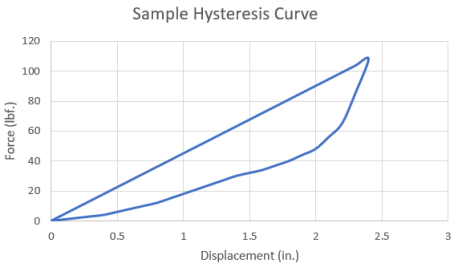
ADVISOR

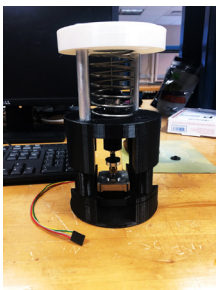
Patrick Kumavor

SPONSOR

defibtech

Mechanical Model of the Human Thorax for Cardiopulmonary Resuscitation Device Testing





The purpose of this project is to create a mechanical model of the human thorax that will allow for benchtop testing of automated resuscitation devices which provide mechanical chest compressions (mCPR). Important properties that affect the motion of the human thorax are the elasticity constant and viscous damping coefficient. Current models used for testing only simulate the elasticity through the use of a linear spring. This new design adds pneumatic dampers in addition to the springs to add the element of nonlinearity. Sensors will also be integrated into the system to collect force and displacement data. This will provide real-time feedback on the chest compressions as well as information for a feedback system that can change the damping coefficient in real-time. The effectiveness of this model will be demonstrated by plotting its force-displacement data using mCPR devices and validating the data against clinical research of the physiological behavior of the human chest.

BIOMEDICAL ENGINEERING

TEAM 5

Haining Li
Yiren Zhou

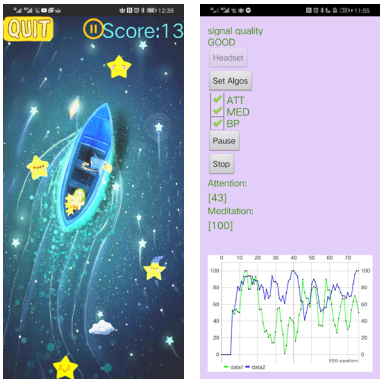
ADVISOR

Sabato Santaniello

SPONSOR

NSEC Lab
Neural Systems Engineering and Control Laboratory

EEG-based Gaming App for Nonepileptic Seizure Prevention



Psychogenic nonepileptic seizures (PNES) are a disease mainly caused by trauma, stress disorders, or depression. The symptoms of PNES are very similar to epileptic seizures, which usually lead to mis- diagnosing and thus result in ineffective treatments. These limitations can be refined by a relaxing EEG- based biofeedback system. This system contains a headset product to acquire and process EEG data in real-time and a new gaming app for Android platforms that positively reinforces the players based on the neural feedback provided by the EEG. The gaming part related to the subject's reaction, and based on their performance, the application would change accordingly and hence, easing their stress.

The design concept of our game is determined after a comprehensive searching on how to relax people. By using an EEG signal detector headset, we are able to obtain brainwaves from PNES patients and transform them into attention and meditation values. These inputs are crucial parameters for our game to be an EEG-based biofeedback system. The game will be changing its diffi- culty according to the user's performance. Therefore, these feedback helps the player reduce their stress by providing ease when he/she is stressed. Constantly playing this game, patients can reduce the occurrence of PNES.

BIOMEDICAL ENGINEERING

TEAM 6

Srinivas Setty
Taylor Wade

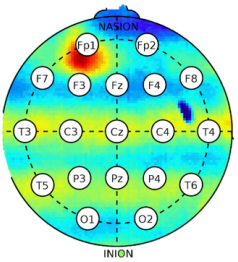
ADVISOR

Sabato Santaniello

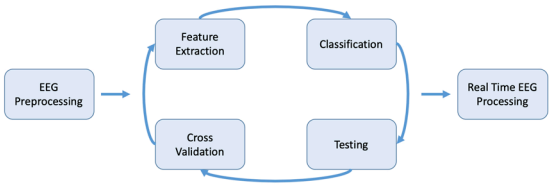
SPONSOR

NSEC Lab
Neural Systems Engineering and Control Laboratory

EEG-based Bedside Decision Support System for Epileptogenic Zone Localization



Being the fourth most common neurological disorder in the United States, Epilepsy is a debilitating disease with widespread impact and dire side effects. By combining an amalgam of harrowing symptoms such as severe bouts of confusion, onset seizure, depression, and anxiety, epilepsy can transform even the simplest of tasks into agony. Therefore, the goal of this project is to provide clinicians with an automated framework for detecting the point of origination of seizures in the brain to assist with the bedside protocols of patients suffering from epilepsy. Using time series EEG data from 50 patients, this project seeks to develop machine learning based classification methods to detect anomalies in electrical activity in the brain, as these anomalies can often function as biomarkers for localized seizure activity. This will be done by using 18 different EEG signals from the 50 patients to develop metrics for anomalous detection through classification. Once the classification algorithms have been thoroughly tested and verified with testing data sets, a physical user interface mapping real time EEG data with the classification algorithms will be developed to function as a bedside decision support system for clinicians to seamlessly detect the origin of seizures.



BIOMEDICAL ENGINEERING

TEAM 7

Renz Patrick Rebeca
Adrienne Schultz

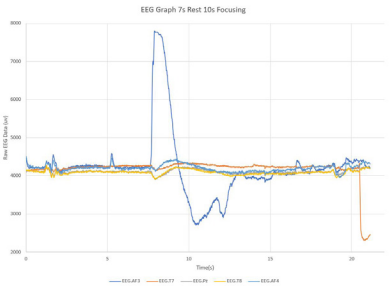
ADVISOR

Sabato Santaniello

SPONSOR

NSEC Lab
Neural Systems Engineering and Control Laboratory

A Brain Computer Interface for Restoring Hand Control in Patients with Stroke



The purpose of this project is to develop a device capable of interpreting brain wave patterns from an electroencephalogram (EEG) in order to control the movements of an exoskeleton attached to the subjects hand. This project is focused on restoring the hand motion of stroke patients, though the system could be applied to a number of other motor disabilities such as paralysis. This device consists of two main parts, the EEG and the exoskeleton hand, which are interfaced using an Arduino. The EEG will provide raw brain wave data into the Arduino which will then be processed into more meaningful information that can be used to distinguish between different hand movements. The motors on the exoskeleton will then respond based on the information received from the Arduino causing the whole exoskeleton to move accordingly.

BIOMEDICAL ENGINEERING

TEAM 8

Dylan Barlow
Emma Sternerup
Andrew Trotta
Erin Williams

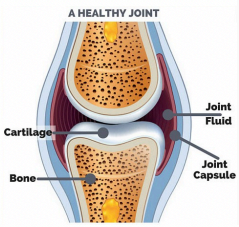
ADVISOR

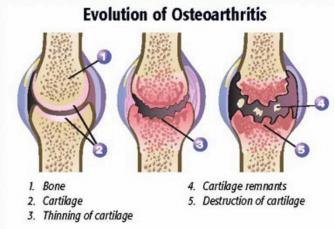
Syam Nukavarapu

SPONSOR

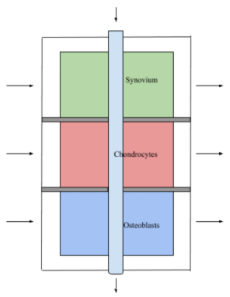
TEST Lab
Tissue Engineering Science & Technology

Modeling the Synovial Joint on a Microchannel Chip





Osteoarthritis is a chronic degenerative disease of articular joints and affects 50-60 million people in the US alone. Currently there are no proven effective treatments or therapies, which is largely attributed to the incongruence between in vitro and in vivo models used during testing. The excessive cost, timeframes, and ethical concerns of current testing processes all point to a need for improved methods, as well as a more accurate model of human in vivo conditions. Organ-on-a-chip devices aim to provide a more convenient and accurate way to replicate human conditions and study disease or pharmaceuticals. Although some organ-on-a-chip devices have been created thus far, a chip that models the synovial joint has yet to be designed. This project's objective is to design and construct a synovial joint on a chip using CAD design and 3D printing. The chip is designed with three microchambers, one for bone, cartilage and synovium, respectively. Each channel has individual fluid flows, as well as cells seeded in hydrogel. We placed a common channel through the center of the chip to model vascularization as a means of introducing pharmaceutical therapies. Due to our focus and emphasis on accurately modeling in vivo conditions, the device created can rapidly increase the development and testing of osteoarthritis drugs and therapies.



BIOMEDICAL ENGINEERING

TEAM 9

Emily Borges
Emily Grandell
Timothy Hurley
Sarah Mascolo
Maxwell Neary
Ian Sands

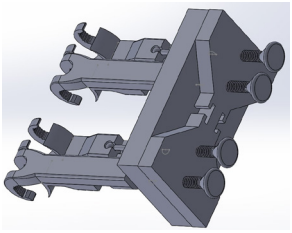
ADVISOR

Sangamesh Kumbar

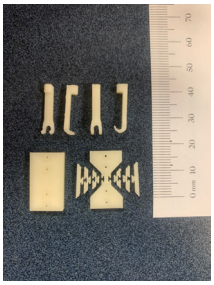
SPONSOR

UCONN HEALTH

Design and Fabrication of an External Bone Fixation Device for Rat Femur Model



Using a critical sized long bone defect in rat models is a very common method of testing the efficacy of bone tissue engineering scaffolds. However, these scaffolds often lack the necessary mechanical properties to support bone regeneration. Therefore, a fixation device must be used to maintain the defect and provide support while the bone heals. Developing an external fixation device for rat femur models will allow for an accurate translation of additional bone healing factors (i.e. scaffolds and composites) onto larger scale models for use in future testing. Due to the average size of rat femurs and the traditional screw fixation method of external devices, bone fracture rates during implantation are a major problem in clinical and research settings. Developing a device to reduce the fracture rate will increase the effectiveness and efficiency of fixation devices and will allow for the study of other factors such as stiffness and load intensity. Using clamps, as opposed to the traditional screw fixation method, can mitigate bone fractures caused by screws. This project will explore the potential of a clamp fixation method in regards to bone fracture reduction while maintaining femur stability.



BIOMEDICAL ENGINEERING

TEAM 10

Wissam Afyouni
Jay Dalal
Tiffany Sarmiento
Venoude Valmyr

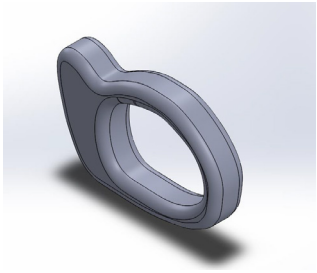
ADVISOR

Patrick Kumavor

SPONSOR

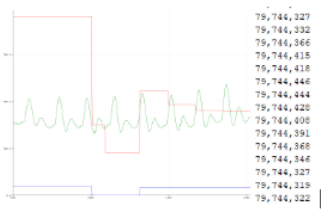
R. Davids

Therawalk: A Therapeutic Walking Assistant



The orthotic device designed, currently named the "Therawalk", is a therapeutic walking assistant. The goal of the project is to create a versatile orthotic device that both aids patients in mobility and provides relief for arthritis. Therawalk incorporates a vibration component to help alleviate the pain caused by arthritis localized within the hands. This will benefit patients who need the aid of a cane, but find the use of one difficult due to the pain in their hands and who, as a result of this pain, struggle with maintaining grip on the cane handle. The cane handle was designed for optimal comfort and ease of use for patients with arthritis, with integrated functionality for the electrical components.

Development of the Therawalk focuses primarily on the integration of electrical components such as the vibration motors and heart rate sensor to a mechanical cane design. Additionally, the cane design will be revisited to enhance aesthetic characteristics, and ensure optimal integration of the electrical components while leaving room for future improvements. The goal of this project is to produce a smart orthotic device that will help the patient's mobility in both clinical and home settings. The Therawalk will have components to deliver vibration therapy, as well as a flashlight and heart rate sensor.



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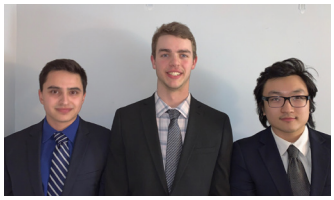


TEAM 11

Matthew Chipdey
Robert Driscoll
Bang Lam

ADVISOR

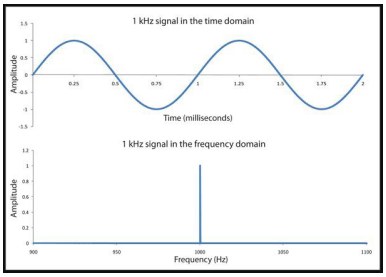
Patrick Kumavor

SPONSOR

UCONN SCHOOL OF ENGINEERING
BIOMEDICAL ENGINEERING

The Design of a White Cane for the Blind With Advanced Sensing Utility Through Audio Feedback

One of the key components of our design is the software which makes it possible. As a proof of concept, we used MatLAB to process audio signals by transforming them into the frequency domain. These signals are processed onboard a laptop, and the main focus of the project is to refine this technology into smaller and more portable parts, with the ultimate goal of creating a system which can be mostly or completely contained inside the handle of the cane. At the time of writing, The Raspberry Pi is a promising candidate for audio processing and this platform is being optimized to take place of a laptop. Another design component is creating a lightweight cane which is properly weighted, with a handle shaped to reduce user fatigue.



BIOMEDICAL ENGINEERING

TEAM 12

Ryan McGlynn
Kimberly Nguyen
Julia Warnken

ADVISORS

Bin Feng
Hugo Posada-Quintero

SPONSOR

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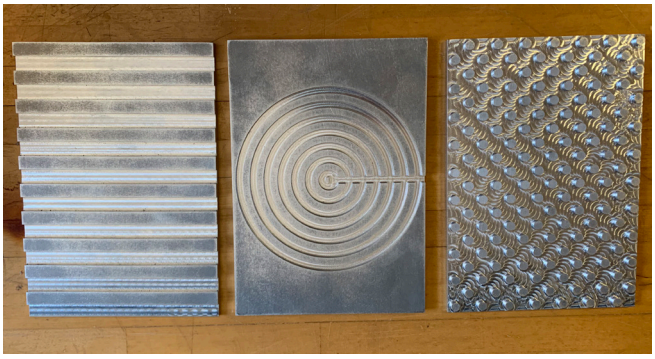
BIOMEDICAL ENGINEERING

Quantitative Pain Testing

This project proposes the idea of redesigning the conventional thermal grills in order to more effectively simulate pain. The conventional design of the thermal grill consists of pipes pumping hot and cold water alternatively for a sensation of pain upon the subject. The new designs consist of spiral shaped metal and circular focus points with the same alternative pattern but different temperature-regulating mechanisms. Heat will be generated through Joule heating while cooling is stimulated through peltier devices. With the use of the thermal grill illusion, pain will be studied in a more ethical method to further the research of pain measurements. The device aims to provide further data recordings for the discovery of a prominent biosensor when interpreting the pain receptors responding to the sensation of pain.



BIOMEDICAL ENGINEERING

TEAM 13

Amanda Astrologo
Chanell Botsis
Norwyn Campbell
Austin Drexler
Charlotte Lao
Helena Newandee

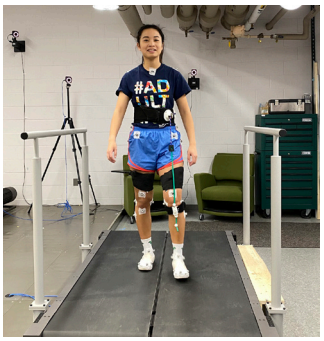
ADVISOR

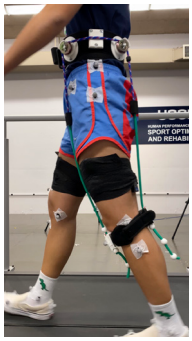
Kristin Morgan

SPONSOR

SPORT OPTIMIZATION AND REHABILITATION

"R" Walk





Though humans have optimized walking to minimize their energy expenditure, it is still energetically expensive, even for healthy individuals. This naturally poses a further challenge for unhealthy individuals, especially when coupled with unstable walking gait. Thus, our goal is to create an unpowered, adaptive, rehabilitative, medical device that assists in strengthening muscles and promoting self-sufficiency during walking. Our device consists of a belt worn above the hips and a strap sitting below the knee of the affected leg. A rope and elastic band system connected between the hip and the knee utilizes a mechanical pulley-lock mechanism. This mechanism allows the device to control the resistance created by the elastic bands which stretch and relax along the leg as a person walks. The elastic bands store and release energy to relieve the strain in leg muscles, particularly in the hamstrings and quadriceps during walking. From rehabilitating athletes with torn ACLs to assisting the elderly with muscle atrophy, we envision our device to be used for a broad spectrum of patients and for a variety of reasons. Our hope is to contribute to a decreased recovery time for the injured and an increased range of mobility for the weak.

BIOMEDICAL ENGINEERING

TEAM 14

Brian Chen
Anthony D'Angio
Helen Phu
Brandon Qiao

ADVISOR

Guoan Zheng

SPONSOR

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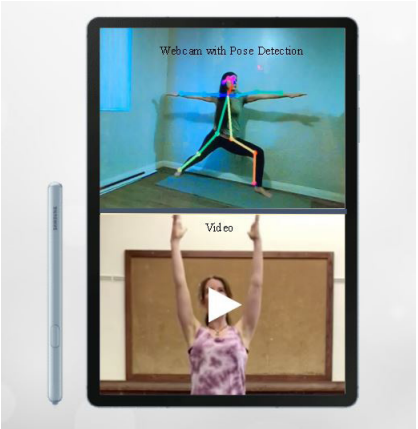
Technology-Assisted Yoga Therapy Program for Individuals with Low Back Pain



Individuals with lower back issues suffer chronic pain which can hinder their ability to perform certain tasks. Physical therapy can be a way to subdue the pain, but it can be expensive and requires additional effort to schedule an appointment and leave the home. Yoga can be done at home, but it requires daily effort from the user to remember to practice and performing a pose incorrectly can lead to worsened back pain. Professional yoga will also require additional traveling and fees. The idea behind our senior design project was to create an Android app that avoided these extra fees, traveling, and appointment making with an easy-to-use, free application that allows for pose detection and app usage tracking. These features enable the user to remember to use the app and the poses will be done correctly. Over long periods of practice and app usage, the yoga will help strengthen the user's back so they can return to their normal life.

BIOMEDICAL ENGINEERING

TEAM 15

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Ryan Newell
Maya Placek
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ADVISOR

Guoan Zheng

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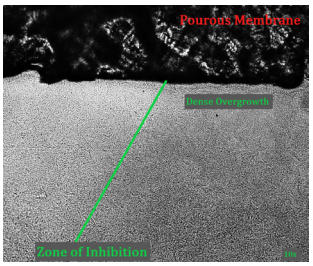
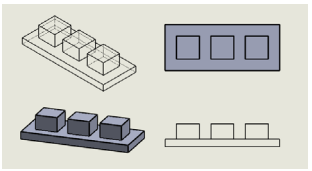
BIOMEDICAL ENGINEERING

Rapid Antibiotic Susceptibility Testing (AST) Platform





The goal of this project is to develop an inexpensive, easy-to-use Antibiotic Susceptibility Testing (AST) platform for rapid antimicrobial susceptibility profiling of pathogens. This project will utilize Escherichia coli K12 as a model organism. Here we propose a device that incorporates the working principle of light microscopy or a speckle-scanning pictographic lensless imaging scheme to visualize (in real-time) the growth of bacterial cells in a microscopic population throughout an antibiotic concentration gradient. This system will utilize a microfluidic platform that consists of three independent wells connected via a porous membrane to establish the gradient over the middle agar growth well. The device may further be optimized by directly imaging a blood sample, effectively bypassing the time it takes to perform traditional culture isolation and propagation for antibiotic susceptibility testing. The time of AST will be decreased to a 1-2 hour process, with observations of growth taken frequently within this timeframe. A zone of inhibition will be determined using the relative growth of individual cells along the span of the antibiotic gradient. The minimum inhibitory concentration may then be calculated using a linear diffusion approximation. These results will help to conclude what antibiotic is the appropriate treatment for a patient to combat antibiotic resistance.

BIOMEDICAL ENGINEERING

TEAM 16

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Jay Patel

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Guoan Zheng

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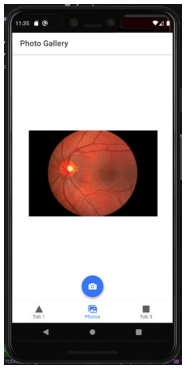
UCONN SCHOOL OF ENGINEERING
BIOMEDICAL ENGINEERING

Device and Mobile App Development for Retinal Image Diagnosis



We are building a deep-learning powered image classification algorithm that is able to predict the likelihood of glaucoma given a human retina image. Our software utilizes the highly optimized Google image classifier named Inception v3, which has been trained to recognize the presence of multiple common items within an image. Using a training paradigm called transfer learning, we have re-trained the Inception classifier to instead recognize the shapes and patterns that are found in cases of retinal glaucoma. Our software will then be deployed to a website that can be accessed via an app on either an iPhone or Android mobile phone. We hope to show the feasibility of such a clinical decision support system, in which physicians are able to use the prediction of an algorithm that can be retrieved quickly and easily to inform their own decision on patient care.

BIOMEDICAL ENGINEERING

TEAM 17

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Krystyna Gielo-Perczak

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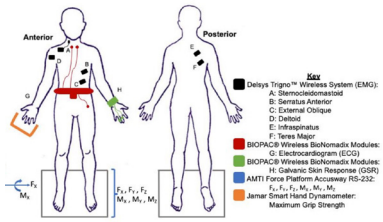
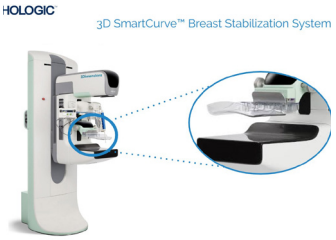
HOLOGIC®
The Science of Sure

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

The objective of this project was to analyze both physiologic and psychological stress experienced by women during a mammogram. This was done in two ways. First, the standard of care, a flat paddle, was used compared to the stress experienced when SmartCurve™ paddle was used in conjunction with the 3Dimensions Mammography system from Hologic Inc. Second, the participant stood in several different positions similar to those used in a mammogram. The following parameters were measured during the study to quantify the stress response: electromyography (EMG), electrocardiogram (ECG), balance control, Galvanic Skin Response (GSR), and grip strength. A questionnaire was also given to the participant to gain insight on their experience.





BIOMEDICAL ENGINEERING

TEAM 18

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UCONN
SCHOOL OF ENGINEERING
BIOMEDICAL ENGINEERING

Validation of a Biofeedback System for Rehabilitation of Shoulder Complex Device

Biofeedback is the process of gaining greater awareness of many physiological functions of one's own body, primarily using electronic or other instruments, with a goal of being able to manipulate the body's systems at will. This mind-body technique features the use of visual or auditory feedback to gain control over involuntary bodily functions. The process involves being connected to a device with sensors that provide feedback about specific aspects of your body. The goal of biofeedback is often to make subtle changes to the body that result in a desired effect. This might include relaxing certain muscles slowing heart rate or respiration, or reducing feelings of pain. By doing this, people are often able to improve their physical, emotional, and mental health. The purpose of our study is to reveal instantaneously to patients and therapists certain physiologic events and to teach the patients to control these otherwise involuntary events by manipulating the displayed signals. Results show that biofeedback is applicable to physical rehabilitation through the determination of an optimal recovery method based on a patient's comfort and muscle activity while performing rehabilitation exercises.

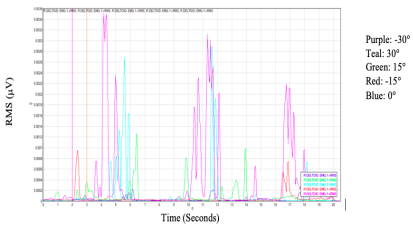

Table 1 *- Mean Value of RMS (μV) at each angular position for all handles*

Angular Position	Handle 1	Handle 2	Handle 3	Handle 4	Handle 5	Handle 6
-30°	1.30	**1.06**	1.29	1.27	1.32	1.29
-15°	2.31	2.05	1.17	1.08	8.84	**1.07**
0°	**1.06**	1.35	1.41	5.11	1.21	1.98
15°	1.17	1.13	4.89	**1.11**	1.29	1.21
30°	**1.19**	1.50	1.29	1.51	1.22	1.21

BIOMEDICAL ENGINEERING

TEAM 19

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Reed Jones
Michael Nicolson

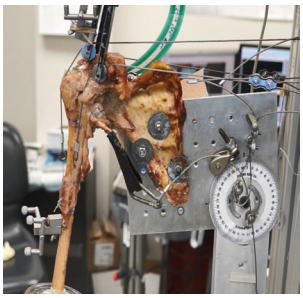
ADVISOR

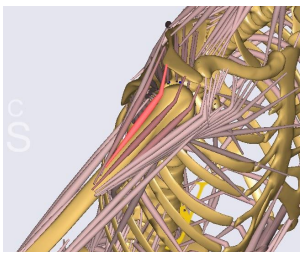
Krystyna Gielo-Perczak

SPONSOR

UCONN HEALTH
The Musculoskeletal Institute

Analyzing Deltoid Stresses of rTSA and Their Effect on Stress Fractures of the Scapula





Reverse Total Shoulder Arthroplasty (rTSA) is becoming a popular surgery to alleviate pain caused by massive rotator cuff damage and shoulder arthritis. However, due to the reversed anatomy, the loads on the muscles within the shoulder are not well known. The Musculoskeletal Institute at UConn Health is currently researching rTSA using a cadaveric shoulder simulator, but the deltoid muscle is not simulated in a way that is accurate to the human anatomy. To shed light on this new anatomy, our team is designing a device that is capable of being installed on the shoulder simulator that will replicate the contraction of the deltoid muscle in the simulator, pulling on both the origin of the deltoid on the acromion, and the insertion of the deltoid on the humerus. AnyBody software is also used to model the forces of the deltoid muscle fibers to ensure correct physical modeling.

BIOMEDICAL ENGINEERING

TEAM 20

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ADVISOR

Krystyna Gielo-Perczak

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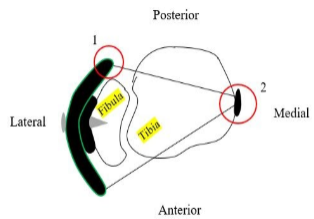
DePuy Synthes
COMPANIES OF Johnson&Johnson

A Fresh Look at High Ankle Sprain Treatment: Surgical Kit for Fibular Fracture



High ankle sprains are a common injury, specifically amongst collegiate athletes participating in contact sports. This includes the partial or complete tearing of ligaments that makeup the distal tibiofibular syndesmosis, resulting in instability. In some cases, the fibula may fracture at the lateral malleolus or in the diaphysis of the fibula, which is the focus of this project. The current market uses screws and plates to attempt to fixate the tibia, fibula, and talus. Our design focuses on the development of a single use, disposable, sterile surgical kit that allows for non-rigid fixation and stabilization of the distal tibiofibular syndesmosis following a high ankle sprain. The kit will allow for an increased ease of use for the physician, an increased average revenue per case, and will allow for rapid adequate surgical training. The biomechanics of the distal tibiofibular syndesmosis will be investigated, as well as the current products to market, to develop a novel design for Depuy Synthes, part of the Johnson and Johnson medical devices company. Approved through the IRB, human subjects, both healthy and injured, will be analyzed while using the force platform from a sitting to standing position. We will also test our designs in the Depuy Synthes cadaver lab.

BIOMEDICAL ENGINEERING

TEAM 21

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Bryan Dettman
Eleni Markopoulos
Sayeda Najamussahar Peerzade

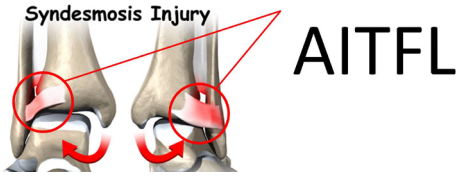
ADVISOR

Krystyna Gielo-Perczak

SPONSOR

DePuy Synthes
MITEK SPORTS MEDICINE
COMPANIES OF Johnson & Johnson

A Fresh Look at High Ankle Sprain Treatment in the Absence of a Fracture



High ankle sprains are a common injury, specifically amongst collegiate athletes participating in high impact sports such as football, wrestling, and hockey. In the event of a high ankle sprain, the anterior inferior tibiofibular ligament, otherwise known as the AITFL, is partially or completely torn, separating the tibia from the fibula, and leaving the athlete with a long and strenuous recovery. Treatment of the injury depends on the severity, specifically related to whether the fibula fractures and the type of tear. The new designs and techniques being developed will aim to effectively address concerns with current treatment options by providing a comprehensive surgical care kit. The use of surgical tools will further aid in stabilization and healing of the ligaments in situations where more noninvasive treatment options prove unsuccessful. From the information gathered through research, modeling, and testing, the best and most optimal design for treating a high ankle sprain injury with a torn AITFL was determined to consist of using Orthocord suture along with a winged screw to fixate the torn ligament into the posterior end of the bone. An injection of PRP from the patient's own blood to the site of injury would help expedite the recovery process and prevent chances of chronic ankle instability and post-operative osteoarthritis.

Property	Forces
Compressive Forces at the Ankle	0 - 5500 N
Muscular Compressive Forces at the Ankle	0 - 4400 N
Shear Forces at the Ankle	-300 N to 100 N
Moment at the Ankle	-60 N•m to 10 N•m

BIOMEDICAL ENGINEERING

TEAM 22

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Mariam Hafez
Dana Hamed
Michael Parnas
Rachel Passaro

ADVISOR

Kazunori Hoshino

SPONSOR

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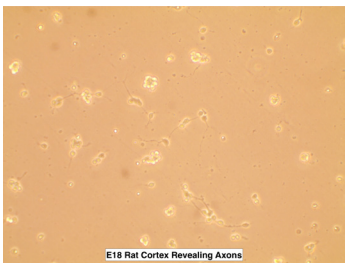
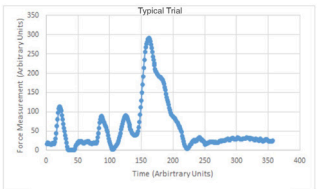
BIOMEDICAL ENGINEERING

In Vitro Model for the Study of Traumatic Brain Injury

The group is using in vitro experimentation related to culturing neurons on collagen-filled silk scaffolds in order to most accurately mimic cortical brain tissue and reduce the use of in vivo traumatic brain injury (TBI) testing. Fabricated scaffolds are housed in the constructed incubator, surrounded by the filtration hood, and cultured for extended periods of time under standard cell culture conditions of 5% CO2 and 37 °C. After the development of sufficient neuronal networks within the scaffolds, the group will perform mechanical trauma experimentation with the force applicator while a high-speed camera records the damage done by the micro-hammer. Displacement along the scaffold can be tracked from multiple video frames. With these results, strain mapping can be completed with correlation to the associated neural network damage.



E18 Rat Cortex Revealing Axons



Force Measurement of Silk Scaffold Impacted by Spring Tensioned to Five Centimeters

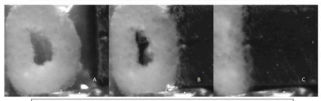


Image of Silk Scaffold Before Impact (A), During Impact (B), and Post-Impact (C).

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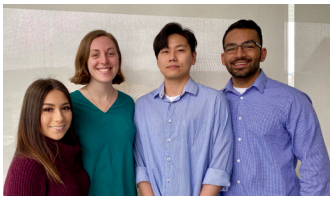

TEAM 23

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Karen Martinez

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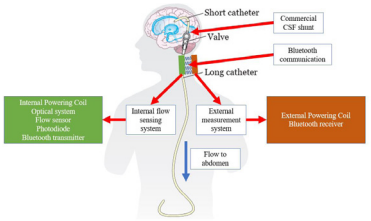
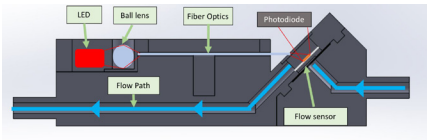
SPONSOR

UCONN SCHOOL OF ENGINEERING
BIOMEDICAL ENGINEERING

Novel Inductively Powered Smart Shunt Sensor for Hydrocephalus





Hydrocephalus is a condition that affects all populations and results in the buildup of cerebrospinal fluid in the ventricles of the brain. Cerebrospinal fluid (CSF) is fluid produced by the brain through the choroid plexuses that is responsible for protecting the brain and spinal cord, supplying nutrients to nervous system tissue and removing waste products from cerebral metabolism. An excess of CSF in the brain can result in increased intracranial pressure and potentially lead to debilitating symptoms or even death if untreated.

The current standard of treatment for hydrocephalus is to surgically insert a shunt to drain fluid from the ventricles to the abdomen. Approximately 65,000 shunts are implanted each year, and while they are intended to be lifelong implants, they have a 40% malfunction rate within the first two years and a 98% malfunction rate at 10 years, indicating serious problems with current shunt designs. Thus, it is of high interest to develop a shunt sensor capable of monitoring the flow-rate of CSF fluid.

In this project, a novel smart shunt sensor that relies on a PDMS check valve and an optical detection system was successfully fabricated to monitor CSF flow rate. A linear relationship between light intensity and flow rate was found when artificial CSF was pumped through the microfluidic sensor using a syringe pump, proving device capabilities.

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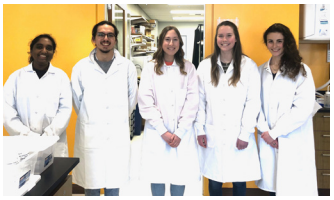

TEAM 24

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Kazunori Hoshino

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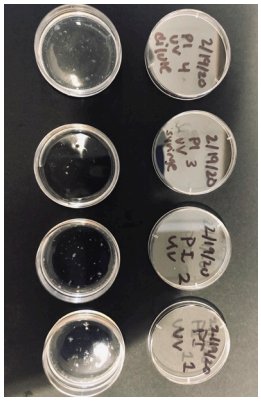
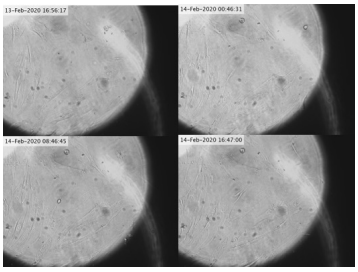
UCONN SCHOOL OF ENGINEERING
BIOMEDICAL ENGINEERING

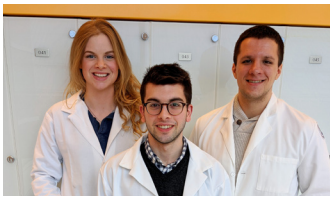
3D Printed Porous Titanium for Smart Implant



Due to the increasing elderly population and number of complicated bone related diseases, engineers have been investigating the uses of interactive titanium implants in biomedical applications. Current research is still in the process of creating a bioactive and successfully osseointegrated femur implant that is safe to be surgically placed in patients. This report presents possible structures, methods, treatments, and materials that can be implemented to ultimately create a porous, titanium smart implant with microchannels. The implant constructed will have a titanium body with appropriate stiffness, tensile strength, and compressive strength that can be handled in vivo. In addition to this core structure, this implant will also contain a hydrogel scaffold to initiate cell growth and interaction using cell culture and animal cell lines. The hydrogel procedure has been developed and tested, fibroblast cells are being cultured for testing (for future osteoblast use), and these components will combine to form the matrix within the titanium scaffold.



BIOMEDICAL ENGINEERING



TEAM 25

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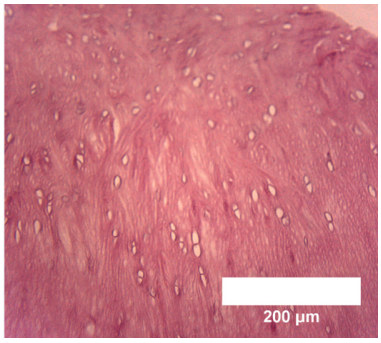
ADVISOR

Syam Nukavarapu

SPONSOR

TEST Lab
Tissue Engineering Science & Technology

Automation of Cartilage Tissue Decellularization



Decellularization is the process of removing the cells from a tissue, leaving only the extracellular components behind. Biological scaffolds composed of extracellular matrix (ECM) are highly useful for regenerative medicine. Decellularized ECM scaffolds have been shown to induce cell mitogenesis and chemotaxis as well as direct cell differentiation, in ways that non-native scaffolds cannot.

The goal of this design experiment was to develop a device that automates a cartilage decellularization protocol. This device enables a researcher to program the desired protocol details, walk away, and return to decellularized tissue. An automated decellularization device presents great promise for tissue engineering research and development, as it streamlines a formerly tedious and potentially inconsistent protocol.

The prototype design concept that is proposed consists of seven identical carboys, each connected to a respective solenoid valve with binary fluid control. The bioreactor chamber housing the cartilage will be similar to the carboys; however, it will be equipped with an ultrasonic sensor to monitor fluid levels. The automation of the decellularization protocol will result in a more standardized final tissue scaffold. Moreover, our device will enable the researcher to modify the decellularization protocol much more easily, enabling experimental benefits.

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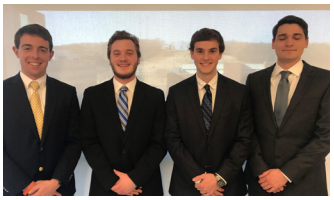

TEAM 26

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ADVISORS

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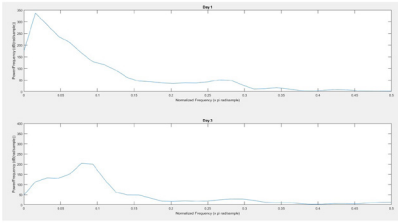
NSMRL

Prediction of Recovery After Exercise

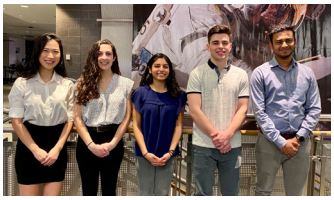


Although physical activity is a prominent factor in most people's daily life, there is little research based on recovery time. The purpose of this study, therefore, was to determine a biometric related to muscle recovery (percent recovered) based on controllable factors. In order to simplify the data, only the biceps were chosen for muscle analysis. The biceps curl was the chosen exercise because it is a simple movement which is easy to perform and monitor. The study was formulated so that an even number of males and females were placed into three test groups. Each group performed the bicep curls on 3 days, the difference between groups being the number of rest days between exercise. Group A had no rest days, group B had one rest day, and group C had 2 rest days. Two forms of data were collected: ECG (electrocardiogram) and EMG (electromyography). ECG sensors were vital in determining participant's heart rates during resting periods and during exercise, crucial to analyzing heart rate variability. EMG sensors, placed on the participant's bicep, allowed further analysis of muscle fiber recruitment and intensity over the testing period. The results should show a trend where the subjects with longer time between exercise will have a more active parasympathetic nervous system than those with shorter rest times.

01-B	Sympathetic / Parasympathetic Ratio	Parasympathetic Value
Day 1	1.567	7.8327
Day 2	1.7523	7.2356
Day 3	1.7992	6.7414

01-A	Sympathetic / Parasympathetic Ratio	Parasympathetic Value
Day 1	1.2356	8.2364
Day 2	1.8695	7.0568
Day 3	2.8659	5.2086

BIOMEDICAL ENGINEERING



TEAM 27

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Muhammed Islam
Avani Khatri
Kaitlynn Leary
Shunyi Li

ADVISOR

Bin Feng

SPONSOR

Medtronic
Further, Together

Local Tissue Perfusion Detection Method

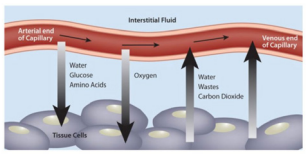

Figure 1. *Visual representation of the flow of nutrients and waste products in and out of local cells through the capillary system.*

Minimally invasive surgery is a highly advantageous, up and coming field of surgery that limits the number and size of incisions made on the patient, and has proven to be much safer than open surgery. It has been found that adequate local tissue perfusion at the tissue incision site contributes to the success rate of surgical procedures. Being able to identify and quantify local tissue perfusion prior to making an incision would help surgeons operate on the healthiest tissue that is most likely to successfully heal. The goals of this project were to explore various methods of tissue perfusion detection and complete a proof of concept study demonstrating the application of UV-VIS fiber optic spectrometry utilizing two wavelength ranges (ultra-violet and visible) for local tissue perfusion. A visual representation of local perfusion is shown in Figure 1. The graph shown in Figure 2. is a graph of the unique absorbance peaks of hemoglobin over the utra-violet to visible light wavelength range.

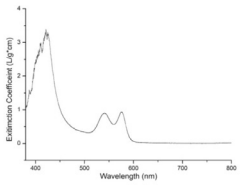

Figure 2. This image is Figure 3. from Liu, P. et all, 2012. Specific absorption spectra of hemoglobin at different PO2 levels: potential noninvasive method to detect PO2 in tissues. Journal of Biomedical Optics 17(12), DOI: 10.1117/1.JBO.17.12.125002

BIOMEDICAL ENGINEERING

TEAM 28

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Martin Han

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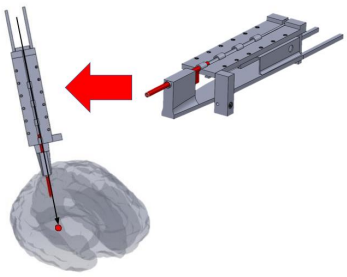
UConn Neural Prostheses Lab

Building a 3D-Printed Surgical Inserter to Deliver Microelectrodes to the Deep Brain for Symptoms of Parkinson's Disease



Parkinson's disease (PD) is a progressive neurodegenerative disorder that is most easily identified by its impairment of basic motor functions. The highly targeted method of deep brain stimulation (DBS) is an FDA-approved method of treatment for Parkinson's disease that targets the deep brain's subthalamic nucleus (STN). DBS delivers electrical stimulation that overrides abnormal electrical signals to decrease the severity of symptoms. This project seeks to make improvements upon 3D printed surgical inserters, used to guide the DBS microelectrodes, to further the accuracy of microelectrode insertions and minimize damage to brain tissue during surgery. Specifically, the improved device will be automated and able to provide real-time data to the user during surgery. The device will need to be highly accurate in order to ensure the microelectrodes reach the STN. The device will be tested on a highly representative brain model using agar to represent the STN and gelatin as the brain tissue. The consistency of gelatin is very similar to brain tissue, provides minimal pathway damage, and is clear, allowing the user to see the insertion as it is occurring. There is both a noticeable difference in consistency between agar and gelatin, as well as an abundance of excess agar that clings to the lead upon removal, allowing the user to easily identify if the STN has been reached.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 1

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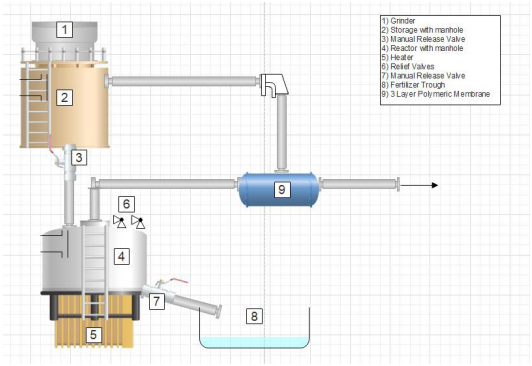
CHEMICAL & BIOMOLECULAR ENGINEERING

Anaerobic Digestion of Food Waste



In the current food waste crisis, 40% of the food produced is thrown away and disposed of in landfills, which release methane and carbon dioxide into the atmosphere. The goal of this project was to design a bioreactor that converts food waste to energy in the form of methane, which is found in biogas along with carbon dioxide. Our design consists of a storage vessel for the food waste, an anaerobic digester that produces biogas and fertilizer from food waste, and a membrane for biogas separation into methane and carbon dioxide. We designed a process that produces enough energy to sustain itself while also providing small buildings with an alternate energy source. We used simulated computer modeling and hand calculations to measure the bioreactor's methane yield and energy requirements. The release of carbon dioxide into the atmosphere is the main environmental concern of this project. Safety concerns include pipe leakage and grinder injuries, which can be addressed with a safety protocol and preventive maintenance of the system. The outcome of this project proves that bioreactors can become our primary method of treating food waste because they provide an efficient and economical method of obtaining energy whilst reducing our carbon footprint in the environment.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 2

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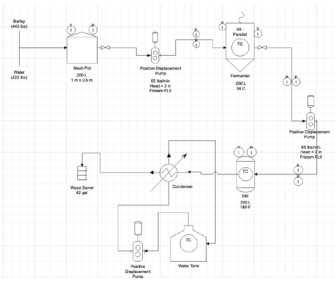
ADVISOR

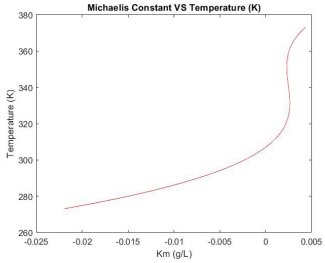
Douglas Cooper

SPONSOR

UCONN SCHOOL OF ENGINEERING
CHEMICAL & BIOMOLECULAR ENGINEERING

Design of a Whiskey Distillation Process





Micro-breweries and distilleries have become one of the fastest growing business trends of the past decade. The goal of this project is to use our knowledge of chemical engineering principles, mainly fermentation and distillation, to develop a micro-distillery process around whiskey production. The idea behind this design is to create a destination for whiskey consumers to come to our facility and enjoy high quality drinks, as well as take home their favorite bottle of whiskey. We have designed our fermentation and distillation process to use barley, which is of our own supply and grown on an on-site farm, along with water, to produce 120 proof whiskey. The fermentation process takes a total of five days. Because of this, we have designed five fermenters in parallel, so the process can be run non-stop. As far as safety is concerned, each unit operation has the proper sensors and controllers. When it comes to hazards, since methanol is produced, it will be burned to create carbon dioxide and water. An in-depth economic analysis has also been done to find out how long it would take to turn a profit, as well as have a positive return of investment. Hypothetically, if this design were to be implemented in a real-life business the way we have constructed it, our distillery will stimulate the local economy by providing jobs and drawing new customers into the area.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 3

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Jack Manson
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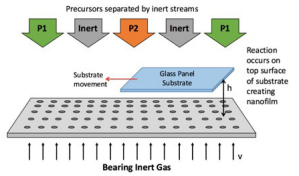
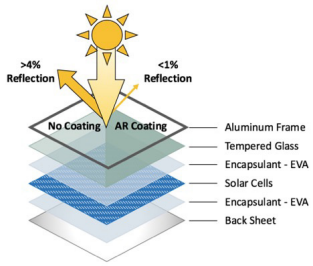
UCONN SCHOOL OF ENGINEERING
CHEMICAL & BIOMOLECULAR ENGINEERING

Spatial Atomic Layer Deposition for Advanced Solar Energy Coatings





Advanced coatings are enabling a variety of new products, many with applications in energy savings. Spatial atomic layer deposition (SALD) is a promising reactor type for efficiently depositing these coatings on large substrates.

This project considers anti-reflective coatings for decreasing reflection based energy loss of solar panels by over 75% and determines the scalability of a SALD process by fluid mechanic and thermodynamic analysis. The goal is to make a recommendation on whether this is a profitable method based on practicality, safety, ethics and economic evaluation.

Additionally, there is a need for a senior lab that enables students to get a thorough understanding of fluid mechanics and its applications. The other main goal of this project is to develop a lab in which students derive the same fluidic models used for the above scale-up portion of this project, and quantify the cogency of such models. This facet of our project fulfills the need for a senior lab and allows for the validation of the model equations that are applied to the scale up analysis described above.

The project impacts include the enhancement of the CHEG department through the addition of a new lab experiment, as well as an advancement in the field of eco-friendly nanofilms, currently held back by inefficient and expensive deposition techniques.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 4

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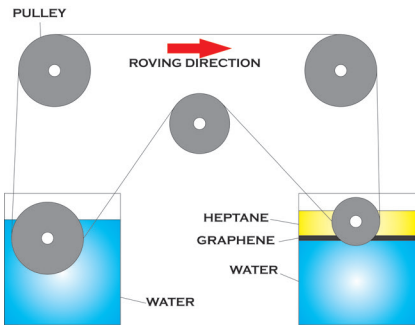
ADVISOR

Richard Parnas

SPONSOR

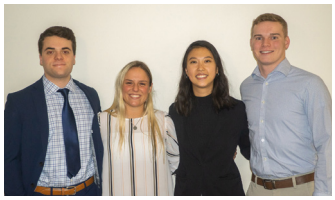
UCONN SCHOOL OF ENGINEERING
CHEMICAL & BIOMOLECULAR ENGINEERING

Large Scale Production of Graphene



Graphene refers to the single layers of carbon atoms arranged in a hexagonal lattice that are the building blocks of graphite. There is a substantial demand for pristine graphene across industries that deal in electronics, coatings, medicine, and energy storage. The motivation of this project is to develop a process to produce graphene on a commercial scale at a significantly cheaper cost than current methods. Our approach involves introducing graphite to a two-phase mixture of heptane and water, causing it to spontaneously exfoliate into graphene and coat the liquid-liquid interface. Graphene will be transferred from the interface using a glass roving on a reel to reel system and then deposited into a water collection container. The effectiveness of the system will be measured by determining the amount of graphene in the collection container which will be compared to calculated theoretical mass transfer and thermodynamic values. Using this information, the process can be upscaled to a commercial level based on demand for graphene. The only safety concern with our process is the use of heptane; proper operating conditions and personal protective equipment will be put into use for its handling. Our solution for producing pristine graphene will allow for significant technological breakthroughs in areas where graphene's properties can be employed. The cost effectiveness of our system will also lead to high profits for graphene producers.

CHEMICAL AND BIOMOLECULAR ENGINEERING



TEAM 5

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Annie Gao
William Rooney
Taylor Welsh

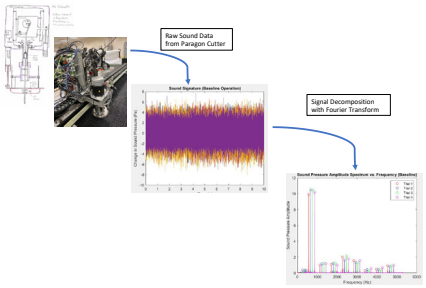
ADVISOR

George Bollas

SPONSOR

GERBER TECHNOLOGY

Fault Detection and Diagnostics through Signal Processing



Gerber Technology (Tolland, CT) is a leader in automated materials cutting for the apparel, graphics, furniture, and aerospace industries. The goal of this project was to streamline fault diagnosis in these automated machines by using signal processing techniques. The sound signatures of an automated cutting machine at various faulty operating conditions were modeled and compared to faultless operating conditions of the machine.

The Fourier Transform was applied to the system to translate the collected sound data to its constituent frequencies. Principal Component Analysis (PCA) was then implemented to reduce the data size and identify signal intensities and peak frequencies that were specific to each operating condition. The classification function of k-nearest neighbors (KNN) was then trained with the data that was analyzed through PCA. After the algorithm was properly trained, KNN was able to compare unknown sound signatures to the known data, labeled as either baseline (faultless-operation), loose knife, no knife, or no belt (faulty-operating conditions) to identify the operating condition they are correlated to. Implementing this fault-feature extraction system into the machines allowed faulty-operation to be resolved more efficiently than guess-and-check resolutions; resulting in safer-repair of the machine, as well as time and money saved by the company.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 6

Christina Cokely
Andrew Coville
Daniel Fernandes
Jillian Murray

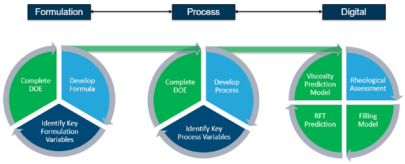
ADVISOR

Anson Ma

SPONSOR

Unilever

End-to-End Model Integration for the Development of a Standardized Design Method



Over the past few years, Unilever has developed multiple digital models and tools to help streamline product and process design; however, the company currently lacks a standardized method that utilizes these tools. The goal of our project was to implement the various digital models and tools to create an end-to-end procedure for product and process design, using Dove Body Wash as a case study. Throughout the fall semester, our team formulated 21 lab-scale batches as part of a design of experiment to identify which ingredients most impacted the final viscosity and pH of the body wash. The data was then processed using statistical software to simulate 5,000 factory-scale batches and subsequently predict the main ingredient drivers. This prediction then served as the basis for the experimental work we carried out in the pilot plant during the second semester. A consolidated design of experiment at the bounds and center of the formulation space was conducted to assess any potential impacts the process had on the product. Then, due to structured data capture, models predicting quality and run conditions at the factory were created with speed and agility. The development of a successful method to facilitate digitally enabled product development will streamline screening of formulations, reduce project timelines and limit over expenditure of time, money, and manpower all while creating a more sustainable business. Implementation of this standardized method will advance Unilever's ability to consistently deliver high-quality products to the 2 billion consumers who use their products every day.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 7

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Caitlyn Cushman
Henry Mackin
Autumn Wagner

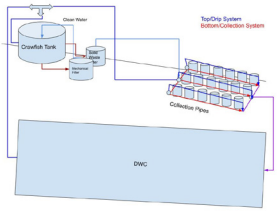
ADVISOR

Kristina Wagstrom

SPONSOR

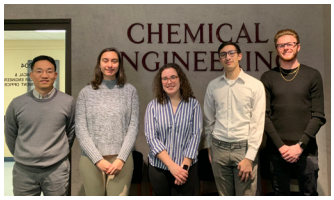
SPRING VALLEY

Designing a Crustacean-Based Aquaponics System at Spring Valley Student Farm



Aquaponics, the combination of raising aquatic animals and growing plants in water, has become increasingly popular and could be used to replace traditional farming. The goal of our project is to design and build a self sustainable aquaponics system for the Spring Valley Student Farm, a part of UConn Dining Services, to provide safe, healthy, and organic vegetables for the UConn community. Using our core chemical engineering knowledge of heat and mass transfer, fluid dynamics, and unit operations, along with complex modeling by MATLAB, COMSOL, and Aspen Plus, that we were able to design an aquaponics system that is able to run in both a coupled and decoupled configuration. It is also through the understanding of biological cycles and bioreactor kinetics, we are able to form differential models of the nitrogenous compounds in the system to ensure that the crawfish within the system are able to support the plants, and the plants the crawfish. Aquaponics has the opportunity to become a leader in the new agricultural era. The continued research and development of such systems like this could help to provide millions of people with the means to sustain themselves with minimal effort, knowledge, and resources. Amid a food and resource crisis in thousands of areas worldwide, it is important that we continue to develop sustainable systems to provide for the always-growing population.

CHEMICAL AND BIOMOLECULAR ENGINEERING



TEAM 8

Ashley Coon
Eben Prostak
Francesca Rudi
Spencer Vogel

ADVISOR

Yongku Cho

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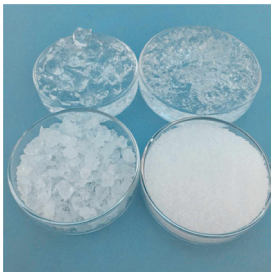
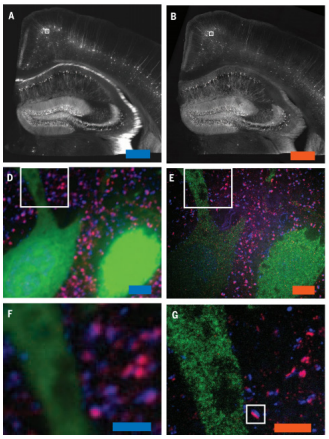
CHEMICAL & BIOMOLECULAR ENGINEERING

Polymer Swelling in Expansion Microscopy





Expansion microscopy is an up-and-coming technology performed using a superabsorbent polymer to expand the contents of desired biological samples for view under a microscope. The project goal was to achieve a fourfold volumetric expansion of a polymer in 15 minutes, while having a quantitative way to measure the uniformity in 3D space. Initially, an experiment was designed to create the polymer matrix and crosslink the polymer to E. coli samples. Iterations of tests were run using two polymer types and two solvent types to determine how the swelling rate is affected. Isotropic expansion was tested by measuring the dimensions of the sample on a grid before and after water was added to the sample. The Flory-Rehner theory was used to model the kinetics of the polymer swelling in response to the addition of water to the cross-linked system. One obstacle faced throughout the project was fulfilling the desire for an environmentally conscious polymer alternative. Sodium polyacrylate, used in some polymer expansion applications, is harmful to aquatic environments and potentially carcinogenic to humans. To accommodate this potential harm, we researched and tested a more environmentally friendly polymer and compared its swelling abilities to sodium polyacrylate. This project provided opportunities to learn more about expansion microscopy and other applications for expanding polymers.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 9

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Patrick Mularzuk
Christiana Nisco

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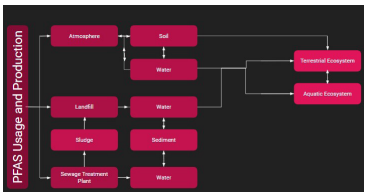
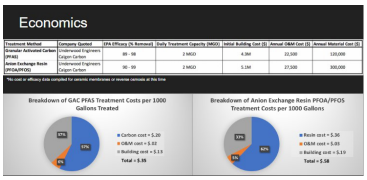
CHEMICAL & BIOMOLECULAR ENGINEERING

PFAS Removal

Perfluorinated compounds (PFCs) are a class of thousands of chemicals that are used in anything from firefighting foams to non-stick materials. These resilient compounds seep into the water supply and accumulate in human tissues. PFCs have been linked to non-quantified health effects. Most conventional processes do not adequately remove PFCs from wastewater. The goal of this project is to remove, concentrate, and destroy PFCs (like PFAS and PFOA) from wastewater. The acceptable level of removal was determined based on EPA regulations suggested in the PFAS Action Act of 2019. We chose to use a combination of Granular Activated Carbon (GAC) and Reverse Osmosis (RO) treatments to remove PFAS. We analyzed the energy consumption of filtering wastewater over time and volume (kW-hr/m 3), productivity of the process (m 3 /day), and cost of the system, both economic ($/ m 3) and environmental (carbon footprint*). Through this project, we hope to remediate the contamination of PFAS in the environment and prevent negative health impacts that come with human consumption.





CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 10

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Caleb Nuhn
Saumya Singh
Sydney Wimberley

ADVISOR

Brian Willis

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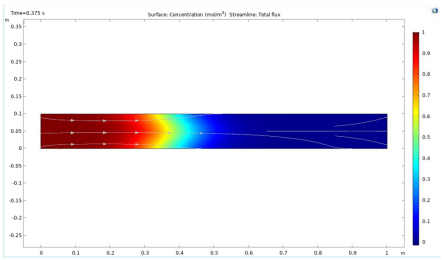
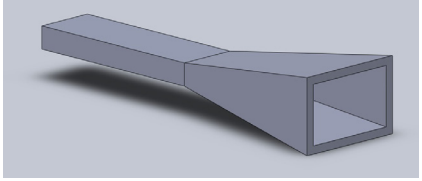
CHEMICAL & BIOMOLECULAR ENGINEERING

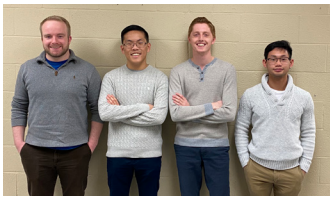
Designing a Portable E-Nose

Chemical vapor sensors are useful in various fields from environmental monitoring to security, but they are limited by their ability to detect a narrow selection of chemicals. New vapor sensors, known as electronic noses or "E-noses", were developed to overcome this issue. Inspired by the structure of a mammalian nose, they use an array of nonspecific sensors to detect volatile substances. The goal of this project is to design a sampling system for a portable E-nose sensor. The key components of the design include using a computer aided modeling software to understand the fluid flow over the sensor chip needed to generate a differentiable signal and 3D printing to produce a feasible prototype. Specifically, a 3D printed nozzle based on a practical computer aided model will be designed to house the sensor and be shaped to provide optimal fluid flow conditions for scent detection. Ideally, a portable E-nose will be able to be carried to locations such as a factory, farm or grocery store to provide quality assurance or validate the authenticity of products. Overall, this product has a low environmental impact as the chips are still good after multiple uses and presents minimal safety hazards at a low production cost. This project will be the first step in making an inexpensive and portable E-nose which will have far-reaching applications in real time chemical vapor analysis.





CHEMICAL AND BIOMOLECULAR ENGINEERING



TEAM 11

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Kyle R. Lacson
Sam Wieczorek

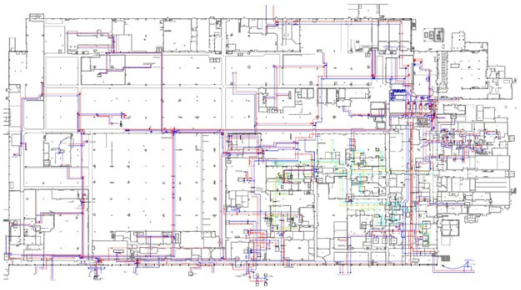
ADVISOR

George Bollas

SPONSOR

Collins Aerospace

Chilled Water System Modeling, Optimization, and Design



Collins Aerospace is a leading aerospace company with business interests in commercial aviation, space exploration, and defense. Various operational processes use chilled water throughout their Windsor Locks facility for cooling purposes; this is one of their most expensive utilities. Due to system age and augmentations, performance has become about 60% less efficient compared to that of the industry standard. The project goal was to recommend design changes to increase system efficiency, equipment lifespan, and ultimately reduce cost of operation. A hydraulic map of the chilled water system was first modeled within AutoCAD. This map was then used to create a hydraulic model within PipeFLO Professional. This model includes the operating characteristics of each component that influences flow within the system; this was a valuable asset when determining operational inefficiencies present within the current chilled water system. Within PipeFLO, varied parameters such as air handler speed, pump speed, type of coolant, etc. were adjusted to simulate varying operating conditions. Several cost saving improvements were recommended to Collins Aerospace from these simulation results.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 12

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Matthew Lewicki
Dominique Schiraldi

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Douglas Cooper

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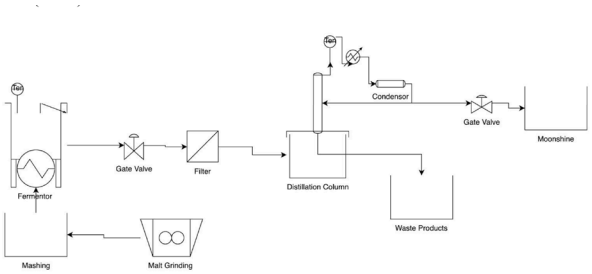
Designing a Moonshine Production Facility



Planning a successful business can be a challenge, however the craft spirit market has great potential to be profitable. Moonshine is a novel product that is easy to produce and makes a great choice for a starting distillery. The goal of this project is to optimize the engineering behind a craft moonshine distillery, while considering marketing, business, and alcohol production. We aim to make 10,000 gallons of 80 proof moonshine per year with a positive return on investment in ten years. Operations required to produce moonshine include: fermentation, distillation, and quality control. We can manipulate grain proportions, yeast, enzymes, and amendments to achieve our desired flavor as well as model this process' kinetics. Batch distillation, using a pot still and small distillation column, will ensure desired alcohol content while removing harmful chemicals, such as methanol. We modeled these processes by applying theory of reaction kinetics, non-steady-state distillation, and computer simulation. The product quality can be measured using factors such as alcohol content, flavor, color, and odor. A successful solution to this problem will be evaluated by estimated profit, return on investment, and efficiency of operations. Entering the craft moonshine market will allow us to fill a niche in the liquor industry while providing a premium product to customers and stakeholders.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 13

Patrick Adamczyk
Daniel Fisher
Cole French
Imran Husain

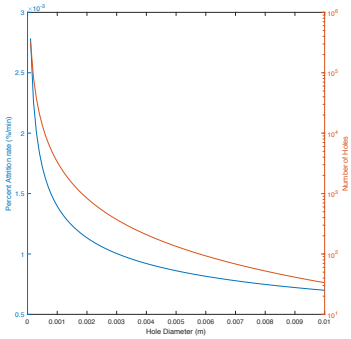
ADVISOR

George Bollas

SPONSOR

CABOT

Distributor Plate Design for Carbon Black Fluidization Reactor



Various complex processes within the chemical engineering world such as solids separation, fluid catalytic cracking, and reactions are accomplished through the use of fluidized beds. Fluidized beds can have a substantial impact as they replace less efficient processes such as liquid-solid mixers with associated dryers. However, a main detriment of fluidized bed reactors is particle attrition, the unintentional breakdown of particles reduced to unuseable fines through collisions with each other and the reactor walls. The goal of our project is to minimize attrition in a fluidized bed reactor by finding the optimal design for a grid plate. Grid plates help ensure even gas distribution to reduce attrition. The attrition rate will be theoretically calculated with an engineering simulation software for modeling, Ansys, in conjunction with a multi-paradigm numerical computing environment and programming language, Matlab. The theoretical attrition rates will be calculated for various grid plate designs such as bubble caps and perforated plates, with and without shrouds. Results will then be compared with experimental data obtained from a 3D printed grid plate once an optimal design is determined. The impact of an optimized grid has the potential to decrease the attrited of carbon black, increasing efficiency of the reaction involved. This will increase profitability and reduce potential negative health effects of the process.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 14

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Madi Fleisch
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Anson Ma

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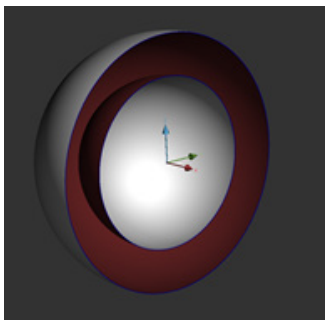
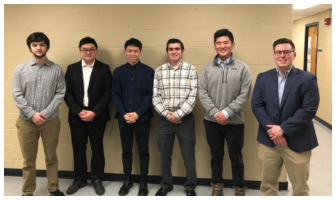
3D Printed Smart Drug Delivery



3-D printing technologies refers to the creation of objects from digital files based on a layer-by-layer or drop-by-drop approach. Our team aims to take advantage of this emerging technology to improve pharmaceutical products. Specifically, we have designed 3-D printed tablets containing two model drugs to be released alternatively. Based on mass transfer principles, the release profile of the 3-D printed tablets will be engineered by controlling the local composition of each drug during printing. Such a design will eliminate the need for the patients to take different drugs at different times, thereby reducing the pill burden and improving medication adherence. 3-D printing also comes with other benefits such as personalized medication, minimal drug waste, and drug abuse prevention. Our project demonstrates how 3-D printing technology can revolutionize the relationship between the pharmaceutical industry and patients.

CHEMICAL AND BIOMOLECULAR ENGINEERING



TEAM 15

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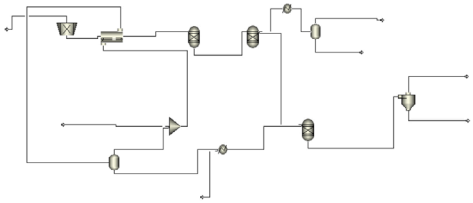
Production of Activated Carbon from Wood Waste



Worldwide carbon emission levels have continuously grown and have now reached all time highs. In 2019, there were 36.8 billion metric tons of carbon dioxide released into the atmosphere. Overall, carbon emissions have caused the global surface temperature to rise by over 1 degree celsius in the last century. The goal of our project is to model a slow pyrolysis process which produces activated carbon from wood waste, within the modeling software, Aspen Plus. The wood waste will go through four steps; crushing, drying, pyrolysis, and activating. The waste will first be crushed into uniform particle sizes to increase the surface area which will help in effective drying. The crushed wood will then go through a dryer to reduce the moisture content. Pyrolysis is a thermal decomposition where organic materials are heated at elevated temperatures between 300°C - 800°C in an inert atmosphere. The products of pyrolysis will be solid char, bio-oil, and syngas. The char must then be activated through either steam, physical or chemical activation. Variables will be changed independently of each other to determine the ideal configuration for biochar production. Once the ideal configuration is determined, the results will be compared to the energy output of fossil fuels. Finally, we will be able to determine if this wood pyrolysis process can be a realistic alternative to coal processes.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 16

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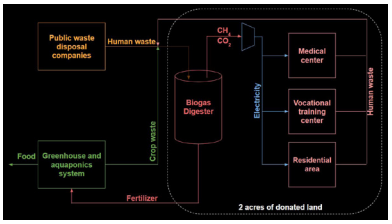
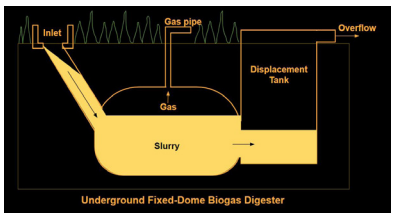
Design of a Biogas Digester for Rural Uganda

Guiding Light Orphans (GLO), a nonprofit charitable organization, is addressing the ongoing health crisis in rural Masindi, Uganda. The community faces sanitation issues due to poor human waste disposal and lack of healthcare due to unreliable electricity. The goal of this project was to design a biogas digester to improve sanitation and provide a stable source of electricity. Inside the digester, human waste and crop residue will undergo anaerobic digestion to create biogas and digestate. The biogas will consistently power a medical center and vocational school, which GLO plans to build. These facilities will create a healthier and more sustainable community by providing healthcare, food security, and professional training. The digestate will be treated using UV light, making it safe to use as fertilizer. We calculated the volume of the biogas digester, the biogas and digestate yields, and the expected electricity output by modeling the kinetics and thermodynamics of the anaerobic digestion reactions. These reactions produce enough biogas to power the proposed facilities. The digester is relatively inexpensive and easy to maintain since it may be difficult for villagers to get help operating it in this rural community. By converting waste into energy, this project reduces environmental impact and gives the community a reliable source of electricity.





CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 17

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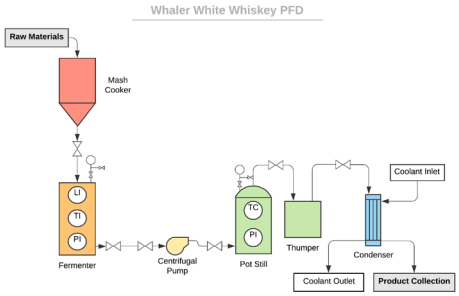
Economic Feasibility and Design of Full Scale White Whiskey Production Facility

The craft spirits market has great potential as shown by the recent craft beer industry boom. We present Whaler White Whiskey, a craft moonshine distillery that will be designed for production, facility tours, and tastings in Stamford, Connecticut. Our goal is to output 500 gallons a week of traditional and specialty moonshine flavors using local raw materials. Ingredients will be stored on-site then fermented through a batch process to eight percent alcohol by volume. After, the fermented intermediate will be distilled in a two stage distillation process. The fermentation and distillation processes were modeled to determine the outlet streams and energy requirements. Quality specifications will ensure safe production of a consistent forty percent alcohol by volume product. Our product will be bottled then sold on-site and through local vendors. Process economics were calculated to predict startup costs and feasibility. Become a Whaler and let your tastebuds experience our moonshine today!



CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 18

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Sam Weinberg

ADVISORS

Stefan Schaffoener
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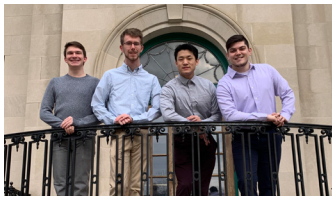
Nel Hydrogen

Nel Hydrogen is a global powerhouse in the hydrogen industry. One focus of Nel Hydrogen is onsite generation of high purity hydrogen gas through electrolysis of water in portable electrolyzer cells. The manufacturing of these cells currently utilizes hydrofluoric acid (HF) for etching of porous titanium electrodes. The goal of this project is to establish and optimize a replacement etching procedure that uses a less hazardous etchant to mitigate safety risks and manufacturing costs.

Our approach to this problem includes a combination of experimental work guided by factorial design and computational model through the Julia programming language. Performance of the etching process is measured through mass transport and resistivity through the porous plate. The new etching process must produce porous plates with equal or superior mass transport and resistivity properties to those created via the currently implemented HF-based process.

This project seeks to resolve economic and environmental challenges currently faced in the alternative energy industry. Hydrogen energy is a rapidly growing technological field, and improved manufacturing of electrolyzer cells could reduce the economic barriers currently faced by hydrogen for widespread implementation.

CHEMICAL AND BIOMOLECULAR ENGINEERING



TEAM 19

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Mathieu Roy
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Richard Parnas

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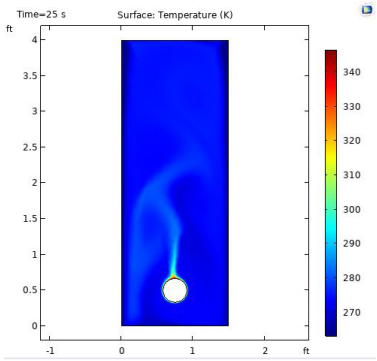
KENEY PARK SUSTAINABILITY PROJECT

Keney Park Solar Thermal



The Keney Park Sustainability Project has sponsored our senior design team to install a solar thermal heating system for its greenhouse in Hartford. The goal of this project is to allow a greenhouse to produce crops throughout the winter. Our system supplements propane heating with solar energy and reduces fossil fuel use in the winter by up to half. Solar energy is collected by a heat transfer fluid and stored by heating a tank of water, which is used to heat plants throughout the greenhouse. A 'mini-greenhouse' design increases the efficiency of the system by confining any heat given off, reducing heat loss. The time-dependent temperature distribution in the 'mini-greenhouse' will be modeled using finite element modeling in COMSOL. This COMSOL study models natural convection from a pipe to determine an ideal radiator configuration for heating plants on a tiered growing shelf. The group will produce a proposal to Keney Park including a bill of materials, a piping and instrumentation diagram, and any manufacturers or contractors needed to install the solar thermal system. The food produced by the system will be donated to Hartford Public Schools, a school system that serves a food-insecure community. Solar heating is a cleaner source of energy than propane, so installing solar thermal will reduce CO2 emissions and the greenhouses' contribution to Hartford air pollution.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 20

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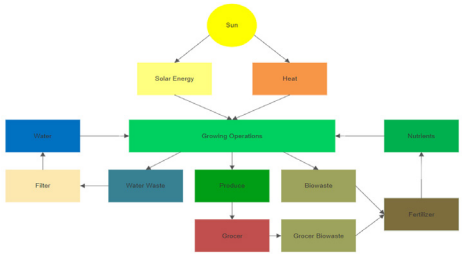
Optimal Design for Intensive Vertical Farming with Aeroponics



By 2020, the global population is expected to exceed 9 billion. Our goal is to design a farming operation to increase food production to account for this projected population growth. The operation must meet a specific nutrient demand, have net-zero greenhouse gas emissions, be compact, and be sustainable. The design must also be applicable to different climate types. The operation is being designed for a temperate climate, Boston, MA, and an arid climate, San Antonio, TX. Our operation is designed to use vertical farming methods in conjunction with aeroponics system in order to be efficient and compact. In the temperate climate we will be using city water. In the arid climate water will be sourced by brackish groundwater desalination for sustainability, ensuring that we are not using more resources than are naturally replenished. Taking all of these ideas into consideration, we will use constrained optimization to determine the optimal design. The results will be compared to the traditional farming methods by measuring the amount of produce per area produced through both methods. We will also compare the amount of waste in both cases. Having recycle streams, maintaining net-zero emissions, and using solar energy allows the operation to stay environmentally friendly. Vertical farming methods allow the use of compact techniques, enabling modern growing operations to meet the nutrient demand of the growing population.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 21

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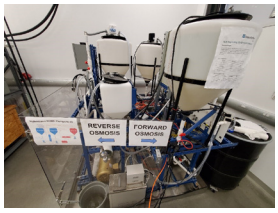
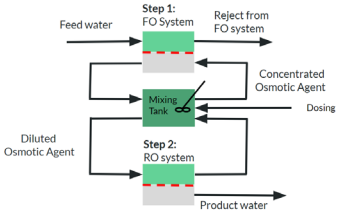
Forward Osmosis Hybrid Systems for Wastewater Reuse and Dewatering Processes



In a FO-RO hybrid system, the goal of the FO unit is to dilute the osmotic agent from the draw solution and pass it on to a continuously stirred tank reactor (CSTR). The purpose of the CSTR is to mix the diluted draw solution stream from the FO unit with the reject stream from the RO unit. Furthermore, the CSTR acts as a buffer that allows us to control the flow of the system. Finally, the goal of the RO unit is to dewater the stream, producing one stream of concentrated osmotic agent, which is returned to the CSTR, and a product stream of recycled water.

After we made a process flow diagram of the system, we modeled an ideal system, under the assumptions that there is no salt bleeding and no fouling at the membranes, as well as no boundary conditions around the membranes. Afterwards, we moved on to modeling non-ideal systems, taking into account that our ideal assumptions are no longer valid. When recording data, we measured the water flux of the system over time, and compared our predictive model to experimental data that was provided to us by the McCutcheon lab. We observed that water fluxes in both FO/RO reach an asymptote, and will converge to be equivalent, therefore reaching steady state.



CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 22

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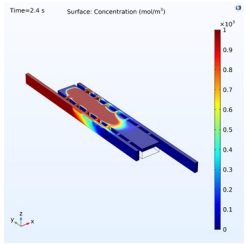
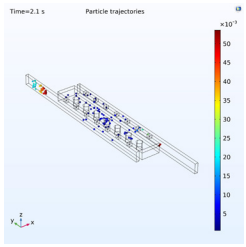
CHEMICAL & BIOMOLECULAR ENGINEERING

Modeling Nanoparticle Drug Carriers in a Tumor-on-a-Chip Microfluidic Device





In 2018, 1.7 million people were diagnosed with cancer. Drug therapy is a common treatment for cancer. Since cancer cells respond uniquely to treatment, a personalized form is needed to find the correct drug therapy. Personalized 3D models are used to examine drug accumulation and uptake. Microfluidic devices provide an ideal platform for a 3D model of cancer cells since they have rapid fabrication and direct imaging of the tumors without use of animal sacrifices.

Tumor-on-a-chip is a microfluidic device that we used to simulate the diffusion of nanoparticles through a tumor and its microenvironment. Nanoparticles are drug carriers known to selectively accumulate at tumor sites due to differences in permeability between healthy and tumor tissues. Our team predicted nanoparticle diffusion using finite element analysis. We controlled physical parameters such as flow rate, nanoparticle characteristics, tumor porosity and device geometry. The microfluidic devices were then fabricated and tested. Using fluorescence optical imaging, we were able to validate the simulated prediction. This tumor-on-a-chip can be applied for screening the nanoparticles through the evaluation of therapeutic efficacy and will revolutionize personalized medicine in the fight against cancers.

CHEMICAL AND BIOMOLECULAR ENGINEERING

TEAM 23

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Tom Scheller

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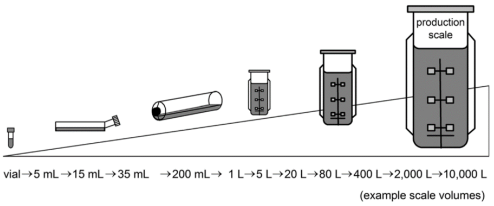
Disposable Bioreactor Seed Train Modeling



Antibodies can effectively treat numerous diseases. The scientific community must therefore develop a cost-effective and efficient process to increase antibody production and meet market demand. To fulfill this objective, we will use a seed train process in which cells grow in successive reactors until the production bioreactor scale is reached. Our team's goal was to minimize the time cells spend in the seed train, as this accounts for nearly half of the antibody production process. By reducing the overall processing time, pharmaceutical companies can produce more antibodies at a lower cost. Using an innovative membrane bioreactor design, we sought to change several key parameters such as the number of bioreactors required and the volume of bioreactors within the seed train. We implemented a computational model that solves coupled cell growth equations while also finding optimal passaging times between reactors. We then compared our model's time-to-market profit and total cost to literature sources. Along the way, we considered the potential safety hazards of developing a large-scale process as well as potential sources of contamination. Our model demonstrates that it is possible for computational methods to expedite the current production process of antibodies and in turn provide essential medications to those who rely on them.

CIVIL ENGINEERING

TEAM 1

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Solar Photovoltaic (PV) System Installation at West Haven Railroad Station

The West Haven railroad station, located on the New Haven Main Line in West Haven, Connecticut, was constructed in 2013. The Connecticut Department of Transportation tasked Civil Engineering and Electrical Engineering students with the design and installation of a new solar photovoltaic (PV) system over the existing railroad station parking lot, along with eight electric car charging stations. Team CE 1 developed design plans for the new solar carport structures in the North parking lot and standard carports in the South parking lot, with room for future expansion. These carport structures were oriented in such a way to maximize solar electrical production, and did not reduce the number of existing parking spaces. Four electric car charging stations were added to each parking lot, located in close proximity to the existing railroad station building. The Civil Engineering tasks for this project included the site layout of the new carport structures, the soil and foundation design calculations for where the structures were installed, and the structural analysis and design for the new structures and electrical charging stations. Team CE 1 completed a full design and cost breakdown for the structural and civil aspects of the Solar PV system installation. All of the structures were designed per ASCE 7-10, AISC Steel Construction Manual 15th ed., and all state and local regulations.

CIVIL ENGINEERING

TEAM 2

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Soil Nail Wall Post-Construction Analysis

ConnDOT built their first permanent soil nail wall in 2002 to allow for construction of an I-95N on ramp below an existing I-95 overpass in the City of Groton. The soil nail wall is located below a perched, h-pile supported stub abutment and was needed for permanent lateral earth support of the excavation below the existing perched abutment. As this was ConnDOT's first permanent soil nail wall, the design was very conservative and did not account for soil arching between h-piles. Soil arching is a phenomenon describing stress redistribution due to relative movement between adjoining soil masses.

For this project our team was hired to complete a post-construction analysis for the existing soil nail wall. To aid in recreating the design we were given the task of restructuring the design using ASD code and SNAP2 software. The tensile loads on the nails calculated by our SNAP model were compared to the actual loads acting on the nails that had been measured by instrumentation. The SNAP model was then adjusted to account for the soil arching effect between the h-piles. Three alternatives were explored to mimic the effect of arching. These included surcharge load reductions, lower unit weights of retained soils, and adding false cohesive strengths to retained soils. We also constructed a 3-D model to demonstrate how soil nail walls work.

CIVIL ENGINEERING

TEAM 3

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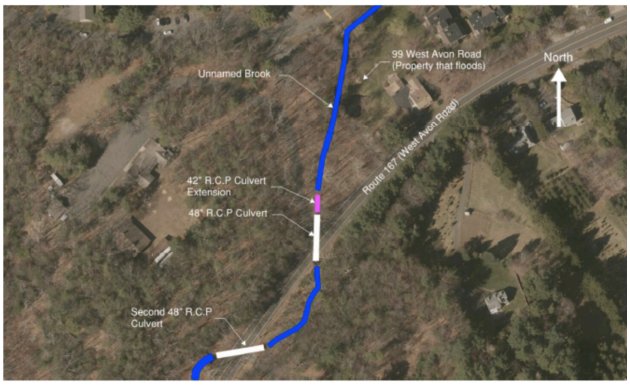
Culvert Replacement over Unnamed Brook

In Farmington, Connecticut, the Lions Club property along Route 167 had been experiencing frequent flooding for several years due to an ineffective system of culverts. Three culverts in a sequence became unable to handle the peak flow rates of the watershed area, most likely because the third culvert had a smaller diameter than the previous two. After a thorough investigation of the hydrology of the watershed and hydraulic capacities of the culvert system, it has been decided to replace the smaller culvert with a larger culvert. Since the other two culverts in this area are comprised of 48" reinforced concrete pipe, the smaller culvert will be replaced with identical components. The increase in pipe diameter reflects the need for a greater flow capacity, which will help alleviate further flooding in the area. After the new culvert is installed, the length of road between the two culverts will be milled and repaved. Guide rails adjacent to each culvert opening will also be replaced with a new rail type that is more appropriate for the roadway conditions.



CIVIL ENGINEERING

TEAM 4

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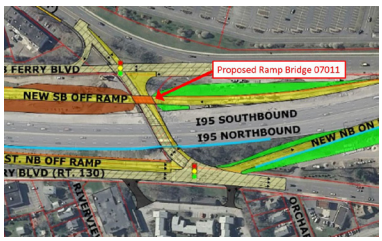
Ramp Bridge 07011 Project

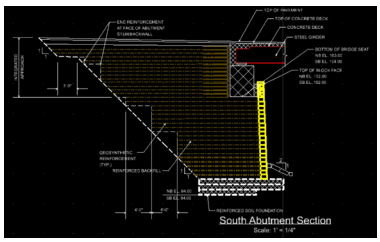
Construction of Ramp Bridge 07011 accommodates the proposed full interchange at Interstate-95 Exit 33. The current partial diamond interchange 33 features an I-95 northbound exit and I-95 southbound entrance in Stratford, CT. The objective of this project is the design and load rating of Bridge 07011, which carries the new I-95 proposed southbound off-ramp for interchange 33.

The ramp bridge span is 100 feet long and features one 12 foot wide lane, a 4 foot wide shoulder, and a 10 foot wide shoulder. The bridge is skewed 29.5° to the roadway below, Barnum Avenue Cutoff. Based on 2018 Average Daily Traffic (ADT) records, an approximate 4,300 vehicles are predicted to use this off-ramp.

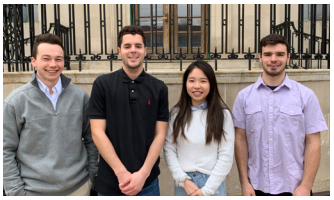
Design of the bridge was completed in accordance with the AASHTO LRFD Bridge Design Specifications and the current CT DOT Bridge Design Manual. AASHTOWare Bridge Design was used in the design of the bridge superstructure. The bridge superstructure is comprised of steel beams placed directly over a Geosynthetic Reinforced Soil-Integrated Bridge System (GRS-IBS) substructure.

The completed design was inputted into AASHTOWare Bridge Rating software and rated under AASHTO HL-93 vehicular live load. The load rating software determines the bridge live load capacity and whether the design passes or fails the CT DOT load rating factor of 1.0.





CIVIL ENGINEERING



TEAM 5

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ADVISOR

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CONNECTICUT DEPARTMENT OF TRANSPORTATION 125 1895 - 2020

Highway Safety Project

The goal of the Highway Safety Project is to provide a cost effective and environmentally responsible solution that will increase the safety at the intersection of Rte. 195 and Rte. 44 for all road users, making UConn and the state of Connecticut a better place to live and travel in. The intersection of interest serves as a vital access point for the state's premier public university and it is crucial that we maintain safe roadways for Connecticut's future. It has been brought to our attention that this intersection experiences a higher crash frequency compared to other intersections in the vicinity of the University of Connecticut. In particular, the intersection experiences a higher proportion of angle crashes than what is typical. Our research suggests that a roundabout at the intersection could reduce crash frequencies associated with angle crashes. Our suggested roundabout countermeasure aims to enhance the Connecticut drivers experience by making travel through the intersection safer and more efficient. The overall long-term benefits in safety and travel will improve the quality of life for residents and commuters alike.

CIVIL ENGINEERING

TEAM 6

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wsp

Superstructure Replacement of Bridge No. 00037 over I-95 in Stamford, CT

Bridge No. 00037 is located in Stamford, CT carrying Route 1 over I-95. The existing bridge is built in 1958, a two-span steel plate girder structure with 242 ft in length and 76 ft-2 in in width. The bridge is comprised of two lanes in each direction, a left turn lane in the westbound direction, and a skewed with support angles greater than 54°. This bridge is in need of replacement due to structural degradation. The objective of this project is to develop a replacement plan of the new Bridge No. 00037 including analysis, design, and construction plan, to increase the minimum vertical clearance, add a water main, repair corroded steel, and repair major spalling of the bridge. To do that, in depth investigation of traffic detour plans, a comparison of steel versus concrete girders, bridge construction type analysis, girder dimension calculations, and a cost analysis were conducted. Based on the investigation, the bridge general design plan were created with an Accelerated Bridge Construction (ABC) approach which includes a deck, girder, and cross frame design, as well as a loading analysis. The structural model was created in MicroStation and all loads were analyzed using SAP2000. This new replacement bridge design meets Connecticut Department of Transportation's Bridge Design Manual and AASHTO LRFD Bridge Specification, increasing the effectiveness and life span of the bridge.

CIVIL ENGINEERING

TEAM 7

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Nicholas Lownes

SPONSOR

Updating Essex Village to Manage Tourism

Working alongside the Essex Economic Development Commission, our team was responsible for managing the implementation of proposed street network plans designed for Essex Village. These plans aimed to improve nonmotorist safety and mobility while preserving the village's historic charm. We developed a plan to temporarily execute the design plans for the local network with minimal impact. To do so, we utilized a technique known as Tactical Urbanism, a low-cost practice using temporary materials over a demonstration period within a localized area to pilot road network improvements for nonmotorists. This period is used to gather data and feedback to determine if the improvements should become permanent fixtures.

Our plan included a tentative schedule, supplies, costs, community engagement plan, staging options, and communal feedback options, to test the effectiveness of the design plans. We presented our proposal, which improved visibility of crosswalks, as well as added sidewalks, bumpouts, a pedestrian refuge and angled parking, to the town's Planning Committee who negotiated which elements they wanted to move forward with.

CIVIL ENGINEERING

TEAM 8

Dante Gilberti
Michael Julian
Joseph Paduano
Matthew Shuler

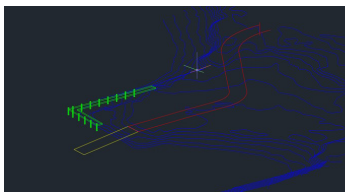
ADVISOR

Nicholas Lownes

SPONSOR

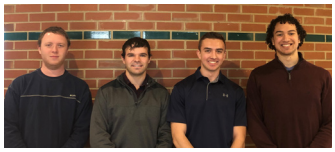
Mystic Water Taxi

Mystic, Connecticut is home to a variety of places to eat, shop, and stay. The town attracts tourists from all around. In an effort to alleviate automotive traffic caused by this surge in visitors, the Town of Stonington tasked the engineering team with designing a water taxi service that would reduce the number of vehicles traveling from the hotel-dominated region to the downtown shopping and restaurant area. The original site is located immediately after the Mystic River Bridge, south of exit 90 off of I-95. The undeveloped location would have required extensive landscaping to make it viable and this would not be economically feasible.



A duck boat service was chosen as the preferred solution instead of a traditional water taxi service. A town owned parcel was chosen that is adjacent to the restaurant Latitude 41 and the Mystic Seaport Museum and is currently occupied by the Mystic River Boathouse Park. Its location and current undeveloped state make it ripe for redevelopment. Using an amphibious vehicle allows the reduction in vehicles traveling to and from the downtown area while allowing the duck boat to pick up passengers directly from the hotels near the originally proposed site. A complete site design of the park was developed with all relevant calculations including stormwater runoff, a boat launch design, a public dock design, and cost estimates.

CIVIL ENGINEERING



TEAM 9

Jeremy Borelli
Ryan Haraghey
Ethan Lawlor
Robert Oakley

ADVISOR

Manish Roy

SPONSOR

Pawcatuck Dinghy Dock

The Town of Stonington in the State of Connecticut is investigating the opportunity of building a small dinghy dock on the Pawcatuck River at the intersection of Mechanic and Prospect Street. The proposed dock will be constructed on the south side of an existing pump station located on the property. This facility will provide access for boaters from nearby marinas to the village of Pawcatuck which offers many dining and entertainment options. It will also serve as an extension of a recreational kayak trail along the Pawcatuck River.

Over the past year, the UConn Senior Design Team 9 has developed a site layout, a construction schedule and estimate, and initiated the permitting process with the Connecticut Department of Energy and Environmental Protection. The design process considered structural, environmental, and budgetary concerns, as well as input from local residents. The site design specifies a floating dock, boardwalk to provide access from the roadway, and a parking area. The plans also detail several optional features, like kayak storage and launching systems.

CIVIL ENGINEERING

TEAM 10

Alena Bianchi
Kerry Doran
Randall Koolis
Matthew Yang

ADVISOR

Manish Roy

SPONSOR

Mason's Island Causeway

With rising sea levels and increased potentiality of one hundred-year storms, the Town of Stonington in Southeastern Connecticut is concerned for the future of Mason's Island Causeway, the only point of access and egress to Mason's Island, an island located in Mystic Harbor. The Town requested that a team of UConn students assess the situation using the skills acquired through education and internship experiences, and to propose and design a solution. Throughout the course of the project, various options and limitations were examined and analyzed. The assessment determined that the best course of action would be to raise the existing causeway and widen the lanes to accommodate the populations of pedestrians and bikers. The primary limitation was the lack of alternative routes of entry/exit to and from the island. To accommodate this, the team has decided that renovation of the causeway must be completed in phases to allow one lane of travel at all times. The renovation efforts will also place a focus on improving/expanding upon the existing green infrastructure, as its inclusion in design can positively impact erosion, water quality, and overall health of Mystic Harbor.

CIVIL ENGINEERING

TEAM 11

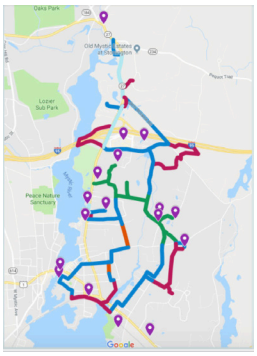
Francesca Esposito
Kendra Hall
Tai Le
Jared Newton

ADVISOR

Manish Roy

SPONSOR

Mystic Trail System



The Mystic Trail System Project considered the feasibility of building a network of trails to connect tourist attractions to community infrastructure in Stonington, CT. The goal for this project was to propose an alternative transportation network that would link area features, maximize transportation efficiency and access, and to minimize environmental impact through several ADA-certified wetland crossings.

The group also developed a cost estimate, and identified strategies to prioritize paths in the system that could most efficiently improve travel. Our areas of interest for this project were Mystic Seaport, Dennison Homestead, Old Mystic Village, Pequotsepos Nature Center, and the downtown waterfront.

To execute the project, team members traveled to the site and gathered data by biking the trail and using the application "Strava GPS Cycling and Running App" to record where they traveled and to collect an inventory of the trails. The group was then able to come up with a basic budget for improving the trail system.

Using the data gathered and available survey data, the group determined the best design solutions to improve these trails; the group proposed to regrade a majority of the trail to improve their conditions, while paving one of the most used portions of the trail with asphalt to be more accommodating to all users.

CIVIL ENGINEERING

TEAM 12

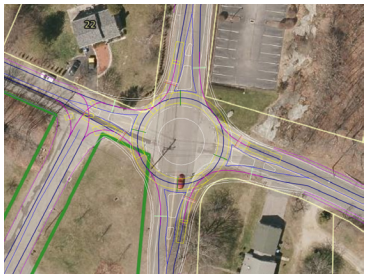
Tavey Chang
Bartosz McCormick
Katherine O'Shea
Adam Plecan

ADVISOR

Nicholas Lownes

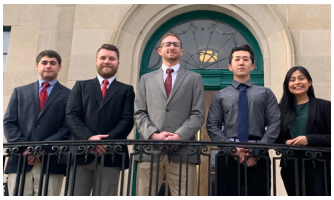
SPONSOR

Intersection Improvements: New London Turnpike and Asylum Street



The city of Norwich, Connecticut has identified the intersection of New London Turnpike and Asylum Street to be unsafe due to the high number of collisions that have occurred there in recent years. This project sought to address these safety concerns in a way that is sensitive to the existing site conditions and the context of the surrounding community. A modern roundabout was selected as the preferred intersection traffic control following an evaluation of preliminary roundabout and signalized design alternatives on the basis of cost, safety, vulnerable user considerations, geometric feasibility, and traffic operations. Traffic operations were analyzed using VISSIM microsimulation models which replicated existing traffic conditions by utilizing traffic data collected manually and via pneumatic traffic counters, as well as aerial drone footage. The project concluded with the development of a geometric design for a modern roundabout that balances vehicular mobility and operational safety while minimizing right-of-way impacts. Additionally, bicycle and pedestrian facilities have been incorporated to enable alternative modes of mobility.

CIVIL ENGINEERING



TEAM 13

Diana Aguirre
Hanwen Bi
Jason Geary
Austin Reich
Anthony Tripodi

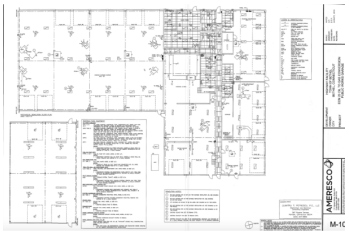
ADVISOR

Manish Roy

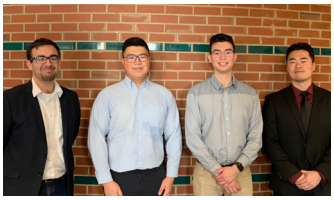
SPONSOR

Building Design and Renovation for Snow Loads

The Town of Bethel has tasked the members with analyzing the adequacy of the steel roof framing system of the Bethel Town Garage. Due to excessive snow loads and inadequate welds, the steel joists require reinforcement in order to fully support the applied loads. The group worked on this project under the direct supervision and guidance of Christopher Baldwin, a building official for the town. The roof is made up of steel joists with horizontal bridging that is entirely supported by steel columns. Through multiple site visits, the framing of the joists were mapped out and the sizes of the steel joists were determined, with the help of the Steel Joist Institute. Using SAP2000 the team modeled the roof and analyzed the adequacy of each steel joist and column. Through careful analysis of the moment and shear capacities, and the amount of deflection, the weak areas that require reinforcement were located. Extensive research was conducted on reinforcement methods that could be utilized to strengthen the framing system to bear the applied loads. Taking cost and practicality into account the design team applied their knowledge and research to determine the most useful type of reinforcement to brace the steel joists and create a stable roof framing system.



CIVIL ENGINEERING



TEAM 14

Yikun He
David Huang
Christopher Rojo
Michael Smith

ADVISOR

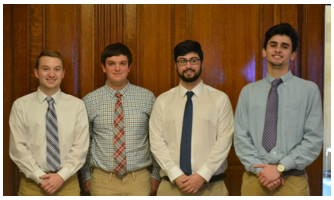
John Ivan

SPONSOR

Cove Road Mobility Study

Cove Road in Stamford, CT is a major connector in Stamford between Shippan and Cove Island Park. Cove Road is a Minor Arterial Roadway from Elm Street to Seaside Avenue and a Minor Collector from Seaside to Weed Avenue. In addition to a dense residential population and small businesses lining Cove Road; the Cove Area is home to Chelsea Piers, NBC, Rogers International School, KT Murphy School, and Cove Island Park. From Elm Street/Shippan Avenue to Weed Avenue, Cove Road had inconsistencies with sidewalks and parking; including narrow sidewalks, sidewalk gaps, undefined separation between sidewalks and parking, and no bicycle facilities. The City has sponsored our team with the goal of promoting safety and enhancing mobility of all roadway users; vehicles, pedestrians, bicyclists, sidewalks and parking. Our team has met the desires of the City and designed a continuous well defined sidewalk from Elm Street to Weed Avenue. Additionally, the team designed an improved on street parking layout for the retail and multifamily housing since there were sections of Cove Road where the parking lane needed to be defined clearly.

CIVIL ENGINEERING



TEAM 15

Sal Luzzi
Daniel Pinto
Aaron Scurlock
Carson Stermer

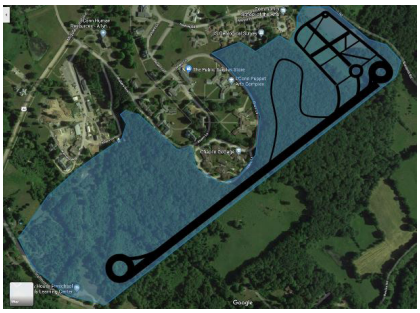
ADVISOR

John Ivan

SPONSOR

CTSRC
Connecticut Transportation Safety Research Center

Connected and Autonomous Vehicle Test Facility on UConn Campus



The Connected and Autonomous Vehicle Test Facility was designed to simulate a diverse set of road environments that will be used for the research and development of autonomous vehicle technology. The Connecticut Transportation Safety Research Center tasked the senior design group with designing the facility and preparing preliminary cost estimates for it to be built in the near future. UConn and the State of Connecticut share an interest in building an autonomous vehicle test facility because as self-driving technology is rapidly developing, confidence in the technology and the safety of road users needs to be assured. The facility was designed with three main traffic environments: urban, rural, and highway. This range of settings will provide users the ability to simulate a variety of possible situations that autonomous vehicles may encounter on the road. Throughout the country there are test facilities for autonomous vehicles being built, but the senior design group's goal for the UConn project was to improve on similar designs by incorporating a plethora of features and creating a realistic roadway environment, while maintaining a feasible project cost. Designing the facility allowed the senior design students to gain practical experience in roadway design, cost estimation, and apply many concepts that were learned throughout their time at the University of Connecticut.

CIVIL ENGINEERING

TEAM 16

Stephanie Kreitler
Anaka Maher
Susie Moon Monda
Daniel Rodier

ADVISOR

Nicholas Lownes

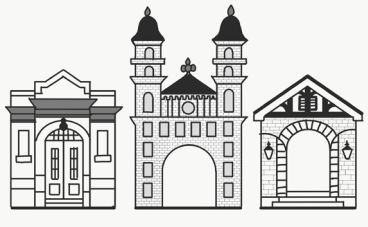
SPONSOR

Town of Thompson Connecticut — Thompson CONNECTICUT

Thompson, CT: Riverside Park Pop-Up Vendor Village

Thompson is working to revitalize the once-thriving downtown district, and regain neighborhood cohesion. One of their revitalization initiatives is this senior design project, their new "Pop-Up Vendor Village," debuting in the near future at the town's Riverside Park.

DASSigns was tasked with the design and layout of the vendor village to cater to the residents of Thompson. Each of the chalet designs has been inspired by a historical building from each of the ten different villages within Thompson, working together with the Thompson Historical Society to ensure that the town's historical charm is well represented in the final park. To further guarantee the success of the revitalized Riverside Park, DASSigns has also expanded the scope of the project to include added signage and transportation improvements to the site to increase accessibility and add an element of placemaking.



With a vendor village that matches Thompson's character, a transportation network that connects the park to the rest of the town center, and added amenities to enhance the attractiveness of the park and the village, Thompson will have the opportunity to regain a sense of a proper downtown and provide flexible opportunities for local businesses to have their own storefronts. In conjunction with the ongoing effort to readapt the nearby historic River Mill, this project is a step towards Thompson's future.

CIVIL ENGINEERING

TEAM 17

Nathan Drinan
Ritu Patel
Nick Roche
Mahnoor Syed

ADVISOR

John Ivan

SPONSOR

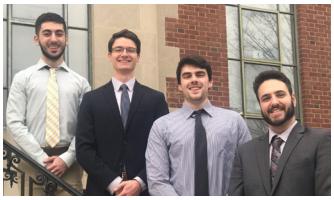
Traffic Improvements for Olcott St at Adams St

The intersection of Adams Street and Olcott Street in the town of Manchester has a number of problems that we hope to rectify. Some of these problems include poor intersection alignment, near misses, poor pedestrian safety, congestion, and poor visibility of other legs of the intersection. Currently the intersection is not signalized and contains no crosswalks. It is located near an elementary school and many school children cross this intersection daily. It is also located near Connecticut State Road Route 44, which receives a high volume of traffic. The intersection is busy especially during peak hours, and the existing geometry of the intersection hinders efficiency.

Our team has delivered four alternative designs for the redevelopment of the roundabout in the town of Manchester. The first alternative design is a roundabout, the second is a traffic signal, the third is an intersection realignment, and the last alternative a "do nothing" approach. The alternatives were designed and evaluated very carefully in order to choose the best alternative.

Our senior design project presents this process of scrutinizing each alternative and choosing the optimal alternative. This alternative was then designed in great detail to be submitted to the Town of Manchester for construction. We would like to thank our sponsor Mr. John DiBiasi, the assistant town engineer for the Town of Manchester. We would also like to thank our senior design advisor Dr. John Ivan.

CIVIL ENGINEERING



TEAM 18

Quinn Becotte
Kays Cetin
Maximillian Grant
Samuel McCollum

ADVISORS

Charles Elias
Shinae Jang

SPONSOR

MATTERN CONSTRUCTION, INC.

Replacement of Bridge No. 02968

CTDOT has determined Bridge No. 02698 is in need of replacement. Adjacent to the intersection of Route 49 and Clark Falls Road in North Stonington, CT, the bridge provides vehicle and pedestrian access over the Pendleton Hill Brook. In its initial state, the bridge was determined to be in poor condition and hydraulically inadequate for being in a Flood Hazard Zone A. Therefore, it was determined that the bridge span needed to be widened to accommodate the larger flow rates while still remaining a viable transit route.

The objective of this project is to design and implement an adequate replacement that services the needs of the community, while also being designed with efficiency and durability in mind. To do this, we conducted an initial site analysis to determine the criteria and constraint of our design. Multiple site visits and research of public information about the land such as soil conditions, traffic statistics, and general topography were conducted. Utilizing SAP2000 and AutoCAD, the cofferdam, bridge deck cross-section, and supporting structures were designed while taking erosion control and foundation design philosophy into consideration. Furthermore, we conducted an in-depth structural analysis to determine design capacity and adequacy. A cost estimate, traffic rerouting for the replacement phase, and life cycle control analysis were also provided.

CIVIL ENGINEERING

TEAM 19

Carolyn Baumgras
Andrew Greenlaw
Yiorgos Panaelidis
Colton Reardon

ADVISORS

Charles Elias
Wei Zhang

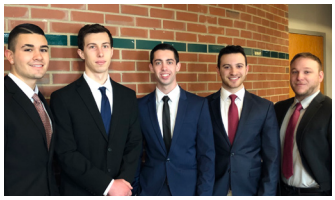
SPONSOR

GPRB

Brooksvale Dam Redesign Project

Brooksvale Dam is located at 524 Brooksvale Ave, Hamden, CT. GPRB was approached by Mark Austin from the Town of Hamden to inspect and redesign the pond and outflow structure at Brooksvale park to handle a 100 year storm. The pond was originally built in the 1960s to provide a recreational area for fishing and ice skating. Over the past ten years the pond has not been holding water, and with continuous development of the surrounding area there are some concerns about the stability of the dam and potential flooding.The dam was thoroughly inspected using guidelines from the CT DEEP. The 24 inch corrugated metal pipe was corroded on the discharge side and there was inadequate riprap protection on both the upstream and downstream slopes. A local company was contracted to perform boring samples of the pond to determine the soil make-up and approximate depth of bedrock. The samples were also tested using sieve analysis to estimate the hydraulic conductivity of the existing soils. GPRB performed a hydrology analysis of the drainage area to determine the required specifications of the dam. The analysis was performed using ArcMap and the watershed boundaries overlaid on a digital elevation model of the site. This data was used to model the existing conditions and design several alternatives for the pond and outflow structure to handle the increased flow of water.

CIVIL ENGINEERING



TEAM 20

Mitchell Blustein
Chris Cavuoto
Nick Furey
Dylan Leitao
Eric Vazquez

ADVISOR

Wei Zhang

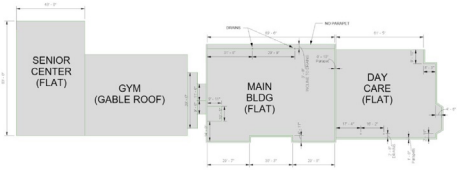
SPONSOR

TOWN OF HAMDEN
Incorporated 1786
STATE OF CONNECTICUT

Design and Evaluation of Keefe Community Center

The Keefe Community Center is placed conveniently in the heart of Hamden, CT at 11 Pine Street. The facility is located at the center of the urban environment in Hamden, making it the ideal place to bring the community together. It is a multi-use facility, housing a daycare, senior center, and a multi purpose gymnasium. The Town of Hamden has requested an evaluation of the Keefe Community Center for deficiencies such as the structural integrity of the roof system under heavy snow and wind loads, drainage, and an emergency management plan.

Our group completed calculations in order to determine the structural integrity of the five different roofs that make up the Community Center. Calculations were done to evaluate if the current roofing system was suitable for average snow loads in Hamden as well as for extreme wind loads. The level of snowfall needed for necessary snow removal from the roof was also calculated. From there, we were able to determine if the current drainage on the exterior of the Community Center was suitable to handle melting snow. Lastly, an emergency management plan was created to provide a procedure for the residents of Hamden if a natural disaster were to occur. The Keefe Community Center was evaluated for its ability to serve as a shelter for the community and how the facility could best serve as part of an emergency plan.



CIVIL ENGINEERING

TEAM 21

Nicole Bibeau
Zhiqi Lin
Nicolas Lozada
Delaney Meyer
Rilind Racaj

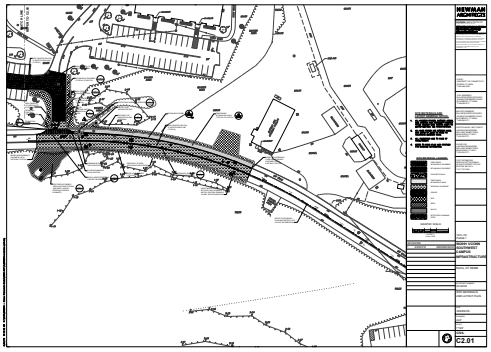
ADVISOR

Nicholas Lownes

SPONSOR

MANAFORT BROTHERS ESTABLISHED MB 1919 100 YEARS

Construction Management and Bidding



The University of Connecticut deemed it necessary to upgrade infrastructure in the Southwest Campus area and thus opened the UConn Southwest Campus Infrastructure Upgrades Project for bidding in 2018. The bidding process and project were then carried out and completed by Manafort Brothers(MB), who won the initial bid. In order to expose a team of students to the processes of bidding and scheduling, MB created a simulation of the bidding and preconstruction process.

All documents provided to interested bidders such as specifications, plans and instructions to bidders were examined in order to create ninety-three work breakdown structures. Plans were then used to perform quantity take-offs for each individual work breakdown structure. Unit prices and RSMeans data were provided by MB to aid in calculating a final estimate. The team then completed the bidding document provided and participated in a simulated bid reveal, producing the winning bid.

The second portion of the project was focused on pre-construction. Submittals required by the specifications were identified and a dozen were drafted to be submitted for approval by MB. A resource-loaded construction schedule was also created utilizing Microsoft Project and the information in RSMeans.

CIVIL ENGINEERING

TEAM 22

Xinyu Lin
Kevin Ortiz
Quinn Packer
Amanda Thompson

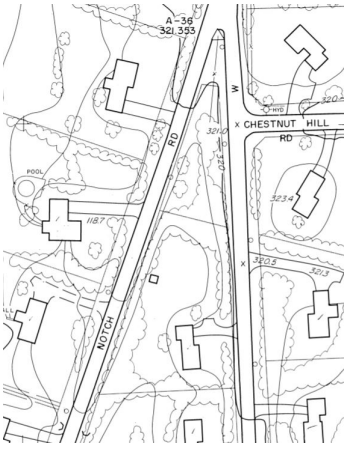
ADVISOR

John Ivan

SPONSOR

Jacobs

Notch Road Improvements



The Town of Simsbury expresses concern for the safety of cyclists, pedestrians and vehicles on Notch Road, a through road between West Mountain Road and Route 44 in Simsbury, CT. In particular, the intersection of West Mountain and Notch Road meet at an angle far greater than the standard of 70 degrees. This leads to faster speeds and poor visibility while using the intersection. The road currently serves as a connector for the Farmington River Trail, a popular bicycle route. Our team of engineers have been trained in transportation problem solving both through relevant coursework and employment opportunities. Larry Murphy from Jacobs Engineering served as our mentor in developing a design to improve the overall safety of Notch Road. Our updated design provides a safer route for cyclists and pedestrians and follows best practices by using AASHTO, CTDOT and Town of Simsbury codes, NACTO and FHWA bicycle safety guides, and drainage, utility, and roundabouts design guides. Informed by site visits, technical guidelines, and decision analysis, our design plan utilizes roundabouts and bike lines to reduce the speed of traffic and increase safety for non-vehicular road users while minimizing cost and environmental impact. Our final set of plans involves vertical and horizontal alignment plans made utilizing ArcGIS and AutoCAD software.

COMPUTER SCIENCE AND ENGINEERING

TEAM 1

Jordan Beecher
Mason DiCicco
Kristian Huber
Lauren Moore
Alex O'Neill

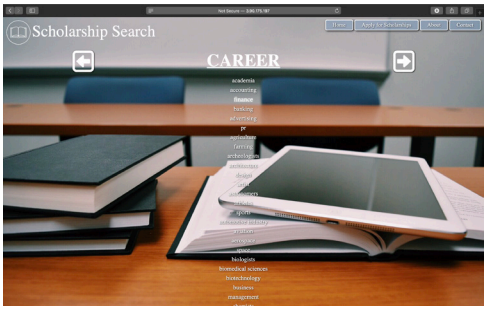
ADVISOR

Seung-Hyun Hong

SPONSOR

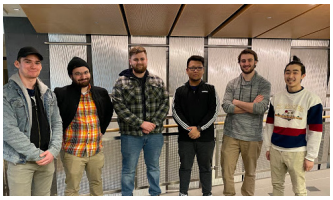
Every Child Every Day
East Hartford Public Schools

Scholarship Matcher



The testing and application process for colleges is expensive and lengthy by itself, but it is not the end of the journey. Once accepted, students, especially those from low income families, must struggle to acquire the funds be able to pay for college. Our goal to solve this problem is to create a website that is simple and intuitive and gives students accurate and applicable scholarships. Once they have a narrowed down list, our website will help create an essay to apply for each scholarship by asking questions that guide the student in the direction of a compelling story. At the end of this project, any high school student should be able to use this website and find more scholarships to apply to and submit better applications that will increase their chances of winning more awards. The front-end sections are user interface and design, scholarship display, and account information. The back-end sections are server code/information flow, database management/ web scraping tool. The front-end is written JavaScript, HTML, and CSS. Those files are handled by the server code. The server uses the NodeJS framework and the website itself is hosted on Amazon's Web Services. The database that stores all of our scholarship information is MongoDB. All of these components come together to set up our website to simplify scholarship searching.

COMPUTER SCIENCE AND ENGINEERING



TEAM 2

Mitchell Chan
Adam Fan
Cameron Slater

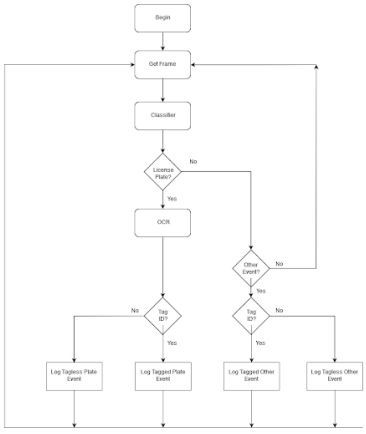
ADVISOR

Joseph Johnson

SPONSOR

CONTROL MODULE INC.

License Plate Recognition

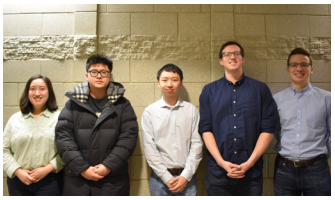


Our sponsor, Control Module Inc. (CMI), is a global provider of innovative systems and solutions for workforce data collection, EV charging, and fleet management.

We were tasked with designing a DVR-type device with event logging that classifies license plates and uses OCR machine learning to read the plate and log the event depending on whether a tagged ID was presented.

The license plate recognizer has two main components. It takes as input a video feed utilizing an IP based camera that the ECE team designed. First it finds a license plate (if one is present). Then, it reads the plate number and logs the event. We used Keras with TensorFlow core to build our neural network.

COMPUTER SCIENCE AND ENGINEERING



TEAM 3

Anthony D'Andrea
Ethan Hanna
Xiangyu He
Michael Lu
Katherine Riedling

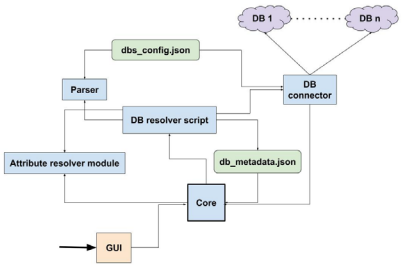
ADVISOR

Jinbo Bi

SPONSOR

CGI

Entity Resolution Tool for Record Retention



CGI is an IT and business consulting company that provides an array of infrastructure, analytics, and data management services for a variety of companies. The purpose of this project is to address entity resolution in the healthcare domain with respect to record retention. This has become an increasingly relevant topic with the rising usage of digital documentation services and concerns about data privacy. The motivation behind this solution is to understand how logical entities can be identified in a heterogeneous collection of databases with sufficient reliability. We seek to ensure that the correct records are expunged safely and accurately from any system.

This software tool searches through available databases that contain some unknown collection of attributes and attribute values, and determines the relationships between different fields by applying a combination of deterministic and probabilistic methods on data containing errors, inconsistencies, or missing values. The user interface will then display these results. However, we are operating on the assumption that there will be a key-identifying attribute that will always remain correct, such as social security numbers.

COMPUTER SCIENCE AND ENGINEERING

TEAM 4

Reed Kroll
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Keshav Patel
Niels Peschel
Jeremy Reiser

ADVISOR

Dong-Guk Shin

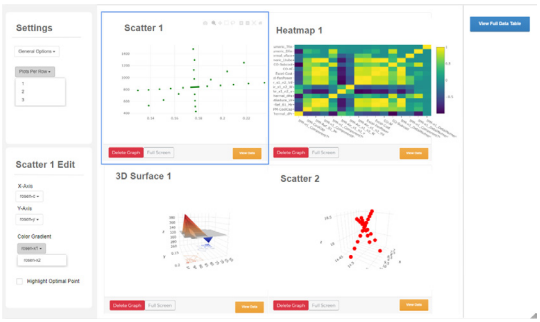
SPONSOR

Carrier
United Technologies

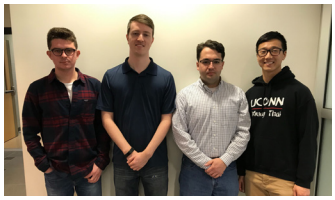
Kalydoscope

The Carrier Corporation uses model based design (MBD) for their product development applications. One of the MBD tool sets, Sandia Dakota, outputs data into HDF5 file format. HDF5 files uses a versatile data model that can represent very complex data objects and a wide variety of metadata.

The Carrier team would like a data visualization application capable of reading/processing the HDF5 format and producing versatile visualizations to interpret the MBD results. There are currently a very limited number of tools available for visualizing HDF5 files and their capabilities are inflexible and limited. The envisioned data visualization application should allow the Carrier team to easily visualize the results of methods, compare and contrast variables, find optimal values, etc. The planned data visualization application should allow the user to create a variety of custom visualizations from the datasets contained within a wide-array of user provided HDF5 files. We are developing this HDF5 data visualization application using the Electron software framework, React and Bootstrap front-end components, and the h5py and plotly libraries for data processing/visualization generation.



COMPUTER SCIENCE AND ENGINEERING



TEAM 5

Tyler Cromwell
Cristian Gutu
Nick Huynh
Michael Welch

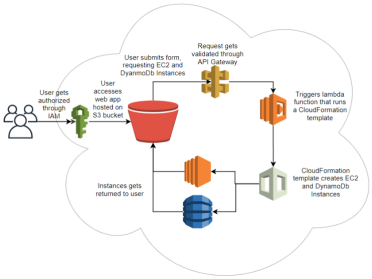
ADVISOR

Joseph Johnson

SPONSOR

LOCKHEED MARTIN

Cloud Developer Management Dashboard

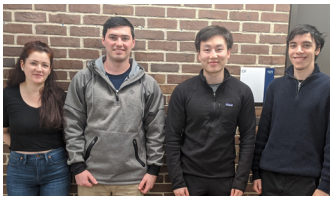


Lockheed Martin is a global high tech, security and aerospace company principally engaged in the research, design, development, manufacture, integration and sustainment of advanced technology systems, products and services.

Lockheed Martin is in the midst of a digital transformation in the Rotary and Mission Systems (RMS) business area, including Sikorsky military and commercial helicopters, integrated air and missile defense, littoral warfare, undersea warfare, etc.

This Senior Design project involves the design, build, and deployment of a web-app that provides users with the ability to easily create and manage AWS resources and associate them with various development efforts. This enterprise-scale, cloud-based application automates repetitive project management tasks that serves as the first iteration of a tool Lockheed Martin that can be deployed for their software development teams. The scope of this project encompasses a wide range of subproblems, specifically: UI/UX design, frontend development, backend development, database design, and cloud architecture design. The UI/UX design and frontend development portions are covered by the user-facing web-app that implements the interaction functionality. The remaining backend development, database design, and cloud architecture design subproblems implement the logic to handle the actions made available through the web-app.

COMPUTER SCIENCE AND ENGINEERING



TEAM 6

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Samantha Hunsley
Daniel Scalzi
Johnny Sit

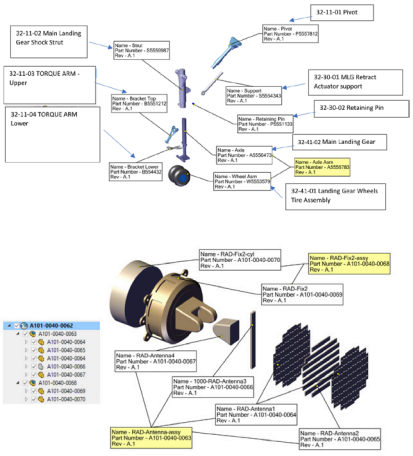
ADVISOR

Joseph Johnson

SPONSOR

LOCKHEED MARTIN

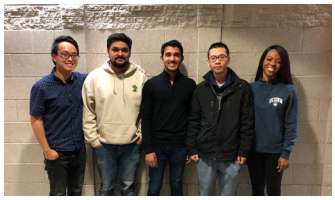
3D System Navigation



Lockheed Martin is a global high tech, security and aerospace company principally engaged in the research, design, development, manufacture, integration and sustainment of advanced technology systems, products and services. Lockheed Martin's mission is to solve complex challenges, advance scientific discovery and deliver innovative solutions that help our customers keep safe.

This project involves the design, development and deployment of a proof of concept for a personnel productivity tool featuring an updated file navigation system. Currently, tree-based file navigation requires users to learn the file system's structure as well as memorize part numbers prior to utilizing the system. Under the new approach in this proof-of-concept, called 3D navigation, personnel are able to open up the web application and easily access the information they need from a 3D model. The web application is hosted on AWS (Amazon Web Services) and allows users to view a 3D model of an object and its parts using standard tree controls. The goal is to leverage this proof-of-concept to ultimately deploy an enterprise system that reduces training time and provides an intuitive, interactive environment for working with model data.

COMPUTER SCIENCE AND ENGINEERING



TEAM 7

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Alan Liu
Mohit Mali
Tyler Nguyen
Amar Sinha

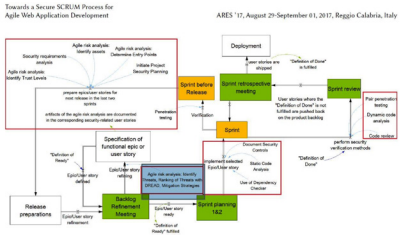
ADVISOR

Hanna Aknouche-Martinsson

SPONSOR

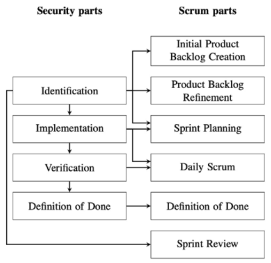
synchrony™

Secure Scrum Design



Being able to create a robust, secure application is a crucial task for any software engineer. With Agile as its adopted methodology, Synchrony proposes to adopt the idea of 'C. Pohl and H.-J. Hof, Secure Scrum and OpenSAMM for Secure Software Developmentin International Journal On Advances in Security, volume 9, numbers 1 and 2, 2016, 1942-2636, Jan. 2016, vol. 9.' to enable discovery, systematic tagging and traceability for software components related to secure practices. Using controlled repositories, this project, Secure Scrum Design, leverages Synchrony's existing CI/CD pipeline to allow security metadata to pass consistently through the pipeline. The project enables this capability by developing OpenAPI specifications across the pipeline elements, starting from the metadata repository and flowing through to executables. In other words, the project enables developers to find tested secure code, include it in their builds, and to trace those security features through the CI/CD pipeline. This capability impacts the following pipeline components such as Eclipse, Jenkins, Jira, BitBucket, Confluence, Pytest, and CEDAR.

Optionally, the project will utilize the specs created for OpenAPI to create test scripts. If successful, the project will enable Synchrony developers to create RESTful interfaces that implement the desired security metadata automation.



COMPUTER SCIENCE AND ENGINEERING

TEAM 8

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Haseeb Khan
Aakib Shaikh
Richard Zheng

ADVISOR

Steven Demurjian

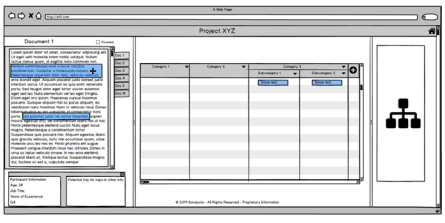
SPONSOR

SONALYSTS

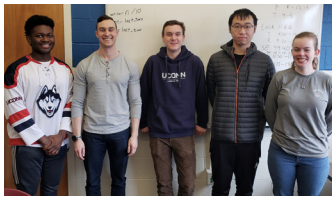
SIFT - Automated Document Analysis

Sonalysts, the US Government, and academia/research institutions conduct qualitative or observational research to gain key insights into the design of systems, using methods such as Cognitive Walkthrough (CWT), Knowledge Elicitation (KE) interviews, and/or focus groups. Currently, data collected via these methods are transcribed, iteratively coded based on thematic analysis; then insights or results are manually generated by tabulating data, custom visualizations are manually developed, and analytical products are generated to disseminate these findings to decision makers (via PowerPoint, Word, Excel, etc.).

SIFT will be a web-based platform to consolidate and automate this process, enabling simultaneous processing/analysis of data and configuration management across a diverse group of users, including human factors engineers, data scientists, UX designers, graphic artists, and software engineers. SIFT will be a web-based technology, enabling collaboration across LANs, WANs, or the open internet depending on use case. The goal is to create a means to more rapidly process text-based qualitative data, glean insights from the data (via analytics or visualizations), develop analytic products, and provide traceability from resultant designs (predominantly visual media), through analysis, and all the way back to raw data.



COMPUTER SCIENCE AND ENGINEERING



TEAM 9

Benjamin Buchanan
Aaron Hill
Daniel Toby
Elizabeth Turano
Dingchen Yan

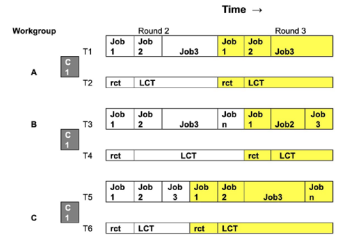
ADVISOR

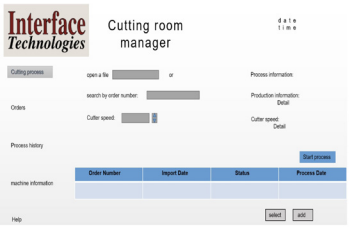
Jacob Scoggin

SPONSOR

Interface Technologies

Cut Room Scheduling Software





The global textile industry is one of the largest consumer goods industries in the world. As the global population continues to grow, the company Interface Technologies (IT) realized a glaring problem in global clothing manufacturing industry. There exists a lack of technological innovation. This has resulted in manufacturers going outside of the United States rather than utilizing automation to lower manufacturing costs. IT has developed software to automate much of the garment production process and is currently working on developing an algorithm to optimize the scheduling of the process.

Currently, a cutting room manager decides how to prioritize what order raw material is cut. The prioritization can be based on the size of the order, the order deadline, the space available in the cutting room and many other factors. Much of this process is passed down from one manager to the next.

IT estimates that an algorithmic scheduler could increase efficiency up to 30%. The algorithm works to optimize the due date of a garment order, amount of material needed to prioritize the orders in a manner more efficient than the way it is typically done. This algorithm has been created by IT and implemented by a senior design team at The University of Connecticut.

COMPUTER SCIENCE AND ENGINEERING

TEAM 10

Andrew Collins
Eric Flower
Sam Markelon

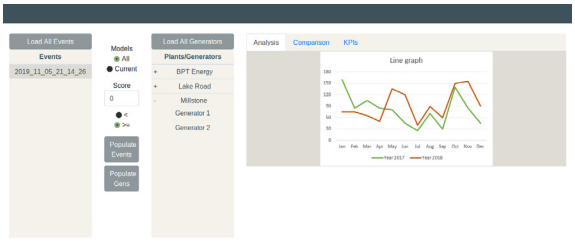
ADVISOR

Wei Wei

SPONSOR

ISO new england

Generator Model Verification Result Analysis System



Power system dynamic models need to accurately represent the actual behavior of the systems. These models are used in planning to identify and mitigate potential criteria violations, determine transfer capability, and develop transmission system reinforcement plans. They are also used in operations for outage coordination studies, establishment of system operating limits, and real-time assessment tools.

ISO New England has developed an online tool - Automatic Power Plant Model Verification (APPMV), that automatically performs the task of power plant model verification using real-time power system disturbances.

This project will develop a database, an application server, and a web-based user-facing front end, which can help the ISO effectively perform the model verification task. This entails implementing a generic event database that stores rich information about each event, and making it easily accessible to data mining tools. This will feed a web-based GUI designed for analyzing and managing APPMV results.

Since the current method of accessing and analyzing this data is manual, a web-GUI will quantitatively and qualitatively enhance the analysis of power grid events for ISO New England engineers. It will provide the engineers with a streamlined process and real-time visibility into grid events, helping keep the lights on in New England.

COMPUTER SCIENCE AND ENGINEERING

TEAM 11

Leonard Adams, III
Travis Bugbee
Klauss Preising
Joseph Warmus
Daniel Zhang

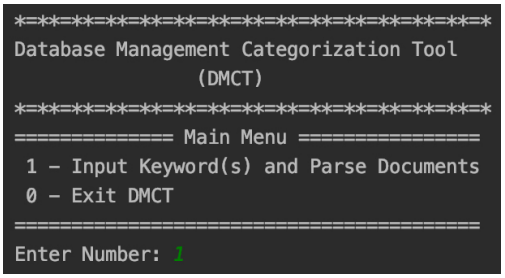
ADVISOR

Steven Demurjian

SPONSOR

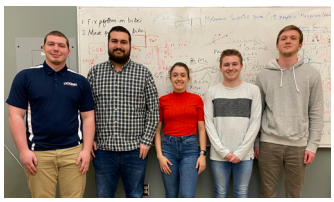
LOCKHEED MARTIN

Data Categorization Management Tool



Lockheed Martin Rotary and Mission Systems (RMS) labs are moving from traditional on-premise servers located in computer rooms across the infrastructure to Amazon Web Services (AWS). The goal is to reduce costs while also creating new data management, access and sharing capability across the RMS portfolio. Data that resides in the labs is stored in a variety of application formats. Moving the data to AWS requires that the data type is properly identified prior to transfer. Data stored within the lab environments can be categorized as export control, third party proprietary, Lockheed Martin Proprietary, or Covered Defense Information (DFARS 254.204-7012). Prior to moving the data to AWS, the current procedure is to manually review the information to ensure that it is labeled or tagged with the correct data category. The process of manually opening every file and applying a label or meta tag is extremely time consuming and inefficient. We here at Lockheed Martin RMS would like the UConn Senior Design Team to create a machine learning solution that can analyze and categorize the data. The solution should allow the data owner the ability to provide input into the recommended categorization and key terms for their program prior to moving the data into AWS.

COMPUTER SCIENCE AND ENGINEERING



TEAM 12

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Araceliz Mare Gomes
David Motta
Charles Sampson

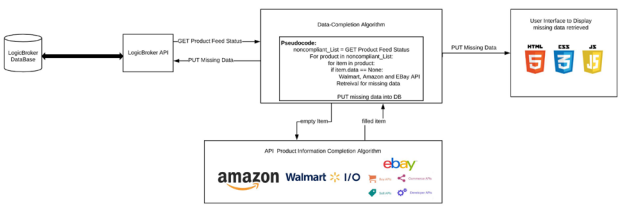
ADVISOR

Seung-Hyun Hong

SPONSOR

logicbroker

Logicbroker Repricing Engine



Our project is to create a repricing engine for Logicbroker. Logicbroker is a company that connects brands and retailers through their cloud based platform by using Dropship Technology to help manufacturers manage and advertise their inventories. The first part of our project is to create a program that interacts with Logicbroker's API to fill in the missing product information in 3 steps: 1) find items with missing information in their system, 2) automatically searches the web for missing data, and 3) updates the missing information in Logicbroker's system. The second part and main focus of our project is a product repricing engine. For a given product, the program presents the user with repricing options, such as price x% below average. Users select an option and provide information through our GUI, so that prices can be found online using the methods we developed in part one. The program calculates the recommended price based on the pricing rules and displays it to the user. A user interface was developed so that a user can interactively run the program.

COMPUTER SCIENCE AND ENGINEERING

TEAM 13

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Sruthi Kalidindi
Caroline Sekel
Julian Shin

ADVISOR

Wei Wei

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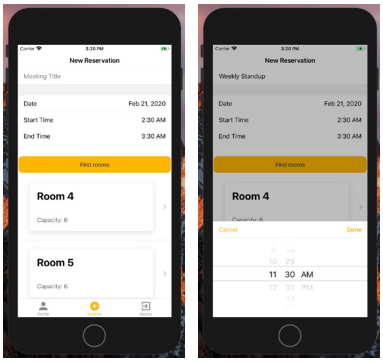
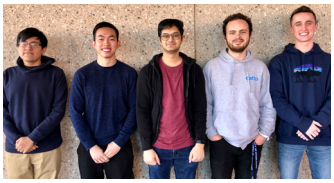
synchrony™

Synchrony Room Reservation System



The Innovation Station at Synchrony's Stamford office is in need of an efficient room reservation system for its conference rooms. Our team worked with Synchrony to create a new room reservation system, built from the ground up, that integrates with Synchrony's Office 365 accounts to deliver an easy-to-use, streamlined experience for all employees. Employees at Synchrony can make reservations and check room availability with specified criteria using our mobile and web applications. Room reservations will be automatically integrated into employees' Office 365 accounts and will be visible on their Outlook calendar. Our team utilized the Ionic framework, an open-source UI toolkit for building mobile and desktop apps, along with Angular and SQLite to develop the application.

COMPUTER SCIENCE AND ENGINEERING



TEAM 14

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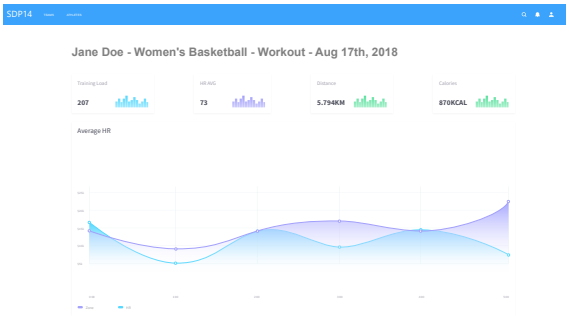
Rome McColl
Matthew Rumbel
Renukanandan Tumu
Lawrence Wu

ADVISOR

Suining He

SPONSOR

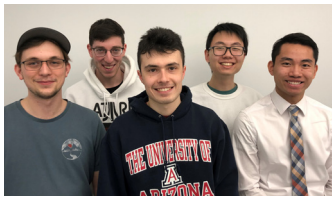
Web-Based Athletic Data Visualization



As college athletics has become increasingly competitive, the use of specialized coaching, monitoring staff, and equipment has become necessary to ensure competitiveness. The UConn Athletics strives to push the performance of its coaching staff and athletes, while ensuring safety. UConn Athletics trainers utilize Polar wearables to monitor the activity of athletes during practice sessions.

UConn Athletics seeks to visualize highly nuanced performance data for their student athletes. Trainers initially leveraged Microsoft Power BI to create visualizations of performance data obtained manually from Polar Team Pro's online portal (exported to CSV). However, the export did not expose the full raw data. The current export only includes data taken at 1 Hz frequency. The use of Polar Team Pro's API will allow access to data taken at 10 Hz frequency, which is needed to accurately calculate nuances in athlete movement and biometrics.

COMPUTER SCIENCE AND ENGINEERING



TEAM 15

Jonathan Ardolino
Mike Huynh
Jeff Shi
Zachary Wahrman
Jack Wohl

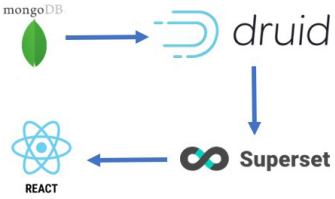
ADVISOR

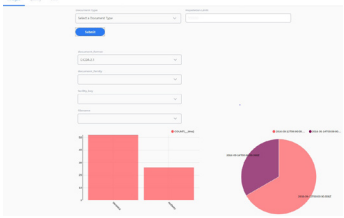
Dong-Guk Shin

SPONSOR

Diameter Health

Fusion Application



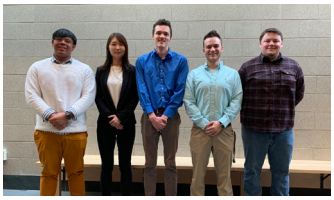


The objective of this project is to help Diameter Health customers to better understand and visualize the benefits and improvements that their enriched and normalized data has.

Currently, Fusion's visualizations are taken directly from a document-oriented NoSQL database, which doesn't perform well for aggregate reporting. The goal is to create a data pipeline from the current MongoDB database to a new analytical reporting source, and further improve the user experience by adapting the current visualizations and redesigning the UI to help customers appreciate the value of their patient data.

Various tools were used in redesigning the application: ReactJS, MongoDB, Python, Apache Superset, Apache Druid. React JS is used for the redesigned front end that includes the embedded analytic visualizations from Apache Superset. The data pipeline takes data from MongoDB and transforms and moves it using Python into Apache Druid, the data source that Apache Superset reads from.

COMPUTER SCIENCE AND ENGINEERING



TEAM 16

Agean Binan
Benjamin Buchmeier
Taeyoung Park
Ethan Pernal
Patrick Thompson

ADVISORS

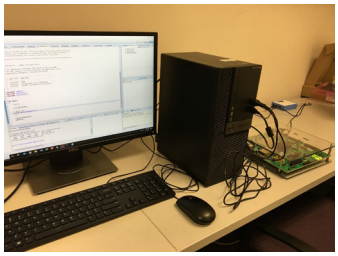
Jerry Shi
Bing Wang

SPONSOR

PRATT & WHITNEY DEPENDABLE ENGINES

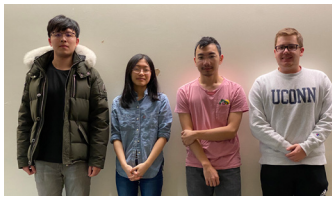
GO BEYOND

Secure Embedded Architecture



The team researched possible avenues of attack and determined what types of attacks are most likely or most crippling to the provided development board. Based on the vulnerability analysis, the team identified viable mitigation strategies for the most relevant attacks. The team designed a secure boot process that makes sure the development board boots into the correct program. The process verifies the boot image with various encryption and authentication methods, and detects attacks with built-in hardware mechanisms. The team has created and tested a prototype secure boot image. The team also evaluated the performance of crypto operations, with and without hardware acceleration, in terms of the execution time, and memory footprint.

COMPUTER SCIENCE AND ENGINEERING



TEAM 17

Xuan Chau
Chris Lo
Martin Place
Yijiang Yu

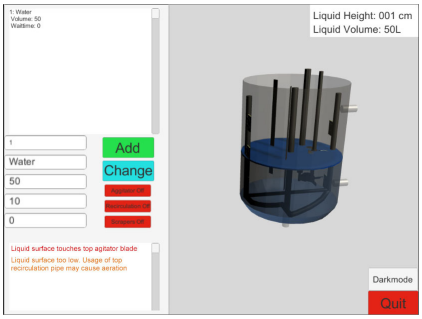
ADVISOR

Dong-Guk Shin

SPONSOR

Unilever

Process Visualization

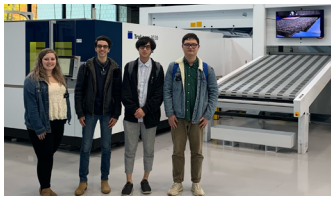


Unilever is a global consumer goods company with over 300 factories worldwide, and produces a variety of personal care products. The company oversees ingredient-mixing operations in large-scale production tanks of varying sizes and configurations.

Unilever's Research and Design teams are constantly creating and testing new products, whose production must be scaled to fit a production-sized environment. This is a complicated and risky process due to several risk factors associated with large-batch mixing. Namely, the vertical height of the liquid must not fall in any "critical points" found within the tank, which would ruin, aerate, or otherwise reduce the quality of the product.

The goal of this project is to create a web-based, Unity 3D process visualization tool that allows Unilever's researchers to accurately observe and predict mixing conditions in a virtual environment. The tool automates critical point checks and volume calculations, while offering a transparent view of the tank. By connecting to Unilever's SQL tank database, the app is capable of accurately modeling any tank that is tracked. Through a simple UI, users can add, remove, and change steps in their theoretical mixing process, while receiving crucial feedback on the state of the mixture.

COMPUTER SCIENCE AND ENGINEERING



TEAM 18

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Kaixiang Lin
Xinyu Lu
Isabelle Wright

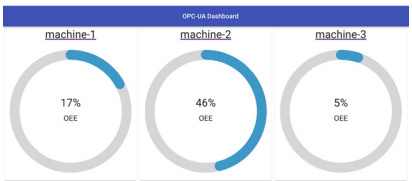
ADVISOR

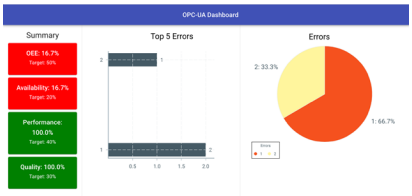
Jacob Scoggin

SPONSOR

TRUMPF

TRUMPF OPC-UA Dashboard





We design and implement a dashboard that extracts, displays, and visualizes information pertaining to the performance of industrial machines. The dashboard communicates with these machines via the OPC Unified Architecture (OPC-UA) protocol, a machine communication protocol that is used for industrial automation. The information that engineers are interested in is Overall Equipment Effectiveness (OEE), a metric used to measure the overall performance of a machine, and can be calculated from records found on each machine. The dashboard has an overview page to show the OEE of all the machines that are running. It also features the option to view a detailed page of each machine. The detailed page has a table showing all the information used to calculate the OEE for a machine, visualizations for errors within the machines, as well as a detailed summary of different areas that the machine is performing well or poor in. The uses of this dashboard are broad, ranging from determining flaws or weak points in the machines, to calibrating the machines to perform better. This dashboard is designed for TRUMPF, a company that specializes in manufacturing solutions in the fields of machine tools and laser technologies, utilizing machines for laser cutting, punching, punch and laser processing, bending, and laser tube processing.

COMPUTER SCIENCE AND ENGINEERING

TEAM 19

Donna Agogliati
Alexander Barone
Adrian Cruz
Daniel Ruskin

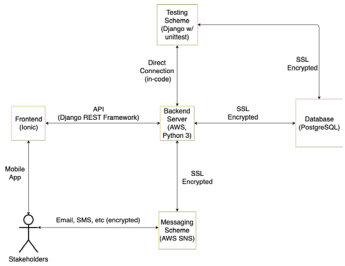
ADVISOR

Jacob Scoggin

SPONSOR

GMIS INTERNATIONAL

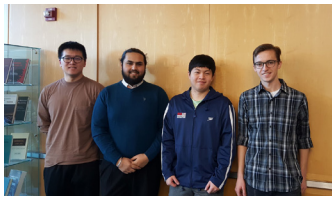
Mobile Incident Log Application



The Town of Manchester commissioned our team to create a mobile app for reporting cybersecurity incidents. Historically, state and local government officials have failed to efficiently report active cybersecurity incidents to relevant stakeholders in a timely manner. It is illustrative that, when an incident is noticed, officials must manually notify a wide variety of incident response managers. It takes a large amount of time to gather the stakeholders' contact information and send custom messages to each one. This time could be better spent on addressing the incident. Accordingly, our team has been instructed to automate this task with a mobile app.

Our mobile app will be used by stakeholders across the state of Connecticut. All IT system users and managers will be provided with an account. These individuals will then use our app to report cybersecurity incidents as they occur. When an incident is created or updated, automated e-mail and SMS notifications will be sent to all relevant stakeholders. Our app will serve as an authoritative source of information for all stakeholders. Stakeholders will refer to our app at all stages of the incident response process. Specifically, with our app, stakeholders will learn about new cybersecurity incidents, monitor the progress of mitigative measures, and identify/contact incident owners.

COMPUTER SCIENCE AND ENGINEERING



TEAM 20

Skylar Fang
Brodin Raymond
Samrath Singh
Neal Xiao

ADVISOR

Suining He

SPONSOR

GENERAL DIGITAL

S.U.D.S (Secure Upload and Download System) Biometric Security

This project focuses on the implementation of a biometric credential validation system in an existing Secure Upload and Download System (S.U.D.S.) device. This device, manufactured by the sponsoring company General Digital, is utilized by mechanics and maintenance operators working on commercial aircraft engines, and is adopted to facilitate the transfer of data in a secure way. Leveraging various forms of biometric authentication, such as facial recognition and fingerprint scanning, this project seeks to improve the current security of the device to a standard which would allow it to be marketed towards military applications. This advance would permit the application of the S.U.D.S. devices upon military aircraft, tanks, and weapons systems, increasing the consumer base for the product greatly. Throughout this project we have devised a system to convert a single stage, simple password authentication into a two-stage, multi-factor, biometrics-based state machine.

COMPUTER SCIENCE AND ENGINEERING

TEAM 21

Zhuoran Cheng
Miranda Du
Dunk Hong
Reuben Ukah
Emily Walder
Travis Wong

ADVISOR

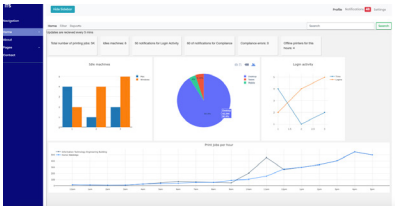
Suining He

SPONSOR

UCONN
INFORMATION TECHNOLOGY SERVICES

ITS Analytics Dashboard

UConn Information Technology Services (ITS), responsible for IT services, supports about 15,000 machines in total, across the different branches of UConn. With such an extensive user base and network system and few analysis tools, it is difficult to detect most of the underlying issues and potential environmental changes without a central data visualization and management software. Therefore, the goal of this project is to develop a web-based system which pulls data directly from different backend data feeds and creates a dashboard so that ITS and potential users, where appropriate, can visualize statistics at a glance on any device. This will greatly alleviate/reduce the complexity of analyzing multiple REST APIs and databases in the system, and allow for potential issues to be detected and addressed before they become larger problems. To address this, we propose an interactive dashboard design, which mainly consists of four different widgets: a graph showing login statistics, pie charts displaying the percentage of computers compliant with a security standard, a table of machines that had last been used, and a table showing machines deemed idle.



COMPUTER SCIENCE AND ENGINEERING

TEAM 22

Mark Adanti
Solomon Poulose
Samson Weiner
Frances Yu

ADVISOR

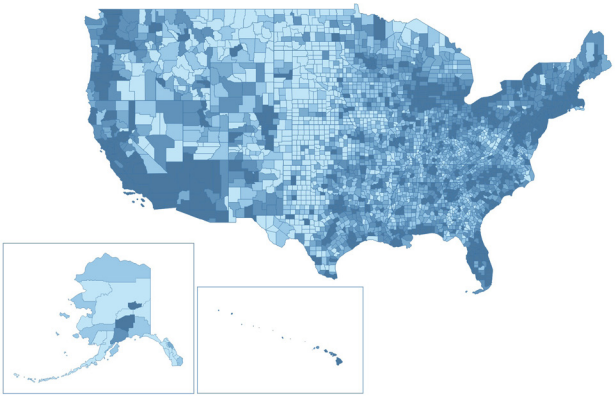
Joseph Johnson

SPONSOR

Cigna

Opioid Epidemic Predictive Modeling

Cigna is a global health service company headquartered in Bloomfield, Connecticut that has been leading the national effort to promote safe pain management and curb opioid addiction and misuse. This project involves developing a machine learning model for understanding trends across geographic areas, the utilization of this research to identify risks, and the attainment of actionable insights on how to address this on both a local and national level. This model is made available to professionals by way of an interactive website for the purposes of information sharing, decision making, and further research.



COMPUTER SCIENCE AND ENGINEERING

TEAM 23

Nick Chan
Greg Foss
Matt Scalzo
Nate Shaw

ADVISOR

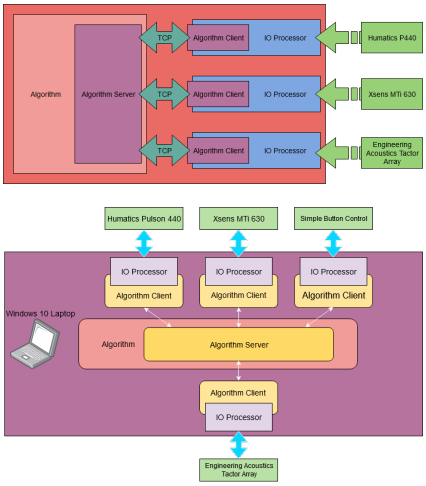
Steven Demurjian

SPONSOR

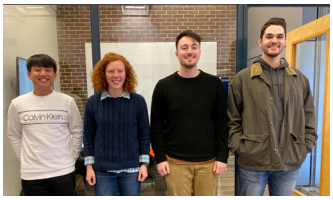
UCONN
COLLEGE OF AGRICULTURE, HEALTH AND NATURAL RESOURCES
KINESIOLOGY

Breadcrumbs: Sensory Biofeedback System

The Sensory Biofeedback System is a wearable set of hardware that collects 3D environmental data and processes it to help a user navigate their environment with impaired vision. The intended use is for firefighters navigating through a burning building performing search and rescue and helping them with disorientation. The Sensory Biofeedback System gives tactile feedback through a belt embedded with several tactor motors that can relay valuable information such as where the firefighter is in the building and their orientation. The firefighter can provide input to the system through a button box that creates a path of virtual breadcrumbs which can be deleted, allowing the system to direct them to the previous one to retrace their steps. The firefighter will wear a backpack with a computer inside connected to all the different components and a belt wrapped around his/her waist with 16 vibration motors (tactors), that communicate the feedback essentially creating a 'vibration compass' like mechanism.



COMPUTER SCIENCE AND ENGINEERING



TEAM 24

Timothy Goodwin
Juhyeon Lee
James Liebler
Emily Maciejewski

ADVISOR

Wei Wei

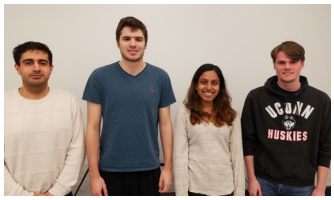
SPONSOR

JONAL LABORATORIES

Visual Inspection Automation

Jonal Laboratories Inc. is a custom manufacturing company that primarily produces elastomeric components for the aerospace industry. Currently, Jonal uses a team of quality inspectors to manually examine each part for defects including chips, contaminations, flashes, and more. However, this is a tedious, non-value-added process subject to human error. Introducing automation would remove pressure from the inspectors, provide them more time to focus on value-added tasks, and increase the speed and efficiency of the defect detection process. Thus, this project entails creating such an automated system to classify a part image as either defective or not defective. To achieve this goal, a convolutional neural network was trained using images of both defective and non-defective parts collected onsite at Jonal in order to perform the necessary binary classification. Once an acceptable accuracy is achieved, a method to integrate the trained model into the currently inspection process, thus creating the desired automated system, is generated.

COMPUTER SCIENCE AND ENGINEERING



TEAM 25

Amin Ahmadi
Mark Chastain
Jackson Royce
Saranya Tadikonda

ADVISOR

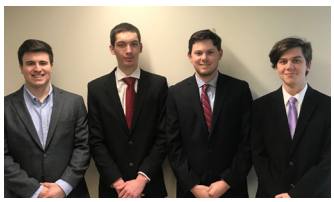
Dong-Guk Shin

SPONSOR

Avitus Marketing App

Avitus Orthopaedics requires a mobile phone app to create a seamless transmission of data between the company and its sales representatives. This app will contain promotional material for the company's representatives to utilize when pitching the company's products to potential customers. The app will also allow its representatives to email promotional material to potential customers so that customers can access this material on their own time. Another feature of the app is enabling sales representatives to access the current inventory management system, take a picture of any documents and upload the image to the application. However, this app is not only targeted towards the employees of Avitus but also customers or potential future customers of the company by offering other useful features. One such feature is providing the company's scheduling information such as the date, time, and location, of future, current or past medical conferences that Avitus will be attending. Another feature is providing forms that can be filled out in the application, similar to how online forms are filled out in web applications. Finally, the application will also be able to schedule an upcoming surgery that utilizes Avitus Orthopaedics products and allow customers to contact an Avitus representative for real-time assistance using an instant messaging feature, similar to slack.

COMPUTER SCIENCE AND ENGINEERING



TEAM 26

Ian Connelly
Matthew Davis
Daniel Ecsedy
Anthony Masullo

ADVISOR

Hanna Aknouche-Martinsson

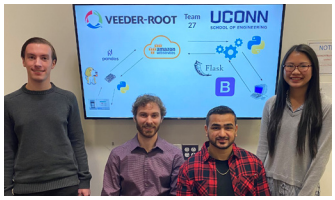
SPONSOR

MOVIA

Optical Camera System

The Movia Optical Camera System was designed to be a self-contained product that is used as a component of larger systems. The system requires it to be used in a robot with a camera, with either the robot or the camera itself having the ability to move. The base component of the system takes input from the camera and outputs an immediate environment map based on the observed optic flow and built-in heuristics. This map can then be used by other subsystems in the robot and enable them to act appropriately within the robot's requirements.

COMPUTER SCIENCE AND ENGINEERING



TEAM 27

Andrew Canova
Nick Hajek
Rishi Mehta
Michelle Tsun

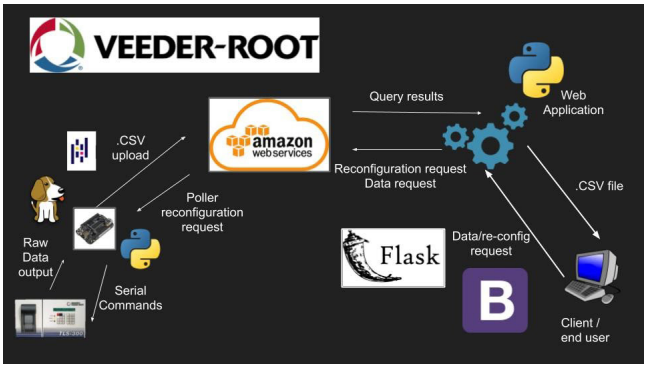
ADVISOR

Seung-Hyun Hong

SPONSOR

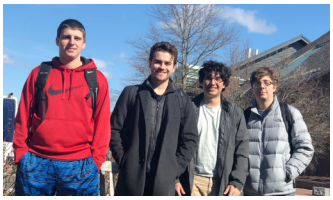
VEEDER-ROOT

Veeder-Root Cloud-Based Fuel Management System



Veeder-Root is a fuel management technology company, specializing in automatic fuel tank gauges. Team 27's task is to create a software solution that manages a group of automatic fuel tank gauges over the internet. The software both collects data and issues polling commands to the gauges remotely. This project leverages Python's Flask web framework to implement a web application, with which Veeder-Root's engineers can retrieve and analyze gas tank data. A gauge controller program, loaded onto a single-board computer located on-site, is utilized to record gas tank data incrementally and store it to the cloud via Amazon Web Services. The web application then fetches data from the cloud database storage and presents it to the end user in .CSV format. Engineers can also manage the gauge devices remotely using the web application's graphical user interface. Team 27 succeeded in creating a system that improves workflow efficiency through remote management of the gauges, obviating the need for engineers to travel to customers and physically interact with the gauge units on-site.

COMPUTER SCIENCE AND ENGINEERING



TEAM 28

Ryan Brandt
Dan Davidson
Matthew Mulhall
Anthony Richard

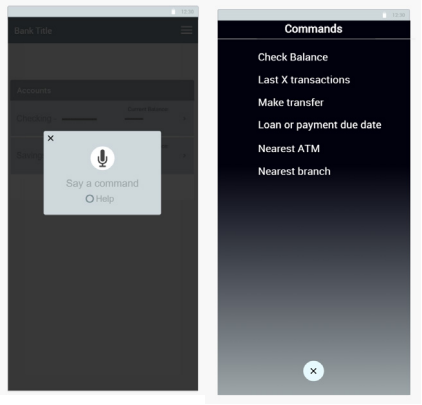
ADVISOR

Hanna Aknouche-Martinsson

SPONSOR

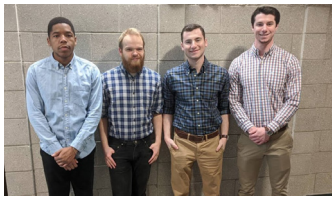
COCC
collaborative to the core

Voice Interface for Mobile Banking App



This project's aim is to add voice command functionality to COCC's existing banking mobile applications. COCC offers android and iOS mobile applications to banks, as a service. This voice assistant will be able to perform several commands such as: transferring funds between accounts, checking balance, and more. In order to achieve this, our team will integrate a scalable and modular system that leverages cutting edge NLP (natural language processing) algorithms to transcribe speech into actionable commands. On top of the functionality that this addition will provide, our team will complete this project in a way that emphasizes modularity to promote additional future commands.

COMPUTER SCIENCE AND ENGINEERING



TEAM 29

Shawn Alexander
Daniel Backal
Noah Morrison
Devan Yeo

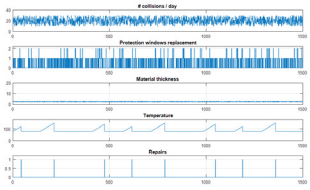
ADVISOR

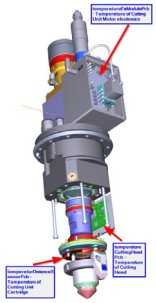
Suining He

SPONSOR

TRUMPF

Preventative Maintenance of Laser Cutting Machines using Machine Learning Models

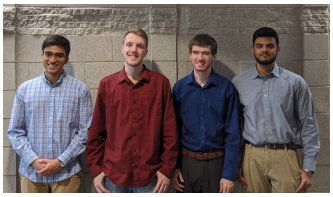




TRUMPF Inc. manufactures industrial laser-cutting machines designed to cut sheet metal. These machines are an essential part of their customers' manufacturing processes and even a few hours of unscheduled down-time can be very costly. To minimize the chances of this, we were tasked with researching and implementing machine learning models that would be able to predict when a machine would fail or need maintenance based on its usage and sensor data. Currently, the data collected from the laser-cutting machines is limited, so to simulate the future state of TRUMPF's data collection system, we generated synthetic datasets representing the data from 1,000 customers, consisting of a time-series log of various sensors on the machine. We used these datasets as training data for machine learning models by injecting patterns and correlations into it, and using repairs as a failure indicator. In addition to models such as a Bayesian model, we utilized clustering algorithms to identify the trends, patterns, and anomalies in the data.

Our research and demonstrations will allow TRUMPF to develop their data analysis process to incorporate machine learning by replacing the synthetic datasets with real sensor data. This will assist both TRUMPF and their customers to save money by minimizing the downtime of their laser-cutting machines.

COMPUTER SCIENCE AND ENGINEERING



TEAM 30

Aakash Balaji
Ryan Marsh
Wilder Perera
Keyur Shah

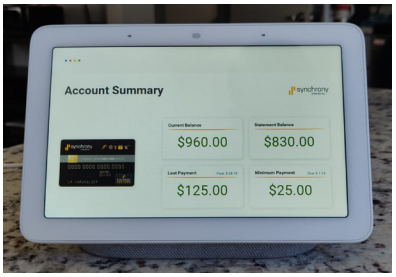
ADVISOR

Wei Wei

SPONSOR

synchrony™

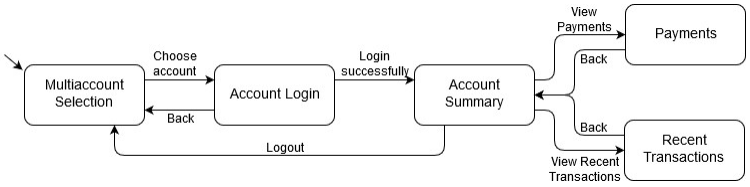
Interactive Canvas Personal Banking Application



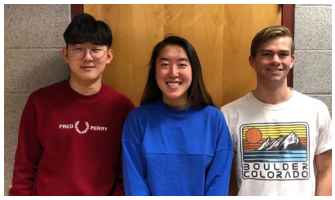
Synchrony is working to continue leading the competitive financial industry by delivering innovative and intuitive banking experiences for their customers. Based on the convenience and growing popularity of voice enabled devices, Synchrony partnered with our team to develop a personal banking application for the Google Nest Hub, a smart speaker with a display. Our application allows customers to view their financial data by simply asking their Google Assistant.

Our application includes features such as viewing account details, recent payments, transactions, and PIN based authentication. We developed the application using Synchrony's existing voice API, HTML, CSS, Javascript, React, Google Actions, Dialogflow, and Firebase.

This application provides the consumer with a hassle-free, and hands-free, way to manage their financial accounts. It represents a continuation of Synchrony's strategy to innovate by leveraging cutting-edge hardware and software tools.



COMPUTER SCIENCE AND ENGINEERING



TEAM 31

Nathaniel Fanning
Zhuoqun Zhan
Sherry Zhang

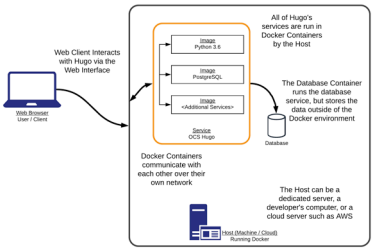
ADVISOR

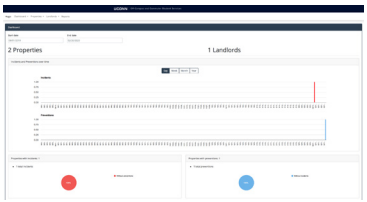
Steven Demurjian

SPONSOR

UCONN
SCHOOL OF ENGINEERING
COMPUTER SCIENCE & ENGINEERING

OCS Hugo: Continuous Delivery

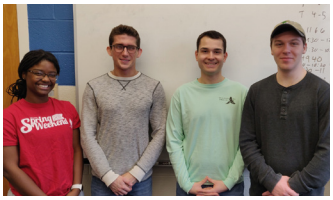




Student Affairs Information Technology (SAIT) provides primary IT support for all staff and departments within the Division of Student Affairs at UConn. For this project, SAIT is seeking to continue development of their project, OCS Hugo, as it moves from its current environment to a new continuous delivery system.

The purpose of Hugo is to assist the Off-Campus and Commuter Student Services department in documenting incidents and planning outreach activities. Hugo helps the office send move-in goodie bags and keep tabs on tenant / landlord issues and legal infractions that might be university-related even when they occur off campus. Hugo stores data which can be reported and represented through analytics and maps to highlight activity hotspots. The end goal is to make Hugo open source so other universities or organizations can use the service. The conversion will consist of creating a standardized environment using Docker, adding support for additional database systems, and removing branding among other tasks. Notable aspects of the project are adding database support for PostgreSQL and using Docker to simplify cloud deployment to services such as AWS and Google Cloud while also creating a stable environment for all users. Secondary goals include migrating from Python 2 to Python 3 and introducing OpenStreetMap in addition to the current support for Google Maps.

COMPUTER SCIENCE AND ENGINEERING



TEAM 32

Imani DaSilva
Ryan King
Daniel Janikowski
Mitko Alexander Mateev

ADVISOR

Jacob Scoggin

SPONSOR

synchrony™

Phishing Orchestration

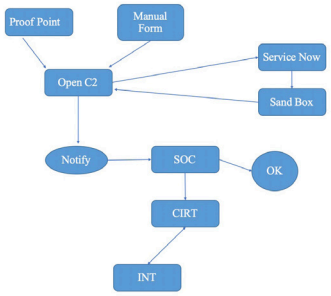
```
@staticmethod
def parseIncomingJSON(incomingJSON):
    # will parse then read message.
    incomingPhishCase = jsonpickle.decode(incomingJSON, classes=PhishCase.PhishCase)

    # record this step in workflow
    ts = []
    ts.append('analyzed by SandBox')
    ts.append(datetime.datetime.now())
    incomingPhishCase.timeStamps.append(ts)

    incomingPhishCase.trace.append('SandBox')

    # is this ServiceNow?
    # ServiceNow --> case to analyze
    if incomingPhishCase.trace[-2] == 'ServiceNow':
        print("analyzing...")
        SandBoxModule.analyzeCase(incomingPhishCase)
        return True

# PHIS-35
```

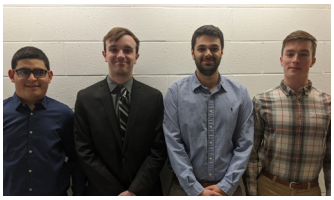


Phishing attacks are a combination of social engineering and technical methods that are used to obtain sensitive information from a user's data, such as login credentials or credit card numbers. Phishing occurs when an attacker disguises themself as a trusted entity in electronic communication. These attacks are aimed at exploiting weaknesses found in end users, such as humans not being properly trained to detect an attack. Phishing is a frequent problem for organizations.

Synchrony is a Fortune 500 company that wants to develop better, faster, and more granular actions for when phishing attacks happen. This is because their current workflow orchestration is not efficient. Attacks that are spread across multiple messages and platforms are challenging for humans to rapidly manage across specialized tools and teams. We were given the challenge to construct an adaptive, self-improving model to orchestrate phishing countermeasures using a cloud service mesh model framework that is a suite of OpenAPI specifications to orchestrate a diversity of phishing actions and associated telemetry.

Our goal for this project is to improve the efficiency of phishing detection at Synchrony. We research more efficient ways to communicate across phishing detection, mitigation and forensics teams in order to reduce the adverse effects of phishing on the company.

COMPUTER SCIENCE AND ENGINEERING



TEAM 33

Ryan Akhundzadeh
Ethan Hansen
Kerwin Mercado
Stephen Moores

ADVISOR

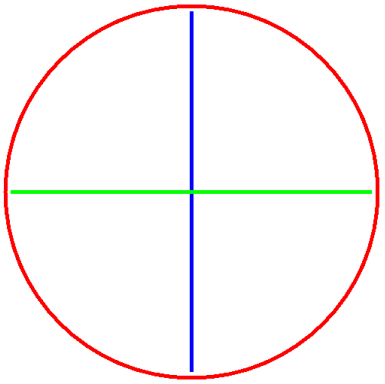
Hanna Aknouche-Martinsson

SPONSOR

GENERAL DYNAMICS
Electric Boat

Artificial Intelligence for Augmented Reality

The goal of this project was to utilize Artificial Intelligence, specifically a Convolutional Neural Network (CNN), to identify a specific symbol that Electric Boat utilizes during the building process. Ultimately, the final program would be able to locate and return the center pixel of the symbol in a given image. The CNN was designed utilizing both Python and Keras. Supervised training of the CNN was conducted using digital recreations of the symbol that were produced by a program that was able to manipulate the homography of a given image. The layers of the CNN were augmented throughout the design process to achieve greater accuracy and reduce over fitting. Once the CNN was trained, further work was done to allow the CNN to identify specific features of symbol, which in turn allowed the image to identify and return the center pixel.



COMPUTER SCIENCE AND ENGINEERING

TEAM 34

Tedros Beyan
Steven Chick
Joao Mbaya
John Owens
Yuxing Peng
Zhaoyu Wu

ADVISOR

Seung-Hyun Hong

SPONSOR

Walter Nelson, Sr.
WNS Enterprises, LLC

Courtesy Messaging Signaling Device

Automobile accidents have been one of the leading causes of injury and/or death around the world. Through miscues, senseless driving, drunk driving, inattention, etc. people are paying the price with their livelihood or lives themselves. With the Courtesy Messaging Signaling Device (CMSD) we will attempt to decrease adverse impacts on property and lives by making roads safer. We envision that the CMSD will allow driver-to-driver and/or driver-to-pedestrian communication. Specifically, the technology will provide drivers with the ability to send messages to other drivers and/or pedestrians from their cars using an app that is accessible on a user's smartphone. In our demonstration of the technology, a driver would be equipped with an LED board that will allow message to be seen from other drivers or pedestrians in their vicinity. We believe that the addition of such technology will make a substantial difference in creating safer roadways for all users.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2001

Dominick Hollister
Riley Lyke

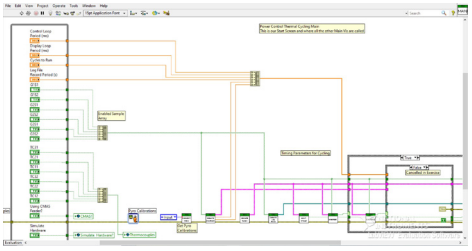
ADVISOR

John Chandy

SPONSOR

ctnext

Data Acquisition and Process Assessment of Accelerated Testing of Thermal Barrier Coatings



Together with MEM Team 05, we were tasked with helping organize data flow and analysis for a testing apparatus located on UConn's Depot Campus. This testing apparatus is used for the accelerated testing of protective thermal barrier coatings to see their effectiveness and durability. It contains several data collection points, from gas flows to temperatures of the samples being tested.

The MEM team focused on creating the database. In the meantime, we focused on editing the LabView code to accommodate the database. This involved changing the current data output into a form that the database can accept. In addition to this, the data needed to be transferred to the database in a secure manner, so local connections were used to provide this interaction. Further goals were to implement some secure industry 4.0 features. One such feature is adaptive decision making, so that if the test starts to go off target, it can correct itself.

Another desired feature is the ability to monitor the sample and based off of their appearance, tell of the sample has failed.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2002

Evan Faulkner
David Sanabria
Sydney Wells

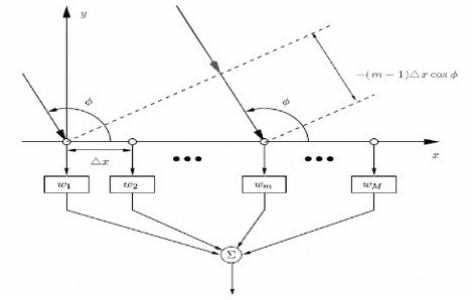
ADVISOR

A. F. M. Anwar

SPONSOR

MITRE

Uniform Linear Array Implementation using Software Defined Radios



Underwater acoustic communication is an active area of research due to its applicability in many industries. In comparison to other forms of underwater communication, acoustics provide a useful combination of versatility, range, and high data rates. However, the underwater acoustic channel presents several challenges to communication. To combat some of these issues, the use of hydrophone arrays with transmitting and receiving elements has been shown to be effective. By leveraging the spatial diversity provided by an array of hydrophones, some of the channel effects can be mitigated, improving the potential performance of both transmitters and receivers. Our team has developed software to transmit and receive signals between two Software Defined Radios with a uniform linear array for transmission and reception.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2003

Alex Fairfax
Colin Hale
Benas Kirvelevicius
Sean Youngblood

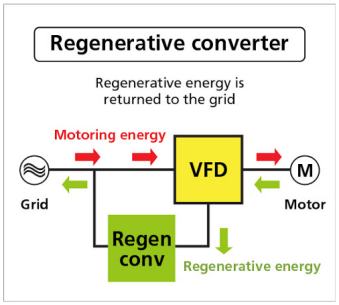
ADVISORS

Sung-Yeul Park
Christopher Johnson,
Lenze Americas

SPONSOR

Lenze

Three Phase AC Regenerative Power Supply



Lenze Americas, our corporate sponsor, constructs variable speed drives in order to power three phase motors. The basic operation of a variable speed drive is to take a fixed input AC source, rectify it to an intermediate DC voltage, and then invert the DC voltage to a variable voltage and frequency, allowing the attached motor to operate at different speeds. These devices are also known as variable frequency drives, or VFDs.

Our group was tasked with constructing a solution to a problem that is encountered with VFDs under a particular condition. When the motor undergoes rapid deceleration, current is fed back into the VFD thus increasing the voltage on the capacitor bank. This condition is known as regenerative energy mode, and it is useful in applications like electric automobiles for recapturing energy. However, in order to keep the capacitor bank in a VFD system from being damaged, the energy must be redirected. The most common method used is to burn off the excess energy through a resistive load. Along with wasting energy, the system generates large amounts of heat, and the additional complexity increases overall cost.

We have designed and constructed an electrical system which removes this excess energy and returns it to the grid via a DC to three-phase AC inverter. This solution is advantageous as our system simultaneously manages the VFD capacitor bank voltage, ensuring safe operation during motor regeneration conditions, and results in a renewable energy system capable of supplying electrical power to the main grid.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2004

Alyona Crews
Andrew Davidson
Nell Kane
Alex Rontey

ADVISOR

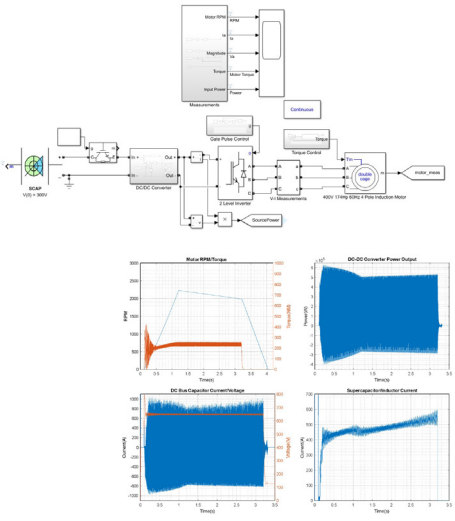
Yang Cao

SPONSOR

GENERAL DYNAMICS
Electric Boat

Pulse Power Conversion for Medium Voltage Systems

In this project, we developed the necessary circuitry to efficiently convert pulse power from an energy storage device to provide a short period of electrical boost to a medium voltage system. The storage device that was chosen for this project was a supercapacitor instead of a battery or flywheel. In phase one, a Simulink test bench was created to provide an electrical boost to an induction motor similar to that of the Tesla Model P85D during the vehicle's insane mode. For phase two, a scaled model of the Simulink test bench was designed and constructed for demonstration purposes. The 1HP scaled model was sized to be representative of laboratory conditions. Testing was conducted to ensure the designed circuit behaved according to the parameters set forth by the sponsor, General Dynamics Electric Boat.



ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2005

Miguel Castaneda Acosta
Kevin Krohomer
Natong Lin
Joseph Roca

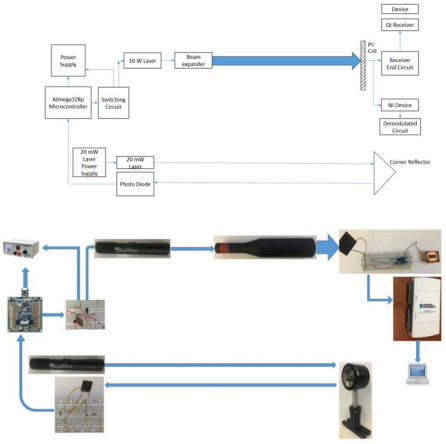
ADVISOR

Shengli Zhou

SPONSOR

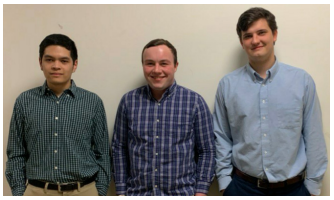
UCONN SCHOOL OF ENGINEERING
ELECTRICAL & COMPUTER ENGINEERING

Wireless Charging and Data Transmission Via Resonant Beam



We need to charge our electronic devices on a daily basis. The inconvenience of carrying a power cord and looking for an outlet brings us to a demand of wireless charging. In our project, we address this problem through the concept of transmitting data and power via resonant beam. Our system consists of a transmitter and receiver, where power is transmitted through a 532 nm laser. There is an optical feedback loop that acts as a trigger to stop the transmission of power when the line of sight is obstructed, therefore providing feedback to a microcontroller unit (MCU). The MCU regulates the power transmission and modulates the data signal. The modulation occurs though the implementation of a switching circuit that is directly controlled by a MCU. At the receiving end, the resonant beam is converted into electrical power via photovoltaic cell and at the same time, the data signal is recovered via software-defined radio. A converter amplifies the output voltage of the PV cell to charge a device and interpret the data.

ELECTRICAL AND COMPUTER ENGINEERING



TEAM 2006

Lucas McPhee
Miren Relucio
Grant Wallace

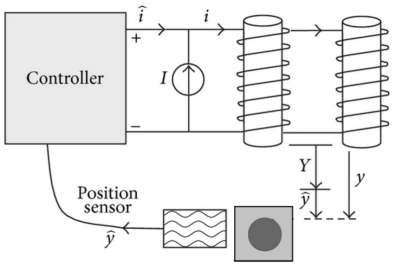
ADVISOR

Liang Zhang

SPONSOR

UCONN SCHOOL OF ENGINEERING
ELECTRICAL & COMPUTER ENGINEERING

Maglev Train Demo



A widely used lab-scale control theory demonstration is the magnetic levitation system which uses an electromagnet to lift a steel ball airborne compensating for the downward force of gravity. The magnetic steel ball levitation demo illustrates the idea of real-world applications such as Maglev trains. The current steel ball levitation demo used by the ECE department requires a connection with a computer running MATLAB/Simulink and cannot perform any lateral movement of the elevated object. Thus, the goal of this project is to implement a standalone steel ball levitation demo that has the ability to move laterally. The device will be implemented using inverted electromagnets to levitate steel ball. Distance sensors are used measure the desired distance between the ball and magnet constantly. This distance is sent to a microcontroller which will calculate the amount of current supplied to the electromagnets to levitate the ball at the desired height, depending on its current height. Power electronics are used so that this demo can be powered through a standard 120 V power outlet.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2007

Brian Fomenko
Brandon D'Agostino
Alex Maric

ADVISOR

Shalabh Gupta

SPONSOR

UCONN SCHOOL OF ENGINEERING
ELECTRICAL & COMPUTER ENGINEERING

UAV Package Delivery Demo

Autonomous drone technology has expanded rapidly into civilian market sectors over the last two decades despite primarily serving in military roles throughout the latter third of the twentieth century. Particularly interesting are the efforts of logistic-giants whose warehouses and service infrastructures are becoming more reliant on autonomous drone technology. For example, Amazon has been exploring fully autonomous package delivery by way of Unmanned Aerial Vehicles (UAVs) in recent years, with trial-runs being carried out in select parts of North America already.

Developing these UAV Package Delivery Drones presents many engineering design challenges that necessitate a portfolio of diverse skills spanning different fields such as: control systems, electrical engineering, communication systems, computer vision, machine learning, and others.

One such challenge is integrating a computer vision system with the navigational capabilities of the drone in the aim of being able to autonomously identify and navigate towards some object, such as a package marked for delivery or pick-up.

In this project, we integrate an off-the-shelf computer vision system (PixyCam) with an existing quad-copter flight control platform (Pixhawk4/PX4) to demonstrate autonomous recognition of and navigation towards identified objects/packages.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2008

Zachary Ahearn
Spencer Arnold
Dennis Basar
Waleed Hussain

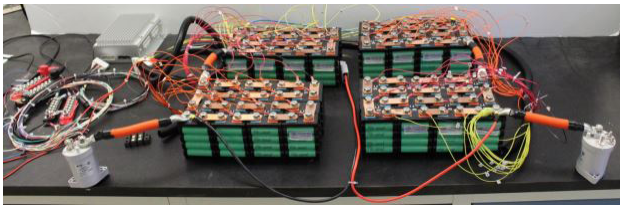
ADVISOR

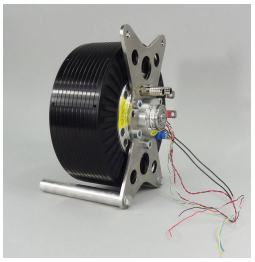
Sung-Yeul Park

SPONSOR

UCEM ELECTRIC MOTORSPORTS

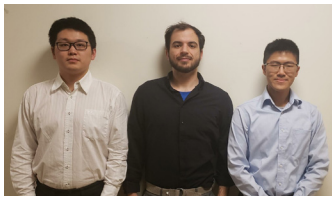
Power Train System Integration for Electric Cars





The UConn Electric Motorsport Club (UCEM) is in the process of building a single-seat electric race car to compete at Formula SAE Electric events. The UCEM team wants a powertrain system that is capable of high speeds, high acceleration, and a long battery life. The powertrain must also be able to communicate with the on-board low voltage system, as well as deliver real-time information to the driver during operation. The electric vehicle will be powered by a high voltage accumulator system, which consists of 64 lithium ion battery packs, outputting a substantial voltage of 268 V. The batteries will be monitored and controlled through a battery management system (BMS), and charged via an off-board battery charging unit. The vehicle will be propelled by a single electric motor, which will be controlled through a motor controller. The motor drive system is capable of outputting a constant 40 horsepower during normal driving conditions. These systems must be integrated into the electric vehicle, and will interface via a CAN protocol. This interface is widely used, and can be easily monitored by the vehicle's control module and driver while in operation. The scope of this project includes testing the accumulator and motor drive systems both separately and together.

ELECTRICAL AND COMPUTER ENGINEERING



TEAM 2009

Gary Chow
Marios Tahiri
Keran Wang

ADVISOR

Lei Wang

SPONSOR

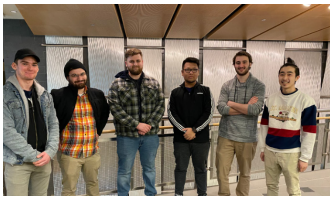
UConn Formula SAE

Sensor Systems for Dynamometer

The UConn Formula SAE team is a student club who design and engineer a formula styled race car to compete with other collegiate teams across the world. The team has a custom built dynamometer (dyno) to help test and tune the engine before putting it in the car. To do this, the engine and dyno have a suite of sensors to gather vital information for the team.

The project calls for an upgrade to the current dyno setup. It will help the team further enhance their design and testing capabilities. The existing software uses LabView to log torque and horsepower. Our project upgrades include measuring the brake specific fuel consumption (BSFC), exhaust differential temperatures, intake pressure transients, component temperatures, and component electrical power draw. A power supply module is designed to supply auxiliary loads when the engine is not running. With this data, the team can improve engine efficiency and power.

ELECTRICAL AND COMPUTER ENGINEERING



TEAM 2010

Gavin Colwell
Cavin Farley
Zachary Murtishi

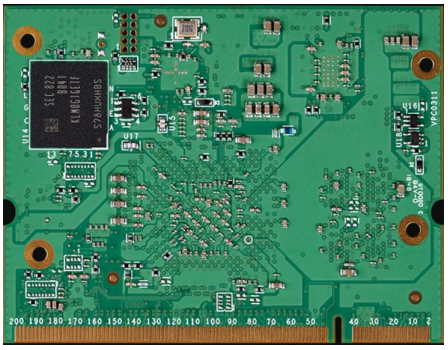
ADVISOR

John Chandy

SPONSOR

Control Module Inc.
Advanced Technology and Manufacturing

ALPR Camera System Replacement



Automatic license plate recognition (ALPR) technologies are vital to many access control systems today. A designer of ALPR-based access control systems, Control Module, Inc seeked a low-cost replacement for their current system design. With their sponsorship, we have been charged with the design of camera hardware for this replacement system. We have designed a modular IP camera platform with support for many peripherals using common protocols. This is in order to provide a design with a long product life that does not need complete replacement upon the obsolescence or discontinuation of a vital component. At the heart of this design is a Linux-enabled system-on-module with hardware support for communication protocols. Using a digital video camera and an array of diagnostics sensors in conjunction with the built-in Ethernet hardware, the system-on-module is configured to combine all data inputs into one continuous data stream. This data stream is read by the computing platform running image processing algorithms to perform analysis for automatic license plate recognition and is then deposited on a safe data backup platform.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2011

Cynthia Bissereth
Jonathan Davis
Ethan McRae

ADVISOR

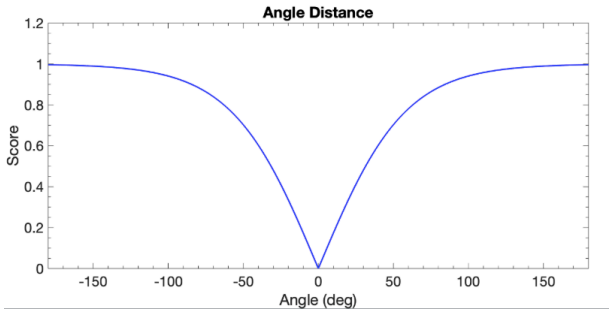
Peter Luh

SPONSOR

ISO new england

Generator Model Verification Result Analysis System

The Generator Model Verification Result Analysis System involves both the theoretical side of evaluating various models and the practical side of implementing the analysis in a software system with a web application. Our responsibility as a member of the ECE team assigned to ISO New England's project is to develop the criteria for how each model will be ranked as well as to develop means for improving the models. The scoring engine will rank models by determining the correlation between the models response to an event with respect to the physically measured response to the same event. This will allow models to be compared to one another quantitatively in terms of their accuracy. In addition, by cross-correlating the model's response and the physical response in the time-domain, we can determine where models were adequate in predicting the physical response and thus determine which part of a model is accurate. This analysis will allow us to better determine how to improve the models.



ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2012

Tedros Beyan
Steven Chick
Joao Mbaya
John Owens
Yuxing Peng
Zhaoyu Wu

ADVISOR

Liang Zhang

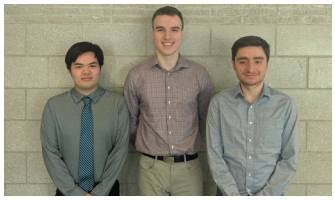
SPONSOR

Walter Nelson, Sr.
WNS Enterprises, LLC

Courtesy Messaging Signaling Device

Automobile accidents have been one of the leading causes of injury and/or death around the world.Through miscues, senseless driving, drunk driving, inattention, etc. people are paying the price with their livelihood or lives themselves. With the Courtesy Messaging Signaling Device (CMSD) we will attempt to decrease adverse impacts on property and lives by making roads safer. We envision that the CMSD will allow driver-to-driver and/or driver-to-pedestrian communication. Specifically, the technology will provide drivers with the ability to send messages to other drivers and/or pedestrians from their cars using an app that is accessible on a user's smartphone. In our demonstration of the technology, a driver would be equipped with an LED board that will allow messages to be seen from other drivers or pedestrians in their vicinity. We believe that the addition of such technology will make a substantial difference in creating safer roadways and environments for all users.

ELECTRICAL AND COMPUTER ENGINEERING



TEAM 2013

Balsha Maric
Long Phan
Wissam Razouki

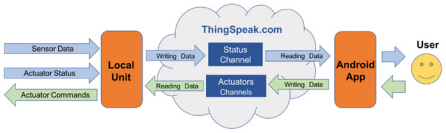
ADVISOR

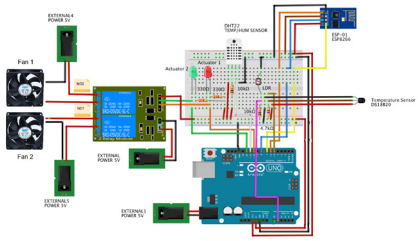
Shalabh Gupta

SPONSOR

Carrier
United Technologies

Verification Strategy and Tools for IoT Systems

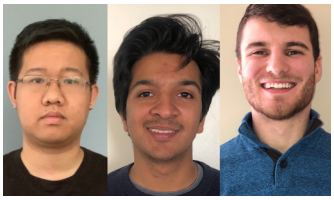




IoT (Internet of Things) is a relatively new field that seeks to connect many common devices and machines we use today to a network, allowing us to easily control and/or monitor them remotely. In the past, these systems were only tested relative to their mechanical components and control systems. However, with the integration of this new IoT infrastructure comes new challenges, requiring more time to be spent testing and verifying the functionality of each device using different techniques. With this new generation of internet-connected devices, our sponsor, Carrier, requires verification methods and a testing architecture capable of being applied to their products.

In order to develop a testing methodology for IoT systems, we needed to design and build a simple IoT system to run tests on. For our system, we utilize ThingSpeak as our cloud platform due to its integration with MATLAB. Data from sensors is captured from the circuit and sent to ThingSpeak. An Android application reads and displays these values in real-time. The app is also able to control actuators on the circuit through the cloud. With this system, we are able to perform various performance, stability, and usability testing/analysis using MATLAB and other software tools, with an end goal of having an established verification methodology for IoT systems in general.

ELECTRICAL AND COMPUTER ENGINEERING



TEAM 2014

John Kaminski
Bowen Liang
Amit Potdar

ADVISORS

Brian McCabe
Sanjay Bajekal
Shengli Zhou

SPONSOR

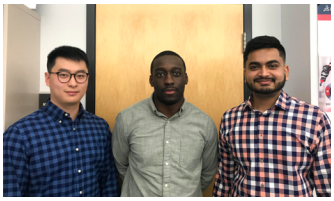
United Technologies Research Center

Software Defined Radio based Secure Wireless Networking

This project will examine the security issues of an existing Software Defined Radio based network which are a critical requirement for wireless communication systems. The threat to be explored is a man-in-the-middle (MITM) attack, where a third party disrupts the communications between two other parties. To combat this, a security algorithm will be added to the physical layer of the system that will identify potential attackers through fingerprints for identification. The fingerprint will be generated using a probing message that is defined by scanning the whole frequency band. This security algorithm will be investigated through experimentation before being added to the physical layer.

The proposed method will begin with two radios transmitting a predetermined message with high power components at known baseband frequencies. Each radio will then measure the received power at these locations to generate a secret key that is unique to the wireless channel being used. Subsequently, devices will be able to authenticate each other based on the secret key that is generated during the probing process.

ELECTRICAL AND COMPUTER ENGINEERING



TEAM 2015

Andrew Louis
Meet Patel
Xuanan Yue

ADVISOR

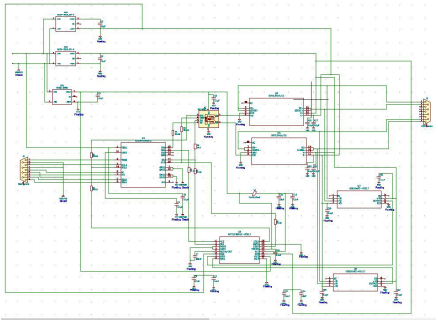
Lei Wang

SPONSOR

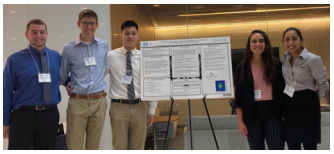
Collins Aerospace

Alternative Lightning Protection Solutions for an Airborne Embedded Controller

Our sponsor, Collins Aerospace has assigned us to come up with alternative solutions for lightning protection for an airborne controller. Our team reviewed possible alternative solutions including galvanic isolation methods to break lightning current loops, reducing TVS size and quantity, and considering the failure modes to ensure that loss of lightning suppression capability cannot fail undetectably. From the potential solutions, we determined that constructing a galvanic isolated circuit using SPI (serial Peripheral Interface) bus system to break the lightning current loop would be the most effective solution. Our main goal for this project was build a working prototype of TVS circuit on PCB (printed circuit board). To test the PCB, we will introduce the lightning simulation and test check the whole process with Raspberry Pi 3.



ELECTRICAL AND COMPUTER ENGINEERING



TEAM 2016

Timothy Beacham
Xu Dong (Andy) Lu
Ryan Pyrch

ADVISOR

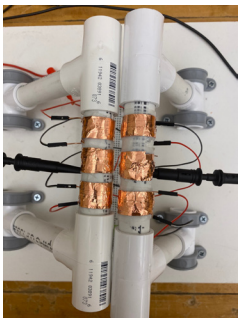
Necmi Biyikli

SPONSOR

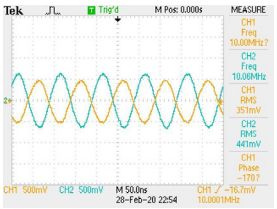
PRATT & WHITNEY DEPENDABLE ENGINES

GO BEYOND

Modeling and Optimization of a Dual-Bore Oil Debris Monitoring System

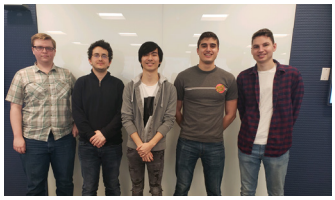


The objective of this project is to model and prototype a dual-bore Oil Debris Monitoring (ODM) system for use in Pratt & Whitney's jet engines. The ODM sensor detects debris particles in engine oil and helps prevent engine failure. The current ODM system used by Pratt & Whitney consists of a single assembly in which the pressurized lubricant flows through a single channel to one ODM sensor. The dual-bore setup minimizes electromagnetic interference between the interacting coils' magnetic fields while optimizing the assembly's ability to detect small particles with high accuracy. The dual-bore split flow path also serves to preserve feasible pressure conditions to ensure the reliability of the ODM sensors.



A single ODM sensor is created using three inductive coils. The outside coils are excitation coils being powered by a sinusoidal function. The middle coil is a sensing coil used to detect the electromagnetic field produced by the excitation coils. When ferromagnetic particles pass through the coils, they disturb the magnetic field. The resulting disturbance causes the sensing coil to observe a higher voltage. The dual-bore ODM setup is created by placing two ODM sensors in parallel. Interactions between the two sets of coils were analyzed to ensure reactions in the sensing coils only occurred when debris was in the corresponding ODM.

ELECTRICAL AND COMPUTER ENGINEERING



TEAM 2017

Alex Ghajar
Edward Han
Alex Samegulin
Glenn Thierfeldt
Matthew Zujewski

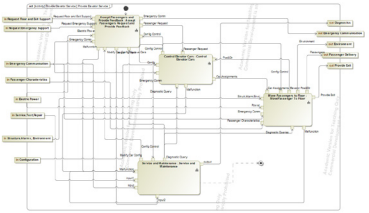
ADVISORS

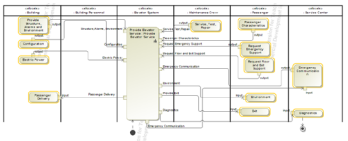
Ashwin Dani
Horea Ilies
Amy Thompson

SPONSOR

OTIS

MBSE using SysML with Application to a Self-Climbing Elevator Design

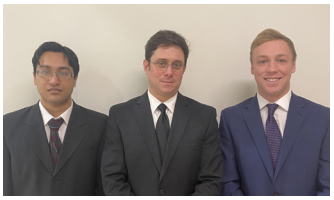




Otis' design practices are document-based processes for system engineering which limit ability to timely and consistently track changes in system and component requirements, design architectures, use cases, component basic data, enabling analysis models and simulation tools, and verification results. Two focal areas at Otis to pursue in order to address these challenges are product and component platforming and Model-Based System Engineering (MBSE). The underlying principle is to move our product design data and engineering documentation into a digital enterprise that facilitates and promotes component rationalization to reuse while enabling product innovation. An example application where such MBSE processes could be applied is a design and optimization of a self-climbing elevator.

Otis has piloted SysML in a few projects that has demonstrated its potential in connecting requirements, behavior, structure, and parametrics. The next step will be to develop a formal process and associated toolset to archive SysML objects into a reusable library to promote effective "catalog shopping" of existing Otis-developed components to reduce our product development time while supporting design innovations. The desired outcome is a SysML archival process to facilitate effective product design and demonstration of this MBSE process to the elevator design to verify its application.

ELECTRICAL AND COMPUTER ENGINEERING



TEAM 2018

Camden Craigie
Adam McCormack
Arif Mobarak

ADVISOR

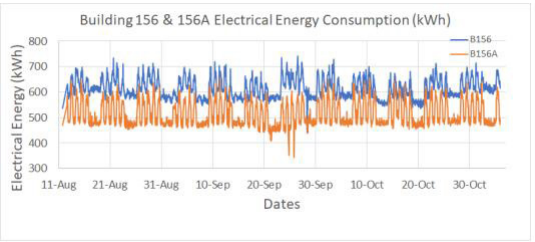
A. F. M. Anwar

SPONSOR

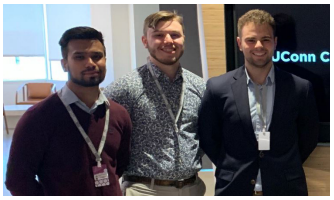
Pfizer

Energy Consumption Analysis

As energy and energy production become a higher visibility and more in demand resource, major companies are looking for ways to supplement their energy sources or reduce their energy consumption. Advanced research laboratories with highly complicated and sensitive instruments are especially looking for less expensive options without sacrificing reliability or environmental impact. Pfizer Groton Research and Development lab is looking for outside ideas on how to reduce waste and energy consumption, but those solutions must have high reliability, cost efficiency, and help to achieve the waste reduction goals of the Pfizer Global Energy Plan.



ELECTRICAL AND COMPUTER ENGINEERING



TEAM 2019

Benjamin Hart
Daniel Leclerc
Rasal Talukdar

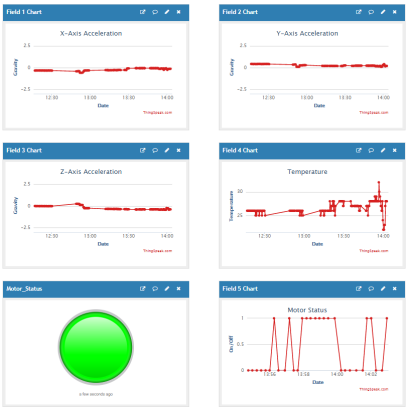
ADVISOR

John Chandy

SPONSOR

Munich RE | Hartford Steam Boiler

Wireless Motor Sensor



Hartford Steam Boiler desires a way to monitor electric motors to assess their condition. Measuring the health of an AC motor can be invasive to the motor and detrimental to the work-flow of a company. The process of diagnosing an AC motor is invasive because it requires the motor to be isolated and subjected to testing and measurements that would not be able to be done while the motor is working in its normal functions. Being able to non-invasively analyze the health of an AC motor would allow for companies to continue production and to be able to predict when a fault will occur in their motors. The wireless sensing of an AC motor's health will make companies be able to better detect faults within their motors, will reduce the time that a company's production is halted, and will provide strategic planning for the maintenance and repair of their motors. The Wireless Motor Sensor project by The Hartford Steam Boiler provides a solution to the problems of invasive AC motor sensing. The Wireless Motor Sensor is able to transmit temperature, vibration, and motor on/off data via a thermocouple, accelerometer, hall sensor, and LoRaWAN to a gateway. The gateway forwards this data to TheThingsNetwork API to be displayed on a console for view. Further analysis of the data can be performed using the data from the console.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2020

Alexandra Paulakos
Alexander Podgorski
Joseph Slivinski

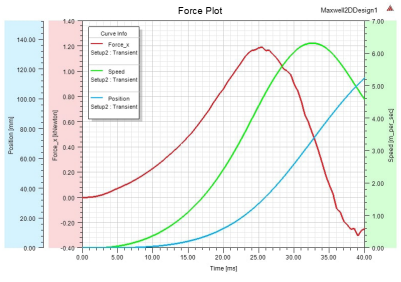
ADVISOR

Abhishek Dutta

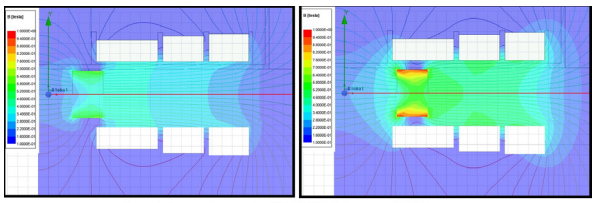
SPONSOR

NAVSEA WARFARE CENTERS NEWPORT

Electromagnetic Expulsion of a Cylindrical Body from an Outer Tube



Group 2020's project is a joint effort between the Mechanical and Electrical teams. The main goal is to expel a cylindrical body from a dry tube into an underwater medium. The project is a continuation of last year's Project 1915. Our challenge was to improve the time between each payload release, as well as increasing the expulsion force, and thus, speed. The means of expulsion is led by the Electrical Engineering team, where the design and fabrication of the tube, coils, and tank are led by the Mechanical Engineering team. The firing mechanism uses the principles of electromagnetism, using stored voltage in large capacitors and a pulse forming network to 'dump' current into three different inductive coils. The coils are fired at interval stages to pull the body down the tube and expel it into a water-tight tank.



7ms Transient in ANSYS Maxwell 2D

ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2021

Camila Leyva
Truc Nguyen
Dhaval Patel

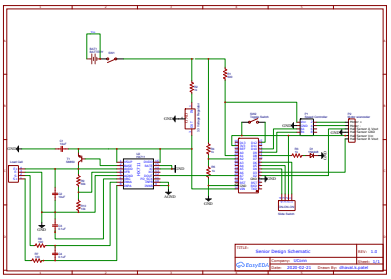
ADVISOR

Abhishek Dutta

SPONSOR

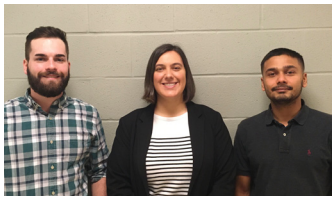
Medtronic

Mobile Hand-held Tissue Compression Tester Final Report



Compared to conventional methods, surgical stapling is easy to use and extremely efficient. Medtronic has already designed a surgical stapler that combines three complex steps into one easy step: compression, sealing, and cutting. Besides being easy to use and efficient it also staples tissue at three different pressures that promotes blood flow into the staple line while still sealing fluid and gas contents within the tissue. However, organs are made up of different tissue types and each of these tissues have different properties. This means that each type of tissue needs to have different methods of stapling in order to optimize tissue sealing, blood flow, as well as other stapling parameters. Moreover, the health of the tissue may be compromised and require different stapling methods as well. Since the design process never ends, Medtronic has requested team 2021 to create a device that can solve this problem. Our task is to create a hand-held device that can conduct stress analysis tests on tissue and transfer the data recorded, which will eventually be used to detect the condition of the tissue. As time progressed, so has team 2021, we have conducted several simulations for the PID control system for the motor. Thus, giving us the ability to fine-tune the values of the PID. The team has also created a development board that is able to control the motor and read displacement. Although the load – cell is still in the works, the team has figured out and coded a way to transfer data through IOT for easy access.

ELECTRICAL AND COMPUTER ENGINEERING



TEAM 2022

Srijan Banjara
Leah Miller
Michael Tuite

ADVISOR

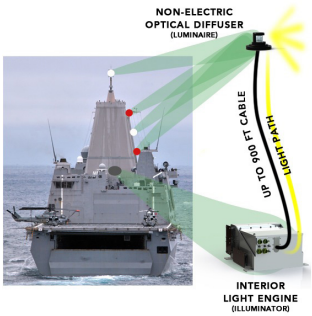
Necmi Biyikli

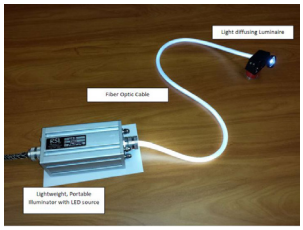
SPONSOR

RSL®
Advanced Lighting Technologies

Portable, Lightweight Fiber Optic Illuminator

In partnership with RSL Fiber Systems, a joint electrical engineering and mechanical engineering team has been tasked with designing and prototyping an LED light engine. The goal of this LED device is to generate light to be carried through a fiber optic cable to a hazardous area, where EM waves could potentially be dangerous. This device would be useful for marine and industrial applications, especially on ships and service vehicles. The device contains an internal battery charging circuit, charged by a car's battery, to allow for portability. There is also the ability to have different LED dimming levels and a flashing function. The control of the driver will be done with an internal microcontroller with Bluetooth capability, allowing for user input and monitoring. All of the circuitry is fully enclosed and thus resistant to water and air, as well as shock, vibration, and EMI.





ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2023

Myles Barrow
Matt Nattila

ADVISOR

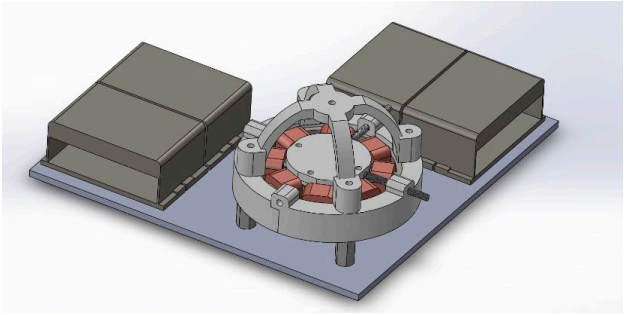
Helena Silva

SPONSOR

United Technologies Research Center

Multi-Dimensional High Frequency Wear Testing

For this project, we have developed a better way to test high frequency vibration wear on a specimen. Originally our sponsor, UTRC, had a test rig capable of creating wear in one dimension at 300Hz. Our new test method has improved upon this by increasing the frequency of movement and is capable of motion and thus wear in two dimensions. To do this we utilized a magnetic bearing driven by amplified signals from our LabVIEW program to provide the motion that the wear test specimen is subject to. Additionally, this has allowed us to create different wear paths by modifying the signals generated by our program. Using a magnetic bearing has allowed us to create vibration wear of up to 1000Hz at an amplitude of only 0.25mm.



ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2024

Colin Rook
Kamal Watt
Tommy Wen

ADVISOR

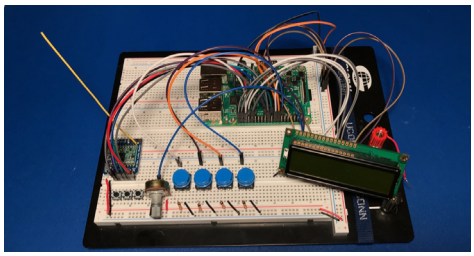
Ashwin Dani

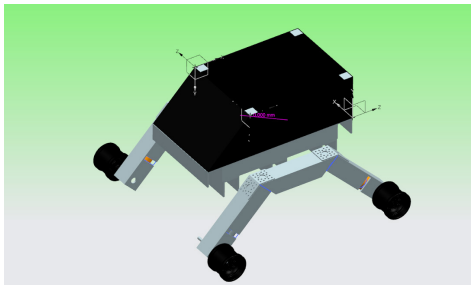
SPONSOR

agriMolution

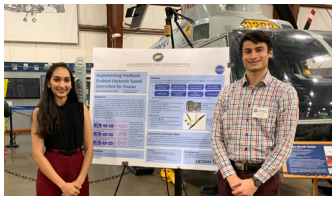
Development of A Field Agri-Robot for Crop Health Monitoring

The farming population in the U.S. is gradually aging and dwindling, but the demand for food is ever-increasing. An autonomous, smart agricultural robot that we have developed for the past two semesters would spare farmers of daily trivial chores on the farm and allow them to devote their focus on more meaningful tasks. The all-terrain, all-weather agri-robot is equipped to collect environmental data such as ambient temperature and humidity, capture images of crop abnormalities powered by a machine-vision algorithm, and alert the user of the GPS coordinates of the problem hotspots on the farm. This machine gives the farmer an extra set of eyes and ears with useful data on crop health and addresses the pending labor shortage in the farming sectors.





ELECTRICAL AND COMPUTER ENGINEERING



TEAM 2025

Noah Del Coro
Hima Patel

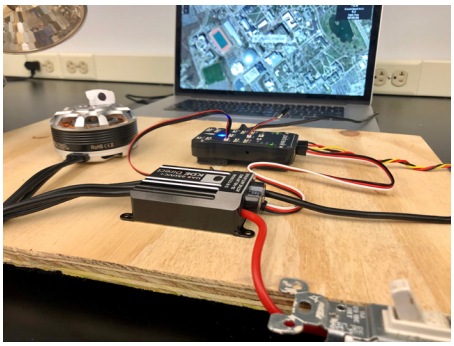
ADVISOR

Ashwin Dani

SPONSOR

UCONN SCHOOL OF ENGINEERING
ELECTRICAL & COMPUTER ENGINEERING

High Power Electronic Speed Controller Integration for Drone Flight Control



NASA is an interested party in this project due to the potential for improving drone flight. A crucial aspect of drone research is the electronic speed controllers (ESCs) that power its rotors. The goal of this senior design project was to conduct a comparison between two well-known ESCs and implement closed loop control on the chosen ESC with NASA's flight hardware.

We began the build process by constructing a robust testbed and running experiments on the KDE ESC and the VESC. We compared the results by analyzing the step response, latency, and bandwidth. To achieve closed loop control, we wrote driver code for NASA's F Prime flight software framework that implements the CAN duplex protocol. This code measures the rotor's rotations per minute (RPM), then uses that to calculate the rotor's thrust vector and command the motor with their respective power. Physical tests were used to quantify the potential performance improvements, as thrust vectoring is hypothesized to lead to more efficient flight.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2026

James Kuveke
Jonathan Luo
James Wales

ADVISOR

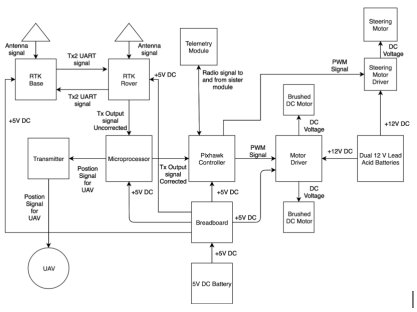
Shalabh Gupta

SPONSOR

ThayerMahan

Unmanned Ground Vehicle for Simulating Unmanned Air Vehicle Landing

ThayerMahan, a maritime surveillance company, works with the United States government to survey and monitor our ocean borders. ThayerMahan has tasked our team, in conjunction with a mechanical engineering team, with the development of an unmanned ground vehicle to simulate the landing of an unmanned air vehicle on an unmanned boat (the ground vehicle will be replaced by a boat in practical use). The vehicle will be able to move towards set way points through gps, the use of two electric motors and the function of skid steering to change direction. To achieve autonomous control and facilitate an accurate landing, the UGV will use RTK GPS technology, which provides extremely accurate coordinates, to transmit its position to the UAV. Once the UAV has received the position of the UGV, it will locate the ground vehicle, and land on a landing platform.



ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2027

Luis Baena
Sam Pevsner
Ben Rattet

ADVISORS

Abhishek Dutta
Helena Silva

SPONSOR

ThayerMahan

Autonomous Air Vehicle Operations from Mobile Host Platform

This project is sponsored by ThayerMahan, located in Groton, CT. ThayerMahan designs, manufactures and operates systems to collect acoustic and electronic information on the world's oceans. These systems allow government and industry partners to protect borders, natural resources, and undersea infrastructure. The goal of the project is to identify the obstacles to reliably land an unmanned aerial vehicle (UAV) on Team 2026's moving unmanned surface vehicle (USV). This requires the use of high-precision GPS hardware.

For the project, off-the-shelf drone parts have been selected in order to create a UAV which was customizable and programmable to our needs. In order to accomplish the goal of landing on a moving vehicle, high-precision RTK GPS (real time kinematic) was chosen allowing latitude, longitude and altitude to be measured with centimeter accuracy. Using a moving baseline configuration, the RTK fix could be computed in order to get the necessary accuracy for landing of the UAV. The design for the landing mechanism will be handled by the Mechanical Engineering team assigned to the project.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2028

Bridget Kennedy
Brittany Smith
Matthew Sodoski

ADVISOR

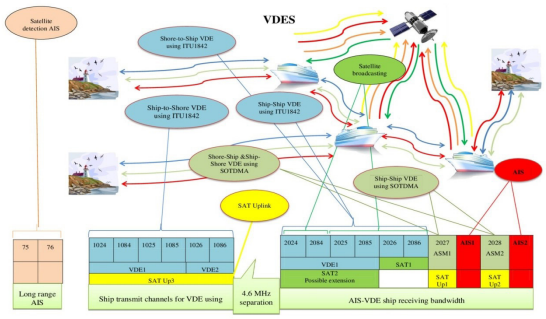
Liang Zhang

SPONSOR

RESEARCH & DEVELOPMENT CENTER
UNITED STATES COAST GUARD

Benchtop VDES Prototype

The goal of the project is to create a prototype of the 6-channel Very High Frequency Data Exchange System (VDES). This will be used for signal transmission and reception for communication in the US Coast Guard. Our current goal is to create the first two Automatic Identification System (AIS) channels. This will be programmed using Software Defined Radio. Each channel will receive and transmit signals at a specified bandwidth. The AIS system will detect ships within a 20 nautical mile range, and receive information such as size, speed, course and weather. After completion of the AIS channels, we can implement the 2 Application Specific Message (ASM) channels, which include more detailed ship information such as sea level. The remaining 2 channels, VDE, can then be implemented by the coast guard or next year's senior design group. This will include satellite and terrestrial ship information. The end result will be a benchtop model that can be demoed by the US coast guard.



ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2029

Robert Bailey
Osman Guster
Sofia Ricciardi

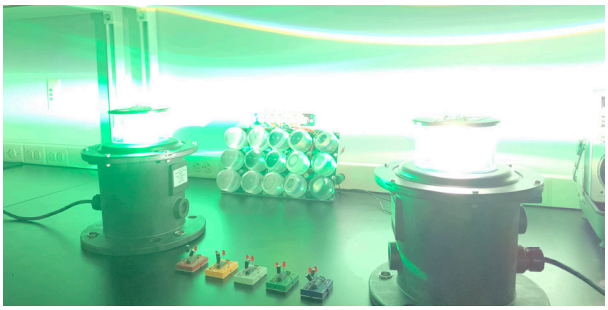
ADVISOR

Helena Silva

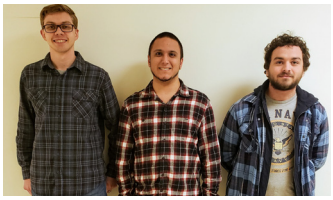
SPONSOR

Vulnerability of Marine Navigation Systems to Electromagnetic Pulse and Geomagnetic Disturbances

This project assesses the vulnerability of marine navigation systems to natural and malicious electromagnetic phenomena, with a particular focus on the beacons and range lights in the aid-to-navigation (ATON) network maintained by the United States Coast Guard. With an adaptive and iterative approach to implementing industry-standard electromagnetic compliance testing, Team 2029 designed a test platform and methodology to assess vulnerability to unwanted currents induced on system power leads. This testing simulates a hazard common to both electromagnetic pulse and geomagnetic disturbances. Results detail frequency-dependent susceptibility for multiple electronic systems, including prototype circuits used for test setup verification and models of ATON devices similar to those in present use. In addition, the team has provided the USCG Research and Development Center with implementation plans for additional testing modalities which could assess vulnerabilities to other EM hazards.



ELECTRICAL AND COMPUTER ENGINEERING



TEAM 2030

Clayton Ehasz
Alex Monsky
Alexander Zabbara

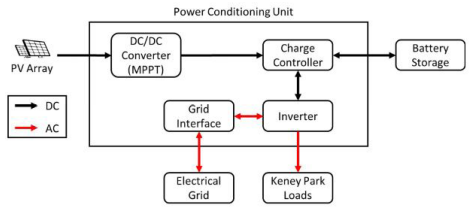
ADVISOR

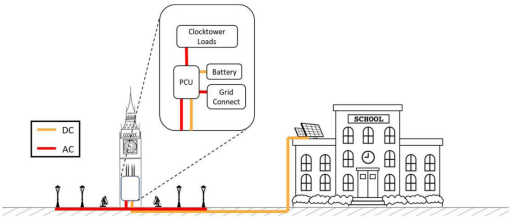
Sung-Yeul Park

SPONSOR

Keney Clock Tower Project Phase II

For Phase II of the Keney Clock Tower Restoration Project, ECE Senior Design Team 2030 is working with the City of Harford and Capital Preparatory Magnet School to complete the restoration of the Keney Clock Tower, located in Hartford, CT. Phase I of the project was completed by last year's Mechanical Engineering Senior Design, where they repaired the mechanical components of the clock tower. Phase II of the project had two main objectives. First, we prepared a feasibility study investigating whether installing a system to provide renewable energy with solar panels to the clock tower and associated park lighting was economical. Second, we worked with students from Capital Preparatory School to foster learning and interest in engineering. Towards that end, we built a demo-scale model of the clock tower system with a solar panel, a charge controller, a battery backup, and an inverter. This was paired with a display panel that contained a one-line diagram as well as sensing and display components to convey information about the system in real time. This was used to teach the students how a system like the one we proposed for the clock tower would function. Finally, we engaged in mentorship events with the students to teach them about the School of Engineering and how to tackle problems with an engineering mindset.





ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2031

Lauren Bledsoe
Jeremy Friedman
Tanner Jackson

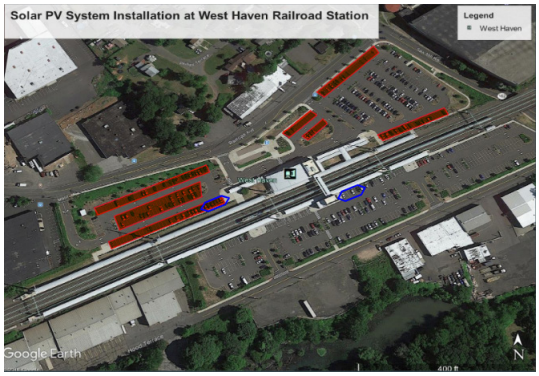
ADVISOR

Necmi Biyikli

SPONSOR

CONNECTICUT DEPARTMENT OF TRANSPORTATION 125 1895 - 2020

Solar PV System Installation at West Haven Railroad Station



The sponsor of this project, the Connecticut Department of Transportation, would like to install a solar PV system for their West Haven railroad station. They would like the solar panels to be installed on top of new carports as part of the project, as well as eight new electric vehicle charging stations. Our group proposed that we install carports for every parking spot, but only install solar panels in the North parking lot for the spots that face north to south. This will allow for easier wiring and minimal railroad closures since the electrical box is located on the north end of the station. These solar panels will be enough to power the railroad station as they can approximately produce 71,000kWh/month which is about 20% more than the max usage that the station consumes.

ELECTRICAL AND COMPUTER ENGINEERING

TEAM 2032

Yinuo Huang
Joseph Morello
Francisco Rivera
Shivendra Singh

ADVISOR

Ashwin Dani

SPONSOR

SIKORSKY
A LOCKHEED MARTIN COMPANY

Autonomous Firefighting Helicopter

Aerial firefighting is a common method of fighting large scale wildfires and for remote fires when ground systems are not deployable. Wildfires are always risky operations, even for helicopter pilots. Obstacle detection systems now being developed for unmanned air vehicles show promise for helicopter applications, either as sense-and-alert systems for piloted aircraft or as sense-and-avoid systems for unpiloted aircraft.

Our team customized a commercially available rotorcraft UAV to demonstrate autonomous obstacle avoidance in flight, while carrying a payload of water to be used in extinguishing a flame. Using a requirement-based development cycle, we selected a variety of lightweight, commercially available sensors to assist the UAV with obstacle avoidance, fire detection, and flight control systems. We installed and interfaced sensors with the existing UAV flight control system, and programmed closed-loop flight control algorithms. System performance was independently proven through requirements driven test procedures.

ENVIRONMENTAL ENGINEERING

TEAM 1

Reginald Denny
Alex DePasquale
Julia Lineweber
Lauren Roper

ADVISOR

Timothy Vadas

SPONSOR

LAKE Chaffee
the best kept secret in CT

Lake Chaffee Algal Bloom Management

Eutrophication and algal blooms have been an increasing issue for many surface waters. Lake Chaffee, a private, man-made lake in Ashford, CT, has not been immune to the consequences of algal blooms. Eutrophication is typically caused by the abundance of nutrients in surface waters. Residents of the Lake Chaffee community have been concerned about how continued algal blooms will affect the health and aesthetics of their lake. Several sources of nutrient input were investigated. Samples of lake water, stormwater, and sediment were taken at different times of the year to test for phosphorus, ammonium, and nitrate. The state of the residents' septic tanks were also investigated, as older systems can easily become contributors to the lake's nutrient load due to their proximity to the water table. Surveys were also distributed to the residents to assess their lifestyle habits, and how they might be contributing to the algal blooms. Possible solutions that were investigated include septic system upgrades, stormwater treatment systems, phosphate control systems, implementing barley straw, lowering the lake levels, and floating islands to mitigate the algal bloom problem. Possible engineering solutions are also accompanied by comprehensive recommendations to the community on how the residents can limit their nutrient contributions through lifestyle choices and property maintenance.

ENVIRONMENTAL ENGINEERING

TEAM 2

Matthew McKenna
Erica Pudvelis

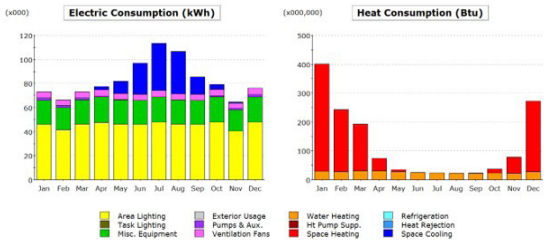
ADVISOR

Shinae Jang

SPONSOR

Pfizer

Process Development for Energy Consumption Analysis



Pfizer is a leading research-based biopharmaceutical company who produces medicines surrounding the fields of cardiovascular health, metabolism, oncology, inflammation, and immunology worldwide. Its headquarters is located in New York City with a branch campus in Groton, CT, the focus for this project. The staff requested an energy consumption audit and analysis of the campus, comparing electricity, steam, and chilled water usage to determine opportunities for improved energy efficiency.

The objective of the project was to develop a multi-disciplinary engineering assessment of energy and water consumption across the Pfizer Groton campus. Due to time constraints, the team chose one focus study building: Building 156 to model the process after. Using the eQuest energy simulation software, the team developed solutions surrounding these target areas of improvement. Additionally, lighting upgrades were proposed and analyzed as well as water reduction techniques.

With the complete modeling of the focus study building, Pfizer staff are able to utilize this universal auditing process on any of the buildings they have on their campus where they see potential savings. Areas with most potential include laboratory single pass through air, hood sashes, and lighting in an effort to meet the goals of their corporate emissions reductions requirements that will be effective January 2023.

ENVIRONMENTAL ENGINEERING

TEAM 3

Olivia Harris
Enita Liang
Jing Ling
Ziyan Zhang

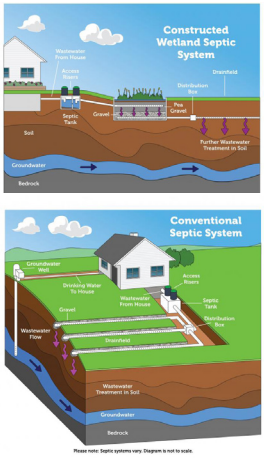
ADVISOR

Timothy Vadas

SPONSOR

CME
A CHA Company

On-Site Wastewater Treatment for Mansfield Four Corners



Hop Knot and Toast are restaurant establishments that are required to manage their wastewater. The waste generated consists of nutrient and solids loadings which include biochemical oxygen demand (BOD), total suspended solids (TSS), nitrogen, phosphorus, and fats/oil/grease (FOG) that must be treated. Although naturally occurring in the ecosystem, discharging highly concentrated contaminated effluents can cause severe ecological harm. The proposed solution is to design an on-site treatment system for the effluent from Mansfield Four Corners restaurants.

In this project, we provided two solutions for wastewater treatment: a septic system with either a leaching field or a subsurface constructed wetland. Both solutions involve primary and secondary treatment. In primary treatment, the wastewater will first go through a grease interceptor and then a septic tank for settling that removes the majority of FOGs and solids. For secondary treatment, the traditional leach field removes phosphate, metal ions, and TSS in the soil but can only remove a small portion of nitrogen. The alternative solution was a vegetated submerged bed wetland which uses microorganisms and vegetation to promote nutrient and organic contaminant removal.

ENVIRONMENTAL ENGINEERING

TEAM 4

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Zoe Demitrack
Jonathan Gareau

ADVISOR

Manish Roy

SPONSOR

Town of Wethersfield
505 SILAS DEANE HIGHWAY
WETHERSFIELD, CONNECTICUT 06109

Town of Wethersfield - Drainage Area Investigations and BMP Design

The General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems, otherwise known as the MS4 Permit, is the result of a USEPA mandate meant to reduce the amount of pollution discharged to a state's surface waters and wetlands. The goal of this Senior Design project was to assist the town of Wethersfield, Connecticut in its efforts to attain compliance with the new stormwater standards. According to previous stormwater research carried out in Wethersfield, the town's only impaired waterway is the Connecticut River. This project focused on the investigation of the stormwater discharge site contributing the most pollution to the Connecticut River in Wethersfield. This location is contributing much higher than acceptable levels of Enterococci/E. coli bacteria. Investigation and further sampling of this site carried out by the senior design team determined that the source of this contamination was system connectivity and proximity with the domestic and industrial sewer in residential areas and interconnections with Hartford's stormwater system. A Best Management Practice (BMP) program was developed for this site to reduce the Enterococci/E. coli outfall concentration to a level in compliance with the new MS4 guidelines. This BMP included maintenance of the adjacent sewer lines and public educational outreach.

ENVIRONMENTAL ENGINEERING

TEAM 5

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Esther Chang
Alex DaSilva

ADVISORS

Timothy Vadas

Town of Stratford -
Susmitha Attota
John Casey

SPONSOR

Town of Stratford – Public Park BMP Design

The Town of Stratford is interested in exploring the option of implementing Stormwater BMPs that require low maintenance and are drought resistant at 2 adjacent lots on 1000 Main Street. Our objective was to investigate three different types of BMPs that could be installed on the Frank DeLuca Parking Lot: Bioswales, Rain Gardens, and Pervious Pavement.

The purpose of implementing these Stormwater BMPs is to mitigate the impacts of climate change in the town as well as provide treatment of the runoff that will be discharged into an inland wetland that is located on the property. Additionally this project seeks to reduce Directly Connected Impervious Areas, in furtherance of the Town's MS4 permit goals. Public education about the Stormwater BMPs and plans for community involvement in the maintenance of the BMPs will also be included to make this project more comprehensive in meeting the town's MS4 permit goals.

The Town staff would like to use the designs developed by Engineering students to apply for grant funding with the Nature Conservancy and/or similar agencies and subsequently implement them.

ENVIRONMENTAL ENGINEERING

TEAM 6

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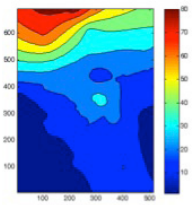
Mehdi Begag
Abdullah Chaudhry
Harrison Mangines

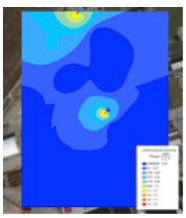
ADVISOR

Amvrossios Bagtzoglou

SPONSOR

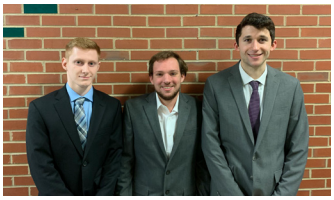
Groundwater Fate and Transport Modeling for Pump and Treat Remedial Design at the Atlantic Shellfish Site in North Kingstown, Rhode Island





Our design group was retained by Comprehensive Environmental Inc. (CEI) and UConn's Civil and Environmental Engineering Department to address the issue of groundwater contamination at the Atlantic Shellfish Site in North Kingstown, Rhode Island. The Former Defense Site hosted decades of chlorinated solvent use by the US Navy and updated groundwater sampling results from CEI showed contaminant levels above regulatory limits across the site. Our group chose to develop a depth-integrated, 2-Dimensional groundwater flow and particle transport model for the site and use it to facilitate the design of a pump & treat system to remediate the chlorinated solvent plume. The field data were incorporated into ArcGIS and using geostatistical techniques were exported in a format that could be integrated with the 2-Dimensional model. The model predicted how the contaminant plume would migrate throughout the subsurface of the site under different conditions. Knowing the extent of the modeled plume, it became possible to incorporate pumping wells into the model to analyze contaminant removal as a function of concentration reduction over time. As a result, optimal pumping rates and locations to best remediate the plume according to regulatory criteria were determined. A pump & treat system with packed column air stripping towers will be implemented as remediation.

ENVIRONMENTAL ENGINEERING



TEAM 7

Connor Campell
Tim Cannata
Chris Coon

ADVISOR

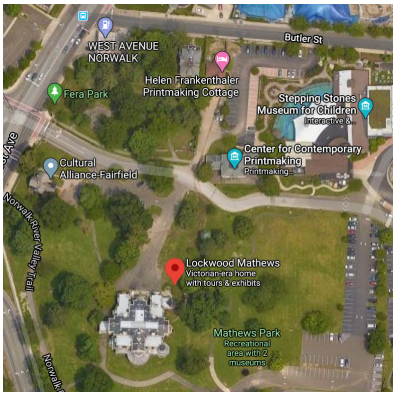
Shinae Jang

SPONSOR

Tighe&Bond

Lockwood Mathews Mansion Water Main Replacement and Parking Lot Redesign

This project is located at the Mathews Park in Norwalk, CT which has four buildings on site. The Lockwood Mathews Mansion Museum, the Cultural Alliance building, public restroom building, and Center for Contemporary Printmaking are connected to a 6" water main and meter pit which after an increase in residence time resulted in an increased layer of biofilm accumulation. The objectives of the project were to redesign the water main to meet current water usage, redesign the parking lot to include a truck turnaround and to utilize Best Management Practices to handle stormwater onsite. The water main was redesigned in accordance with the AWWA M22 Manual of Water Supply Practices. The parking lot for the Lockwood Mathews Mansion Museum was redesigned using the ADA Parking Codes to include a hammerhead turnaround. A bioretention basin was designed to handle the stormwater from the parking lot. The project will allow for improved water quality to the buildings, along with increased accessibility to Lockwood Mathews Mansion. Finally, stormwater runoff from the parking lot will be treated via the bioretention basin to reduce peak flows and increase infiltration.



ENVIRONMENTAL ENGINEERING

TEAM 8

Leonardo Abreu
James Kennedy
Mackenzie Pias
Jason Soltys

ADVISOR

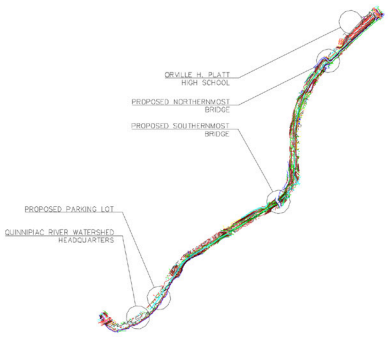
Wei Zhang

SPONSOR

Lenard Engineering, Inc.

Analysis and Design of Meriden Rails to Trails Project

This project involved an environmentally friendly design of a rail-to-trail conversion and a parking lot on a site in Meriden, CT. Once a railroad, this mile-long strip passes by a high school and a scenic view of a pond. The railroad tracks were converted into an asphalt trail that can be enjoyed by pedestrians and bikers. Multiple elements on the site had to be design and analyzed. This included the design and calculations of two bridges, horizontal and vertical alignments, the parking lot, and drainage. To connect the two points along the trail that crossed over a brook, two simply supported steel pedestrian bridges were designed. In addition to the design loads from pedestrians, the bridges were designed for bikers, and an H5 design vehicle. The parking lot was constructed with a central bioretention basin to aid the navigation of the parking lot, reduce the amount of stormwater runoff generated, and provide a visually pleasing assortment of native plants. A section of open grass was converted into a playground that can be used by the pedestrians. Overall, the project revitalizes the former railroad tracks by providing a space to embrace and interact with nature.



ENVIRONMENTAL ENGINEERING

TEAM 9

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Hejia Wang
Erika Yao

ADVISOR

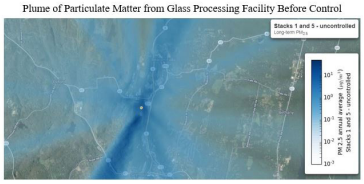
Timothy Vadas

SPONSOR

FUSS & O'NEILL

Air Emissions Control Design for Recycle Glass Processing Facility

Plume of Particulate Matter from Glass Processing Facility Before Control



Plume of Particulate Matter from Glass Processing Facility After Control

In an effort to utilize recycled glass while increasing the sustainability of construction practices, pozzolan is created from recycled glass and added to many products as a supplementary cementitious material. Throughout the manufacturing process, a large amount of particulate matter (PM) is created and must be controlled in order to prevent it from being released to the atmosphere. In order to design appropriate control technology, existing manufacturing processes were assessed for PM emissions rates and an air model was generated.

To meet the applicable air emission control criteria, control devices were designed to lower the concentration of PM of all sizes in the exhaust air that is leaving the facility. A cyclone and fabric filters in series were sized to do this. These devices were chosen based on the best available control technology (BACT) assessment in accordance with the New Source Review (NSR) permit. Air modeling was used to quantify the potential maximum concentration of each pollutant before and after the control devices are implemented. Based on the air modeling, implementing a cyclone and fabric filter in series reduced the potential maximum concentration of PM to below Connecticut's regulatory standards. This design is also the most cost-effective solution compared to other potential designs and requires a minimal amount of maintenance to operate efficiently.

ENVIRONMENTAL ENGINEERING

TEAM 10

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Nissrine Essafi
Samuel Worobel

ADVISORS

Maria Chrysochoou
Amine Dahmani
Tim Vadas

SPONSOR

Loureiro

Centredale Manor Restoration Project: Allendale Pond Sediment Remediation

The Centredale Manor Restoration Project (CMRP) is an active Superfund clean-up site in North Providence and Johnston, Rhode Island. The Source Area (SA) of the CMRP once contained a chemical plant and a drum reconditioning facility whose operations resulted in releases of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin and its congeners (dioxin) into the local environment, including two dammed ponds downstream of the SA. Allendale Pond (AP) – the pond immediately adjacent to the south of the SA – contains sediment contaminated with dioxin and was the subject of this project.

Our team was tasked with compiling environmental sampling data of dioxin concentrations taken from AP; utilizing professional statistical software to analyze that data to determine compliance with regulatory limits for planned remediation by excavation; considering and recommending sediment dewatering and disposal methods; and considering an alternative remedial option: armored capping with a chemical isolation layer.

Based on regulatory cleanup goals and available data, the team utilized statistical software to analyze sampling data and compute the UCL95 using USEPA-approved statistical methods. In addition, the required excavation, dewatering and disposal of AP sediment were estimated based on analytical and statistical results, and an alternative remedial design was made.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

TEAM 1

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Lucas Kamakura
David Sandor
Ben Zekowski

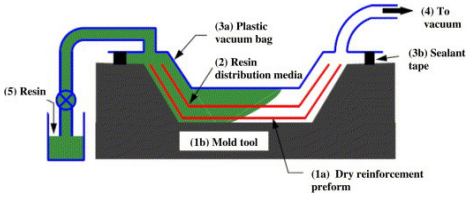
ADVISOR

Jiong Tang

SPONSORS

AIR FORCE RESEARCH LABORATORY

Advanced Composite Manufacturing Process Testbed



The use of carbon composites is growing rapidly in a variety of industries including aerospace and automotive manufacturing. Composite structures have the benefit of being extremely durable and lightweight. Our project, sponsored by Air Force Research Labs, focuses on a method of composite production referred to as vacuum assisted resin transfer molding (VARTM). This process, while effective, can result in an imperfect product with several possible defects. We are working to construct a testbed that will allow us to adjust certain production parameters in an effort to improve the process and ultimately the final composite product. An increased level of durability will benefit military operations through improved composite reliability.

We are currently in the building phase of the test bed and hope to have a functional VARTM system within the next two weeks. Our data collection and analysis will follow shortly after successful construction.

Our team will supply the final test bed analysis to the sponsor who will use the relevant information to improve carbon composite manufacturing. This senior design group is a part of a long term University run project with the same final objective.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

TEAM 2

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Leah Gervin
Arjun Kaneria

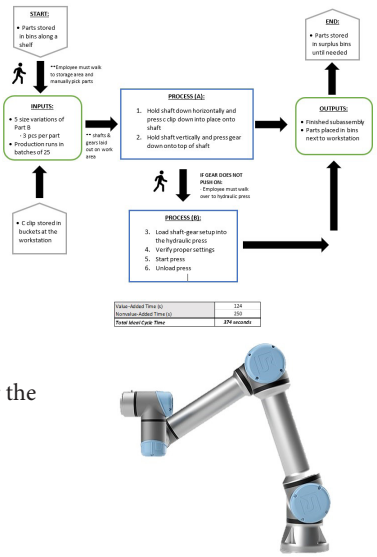
ADVISORS

Craig Calvert
Frank J. Cunha

SPONSORS

BELIMO®

Assembly Process Improvement with Cobot



Belimo Holding AG is a Swiss-based international manufacturer of valves, actuators, and sensors for heating, ventilation, and air-conditioning systems. The firm's North American headquarters is located in Danbury, Connecticut. As a market leader globally, Belimo seeks to further expand its manufacturing capabilities through automation. To accomplish this, the North American headquarters would like to gauge the feasibility of introducing a cobot into their production then design a plan for implementation. The perceived benefits of implementing a cobot include decreasing cost-structure, shortening lead-times, and increasing available human capital.

The UConn team assigned to this project has completed a review for feasibility and designed a new work cell layout. While observing feasibility, the team identified a target sub-assembly process that includes a shaft, gear, and a C-clip. This process assembles thousands of parts each year which makes it a valuable focus for automation. After reviewing available information, the Universal Robot 5 was recommended based on the cobot's reach, repeatability, degrees of freedom, and safety features. After the cobot selection was approved, the team finalized their recommendations for the new work cell layout.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

TEAM 3

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Christopher Fernandes
Austin Kelly
Timothy Noto

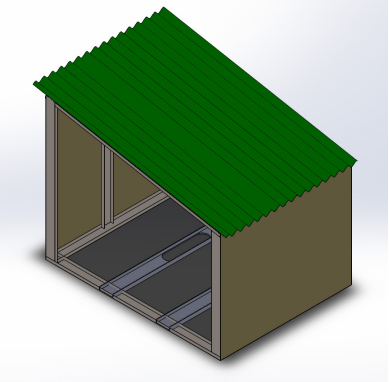
ADVISORS

Craig Calvert
Frank J. Cunha
Jason Lee

SPONSORS

LAND MAVERICK

Autonomous Robot Docking Station



In an age of volatile weather conditions, golf courses, turf management companies, and caretakers of athletic fields all have difficulty accurately assessing the quality of their soil and taking steps to improve it. With this challenge in mind, our sponsor Emily Yale has created an electrically driven robot that aims to improve soil data collection. This robot autonomously navigates the property, performs soil testing, and generates information about how to effectively improve the conditions localized to small areas of the property.

Our senior design project centers around designing and prototyping a charging/docking station for this robot. The structure created has been designed to not only withstand a variety of New England weather elements but also appeal to the high quality standards of golf course owners. Also included is a charging system with which the robot can interact autonomously. This prototype has been created with DFM (design for manufacture) techniques in mind. Our team had to work within a tight budget which required analyzing assembly methods, labor constraints, and precise material selection. Ultimately, we arrived at a product that satisfies sponsor requirements. In doing so we were proud to demonstrate our engineering and business knowledge, as well as increase our competencies in specific areas such as statics and electronics/circuitry.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

TEAM 4

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Silvanna Moran-Vargas
Matthew Ruyffaelaert
Kiley Stotler

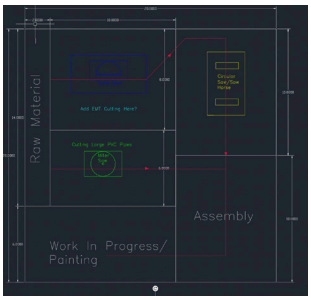
ADVISORS

Craig Calvert
Frank J. Cunha

SPONSORS

LEVO INTERNATIONAL

Distributed Hydroponic Farming



LEVO International was founded in 2015 by Christian Heiden. The company is a nonprofit organization whose mission is to address the issues of food insecurity in developing countries and food responsibility in the United States.

In 2017, a LEVO International team set up eight initial hydroponic farming systems in Haiti. The systems were extremely successful, and the company is looking to scale up their operation. LEVO hopes to reach full production capacity of about 10,000 units a month by early 2022.

Our project is to create an actionable Manufacturing Plan for the Hydroponic system, Babylon 1.3, that includes an assembly layout and a flow chart to fit the demand of 1000 units per month. We accomplished this by way of investigating the current process, thus, creating a baseline that can be referenced and continuously used as their company evolves.

Included in the Manufacturing Plan is a business case that explores the feasibility of the increase in scale at LEVO International.

Our secondary objective was to create a standardized work procedure for the manufacturing of the hydroponic gardens. We optimized the process and created a visual representation that can be easily understood in order to help expedite the training of new volunteers and employees.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

TEAM 5

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Nicholas Porebski
Clayton Schneider
Michael Windover

ADVISORS

Craig Calvert
Frank J. Cunha

SPONSORS

CTNext through CTIN4SPIRE

PRATT & WHITNEY DEPENDABLE ENGINES

GO BEYOND

Process Improvement Initiative for Research Lab's Data Management for Thermal Barrier Coating Testing

Pratt & Whitney is sponsoring a research team that is located at the University of Connecticut's Depot Campus. The research team is preforming accelerated testing on the lifetime of thermal barrier coatings. Their research is focused on expanding the capabilities of aircraft engines through the deeper understanding of TBCs. The lab is equipped with a burner rig where the tests take place. The current process has an excessive amount of Muda, as the team wastes their time manually collecting, manipulating and analyzing the massive amount of data produced from their experiments. This data includes pre-testing requirements, test parameters, test results, and final analysis, which are in the form of thermal, numerical, and optical data. Our team is working to implement Industry 4.0 techniques into their data management processes. We are looking to streamline their ability to collect, store and analyze their data. This will ultimately empower them to make data driven decisions at quicker speeds with higher confidence.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

TEAM 6

Elias Bitzarakis
Abigail Gosselin
Alicia Lungo

ADVISORS

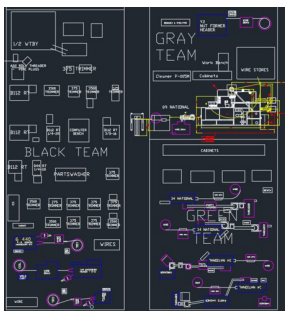
Craig Calvert
Frank J. Cunha

SPONSORS

HOLO-KROME®

Creating Manufacturing Agility

Efficient usage of space is one of the most challenging aspects of today's manufacturing environment. Holo-Krome is a leading manufacturer of custom and generic fasteners in the United States. Our team is working to complete a redesign of Holo-Krome's current floor layout in order to optimize the floor space being used. The addition of two high efficiency machines will enable the company to meet growing demand and better accommodate the customer's specifications. As business and engineering students, we have a unique background to create a layout that optimizes floor space with consideration given to business measures. We have decided the best way to do this is through the creation of an agile cell, freeing up space for the new machines while accommodating monthly shifts in demand.



MANAGEMENT AND ENGINEERING FOR MANUFACTURING

TEAM 7

Ryan Agro
Mitchell Aureli
Thomas Smith
Zhiqiang Xie

ADVISORS

Craig Calvert
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SPONSORS

KENEY PARK SUSTAINABILITY PROJECT

Spring Valley Farm - Industrial IoT

The Internet of Things (IoT) is a collection of interconnected devices capable of transferring data throughout a network. These devices are linked together to create technological synergies throughout the system. As with any rising technology, commercial adoption is a key factor in its worldwide use.

This project integrates IoT at UConn's Spring Valley Student Farm for use as a prototype to guide the design of a larger system at Keney Park, a park in Hartford, CT. Both setups consist of a solar thermal water heater and backup propane tank providing thermal energy to hot water radiators that heat an internal space. The farm uses the heat to maintain a growable soil temperature for plants year-round. Keney Park uses the heat for a public display area.

Our method of integrating IoT started with data collection. Our prototype collects data from sensors in the greenhouse. Examples include soil and solar panel temperatures, and the flow rate of propane from our backup power source. This data is automatically uploaded to Splunk—a data aggregation, analysis, and visualization platform—through a Raspberry Pi computer. Splunk allows this data to be displayed on computers, phones, smart TVs, and with augmented reality. With an easy-to-navigate interface, the stakeholders of this project are able to view and make decisions based on relevant metrics from anywhere in the world.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

TEAM 8

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Matt Pateiro
Marissa Thill

ADVISORS

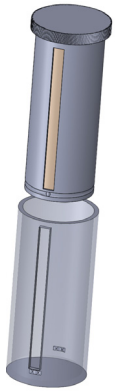
Craig Calvert
Frank Cunha
Jason Lee

Reverge Anselmo
Erika Sather

SPONSORS

NATRIUM

Natrium: Single-Use Personal Sanitary Barrier



Public surfaces such as fast-food restaurant tables and airline tray tables are notorious for harboring high levels of germs and potentially contagious matter, and the maintenance of these spaces is unreliable. The goal of the Natrium product is to develop a container to hold and dispense biodegradable, antimicrobial personal sanitary barriers. In doing so, Natrium will provide an eco-friendly, effective, and non-obtrusive solution for people concerned about the safety of shared public surfaces.

Currently, our group has finalized material selection of the barrier after performing rigorous material and chemical testing. We are working towards optimizing our barrier container design. We are directly testing and iterating our design based on ergonomics, aesthetics, manufacturability, and durability.

Our team has not only been engineering through our given problem, but we are also constructing a well thought out business plan to navigate the Natrium product's launch once it is completed. We have carefully made designs and material selections based on market research and we will be running thorough user testing to ensure this is a product that consumers will enjoy using.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

TEAM 9

Daniel Castillo
Omar Anwar-Krumeich
Maxwell Lezon

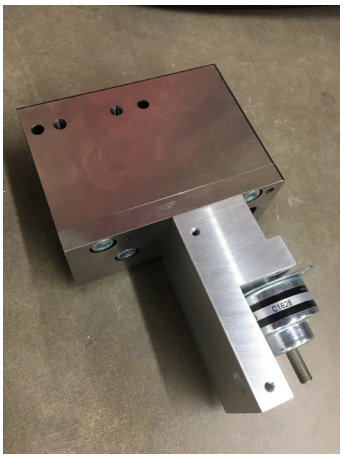
ADVISORS

Craig Calvert
Frank J. Cunha

SPONSOR

SONICS
SONICS & MATERIALS, INC.

Improved Ultrasonic Wire Splicer



Sonics & Materials Inc. has been a leader in the fields of both liquid processing and ultrasonic metal welding, sealing and cutting for the last 50 years. We were tasked with applying cost reduction efforts and improving serviceability to the MWS 20 ultrasonic metal welder. This device welds metal wires from .5 mm2and 40 mm2using ultrasonic vibrations to mechanically combine, unlike traditional welding. Upon close observation of all mechanisms within the device, we determined that the mechanisms moving the gather block were relatively costly for their function compared to other mechanisms in the device. Additionally, Sonics & Materials Inc. highlighted customer complaints about wire debris from previous welds decreasing the device's welding turnover rate and serviceability. Working jointly with the ME team, we simplified the mechanism moving the gather tool by replacing it with a fixture and a linear actuator which reduced unit costs by nearly 30% while maintaining performance. We also focused our efforts on solving the issue of wire debris hurting serviceability by increasing the anvil mechanism driving force. This driving force was increased by redesigning the air cylinder and the respective components used with it. Wear improvement literature research was conducted with new coating recommendation. To conclude, a financial comparison between the old and new design was done.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

TEAM 10

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Rui Lin
Richard Perret
Kenneth Schif

ADVISORS

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Frank J. Cunha

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MANAGEMENT & ENGINEERING FOR MANUFACTURING

Understanding the Capabilities of IoT in Manufacturing

The manufacturing sector has already entered the fourth industrial revolution that companies are only starting to realize the potential of Industrial Industry of Things (IIoT). However, implementation of IIoT is a massive undertaking in terms of understanding and utilizing the hardware, software, and amount of data that comes in. The project provides a testbed that aims to educate prospective students the meaning of IIoT and its applications in manufacturing through hands-on demonstration of a miniature assembly line.

The current devices used in the testbed consist of an I/O link, a Siemens programmable logic controller (PLC), a Siemens human-machine interface (HMI), and a Raspberry Pi. The team has been primarily responsible for programming and networking testbed devices into the functional state. The testbed has been designed to be intuitive and educationally stimulating to new students through dynamic input-output process capabilities and interactive Augmented Reality data reporting via Splunk. An in depth description of device functions and their integration within the testbed has been documented by the team. This documentation will be passed down to future interest groups and stakeholders to continuously improve the testbed.

MANAGEMENT AND ENGINEERING FOR MANUFACTURING

TEAM 11

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Brendan Berg
Anthony Marino

ADVISORS

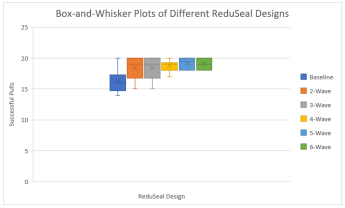
Frank J. Cunha
Craig Calvert

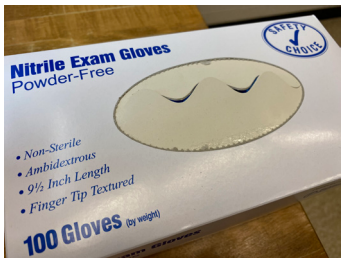
SPONSOR

UCONN SCHOOL OF NURSING

ReduSeal - The Universal Solution to Glove Waste

The ReduSeal™ product is designed to reduce industry glove waste. Through experimental data, industry glove waste was determined to be 19%. This value supports the initial approximation that was provided by our Sponsors at the UConn School of Nursing, which was 20%. After finding the baseline glove waste value without ReduSeal™, different designs of the product were tested to determine which was most effective. The 6-Wave design for ReduSeal™ was determined to be the best, with a glove waste reduction of 68%, from 19% to 6%. Using this information, as well as data gathered from competitors' products and real-world tests, ReduSeal™ is currently being marketed to large glove manufacturers. Pursuing a licensing deal to allow glove manufacturers to use the ReduSeal™ design and incorporate eit into the production of their boxes will allow for widespread distribution of the product. This distribution will help reduce glove waste across industries such as healthcare, food service, manufacturing, and many more.





MANAGEMENT AND ENGINEERING FOR MANUFACTURING

TEAM 12

Alex Biron
Meghan Palumbo
Kelly Quinn
Jason Trieu

ADVISORS

Frank J. Cunha
Craig Calvert

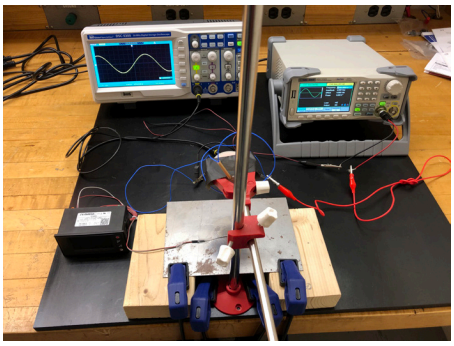
SPONSOR

SPERRY®

Non-Contact Testbed for Railroad Application

Sponsored by the US Department of Transportation, the Transportation Infrastructure Durability Center, and Sperry Rail Services, we designed and built a testbed to demonstrate how non-contact forces can be used to detect faults in metals, with the specific application of railways. This testing method works by observing the dynamic responses produced by inducing a Lorentz force in the metal. This method aims to decrease time and labor input for testing railroad tracks for cracks. The testbed uses an electro-magnetic transducer, which consists of a coil of wire wrapped around a neodymium magnet. The magnetic field produced from the transducer generates eddy currents in the piece of metal being tested. We use an oscilloscope to measure how the current in the coil changes when a defect is present in the metal.

The testbed is used to showcase how the non-contact testing works and it will reside in UConn's MEM lab for future MEM courses to use as a data collection system. This method has applications in a broad range of railroad testing scenarios and has potential for application in businesses that monitor and inspect infrastructure. The future work for this project entails scaling up our proof of concept into a system that can move down a railway track and alert operators when the oscilloscope indicates a defect.



MATERIALS SCIENCE ENGINEERING

TEAM 1

Isaiah Carrington
Victoria Reichelderfer

ADVISOR

Montgomery Shaw

SPONSOR

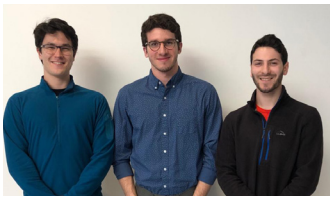
FARREL POMINI
continuous compounding systems

Method for Determining Adhesion to Metal Surface of Molten Polymers

In the polymer processing industry, there is an established need for a greater understanding of how polymer melts interact with various metallic and composite coatings. Molten polymer should stick to the processing equipment without sacrificing productivity or wearing the surface of the rotor. The objective is to establish background information on melt adhesion for the benefit of the industry sponsor, Farrel-Pomini, as well as the polymer processing industry. This will be achieved through a quantitative reference showing the adhesion properties between several commonly used polymer melts and coatings with varying chemistries and surface finishes.

Rheometry and dynamic mechanical analysis (DMA) were used throughout this investigation to perform variations on the standard tack test for adhesion. The normal force required to remove polymer melts from the surfaces was analyzed. This data was then organized into a comprehensive reference.

MATERIALS SCIENCE ENGINEERING



TEAM 2

Elie Azoff-Slifstein
Eric Bissell
Andrew Levin

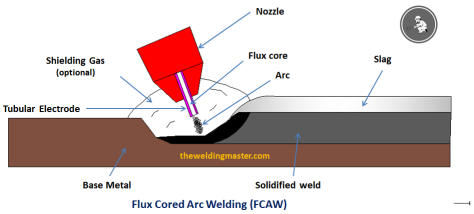
ADVISOR

Mark Aindow

SPONSOR

GENERAL DYNAMICS
Electric Boat

Flux Core Welding Electrode Design for Optimized Toughness Properties in Duplex Stainless Steel



Duplex stainless steel (DSS), known for having desirable mechanical properties and corrosion resistance, has an increasingly important role in structural applications. Welding DSS via a flux core method provides ideal operability, but there is a concern over the toughness properties developed with this welding process.

This project investigates flux core welded DSS samples that were fabricated using three electrodes with differing compositions. The goal is to develop a better understanding of what factors influence toughness, and to determine how these factors can be altered for optimized performance. This project combines skills learned in literature review, materials characterization, and data analysis that we have developed over the past few years. It involves the application of these methods to a real world material science problem.

MATERIALS SCIENCE ENGINEERING

TEAM 3

Riley Blumenfield
Christopher Choi
Aidan Walsh

ADVISOR

Rainer Hebert

SPONSOR

NAVSEA WARFARE CENTERS NEWPORT

Preparation of 3D Printed Plastic Components for Waterborne Environments

The US Navy is interested in learning about the degradation properties of 3D printed polymers for waterborne environments for a broad range of uses, especially for unmanned underwater vehicles (UUVs). The ability to print parts quickly and easily would be beneficial for research prototyping, a reduction in the need to carry spare parts, and weight savings. The goal of this project is to find a 3D printable material with high mechanical properties and UV resistance, as well as a coating that prevents significant degradation of mechanical properties during exposure to seawater. Mechanical test samples were printed from thermoplastic polyurethane 92-A and acrylonitrile styrene acrylate filaments. A subset of the samples was then coated with XTC-3D and XTC-3D mixed with UVO colorant to mitigate degradation in seawater. This degradation behavior was examined with immersion tests of samples in seawater for cycles of three days, followed by tensile testing and Charpy impact testing. If the yield strength and impact toughness of the materials do not decrease more than 10% after completion of the immersion tests over as-printed control samples the project will be considered successful. In addition to the seawater exposure, all materials used must be able to withstand expected operating temperatures ranging from 10°F - 140°F.

MATERIALS SCIENCE ENGINEERING

TEAM 4

Megan Bright
Deanna Guilani
Joseph Podbielski

ADVISOR

Seok-Woo Lee

SPONSOR

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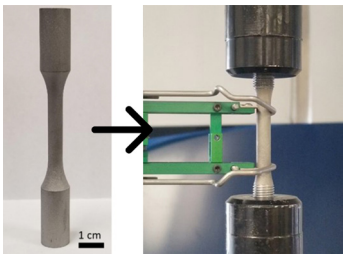
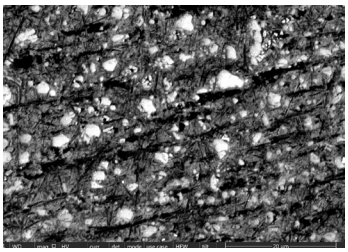
Additive Manufacturing Heat Treatment Optimization for AlSi10Mg



Additive manufacturing, especially of metallic alloys, is an ever-growing field in industry. It provides a faster, more efficient method of prototyping and producing parts. Direct metal laser sintering (DMLS) utilizes a high-power laser to melt a metal feedstock powder to create complex part geometries in a fraction of the time compared to traditional casting and forging techniques.

In aerospace, Al6061 is the most commonly used aluminum alloy due to its superior mechanical properties and light weight. However, Al6061 experiences poor particle adhesion due to its thermal properties and low silicon content, making it a challenge to manufacture parts with desirable mechanical properties using DMLS. In contrast, AlSi10Mg experiences excellent particle bonding during the DMLS process, resulting in superior mechanical properties in comparison to DMLS Al6061, but worse mechanical properties than wrought Al6061. Through the use of heat treatment processes, this project and Sikorsky Aircraft aim to achieve similar mechanical properties to Al6061, but with DMLS AlSi10Mg. Successful heat treatment, mechanical testing, and microstructural analysis will help further advance the understanding of the effects these heat treatment procedures have on AlSi10Mg and additionally allow Sikorsky Aircraft to implement and optimize processes that will pave the way for use of the alloy on aircraft.



MATERIALS SCIENCE ENGINEERING

TEAM 5

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Bryan Nelson
Anthony Nucerino
Davey Rodziewicz
Megan Scott
Klajdi Sosoli

ADVISORS

Jasna Jankovic
UConn

Gabrielle Shoshan
Lefty EQ, LLC

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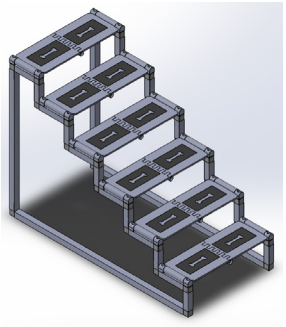
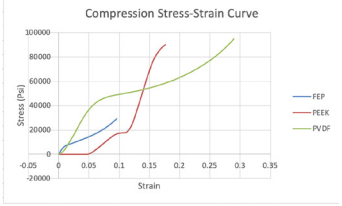
Design and Manufacture of Pet Stairs (Little Roo Pet Stairs)



The goal of this project is to create a collapsible set of pet stairs that will be effective for individuals that are living in confined spaces. In order to do this the stairs need to be lightweight, collapse down to a thickness of 3 inches, while still being tall enough to be used to get into a car or onto the bed or couch. This allows a level of convenience for the owner, while allowing the health of the dog to improve or be maintained. These stairs need to be mass manufactured in a cheap way so the overall cost is less than the stairs currently available for purchase. To do this a collapsible pet stair design must be developed and materials must be chosen in order to be successful. The materials chosen need to be able to support up to 300 pounds of weight. This is so any kind of dog should be able to use them safely. In order to choose the correct material mechanical testing will be done. This includes compression testing, hardness testing, three point bend testing, and DSC. This will be done to assess the material's ability to hold the weight requirement under the conditions it will be in, as well as the material's ability to withstand high temperatures. The stairs need to be able to withstand temperature changes and adverse weather conditions so that the owner can use them in the car, outside, or in the comfort of their home.



MATERIALS SCIENCE ENGINEERING

TEAM 6

Alex Coffey
Justin Hewitt

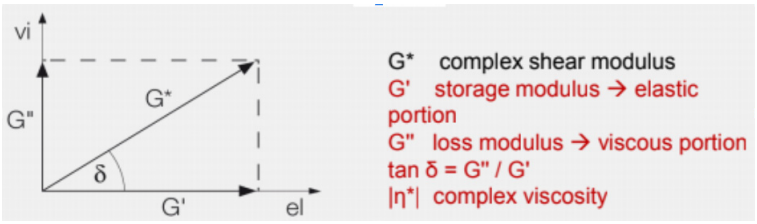
ADVISOR

Rainer Hebert

SPONSOR

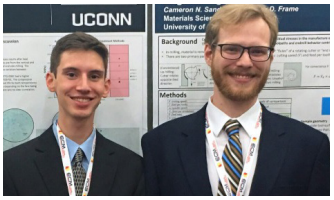
Anton Paar

Optimization of High-Temperature Rheometry for Thixocasting Applications



The main goal of this project is to optimize the viscosity measuring capabilities of Anton Paar's FRS1800 above temperatures of 1300 °C. A titanium cobalt alloy was selected for the project because of the particular challenges to measure reactive metals and at high temperatures. The pronounced temperature range during which solid and liquid phases coexist additionally allows the study of viscosities of the liquid and solid state. This viscosity information is important for thixocasting. A suitable crucible and bob material had to be found in order for the liquid titanium alloy to be measured. Graphite with and without yttria coatings have been evaluated. Testing was applied at different shear rates to evaluate the way the alloy behaves under different conditions. This was done in the fully liquid state as well as the partially solidified state, below the liquidus. Using an oscillatory measurement, the complex moduli were evaluated in order to identify the elastic and viscous components of the sample.

MATERIALS SCIENCE ENGINEERING



TEAM 7

Kevin Sala
Cameron Sanders

ADVISOR

Lesley D. Frame

SPONSOR

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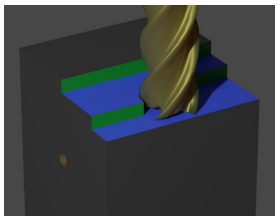
DEPENDABLE ENGINES

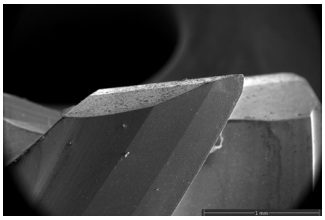
GO BEYOND

Controlling Residual Stresses in Alpha Beta Titanium During Manufacturing



In the aerospace industry, high precision parts are needed to maximize safety. Designing a manufacturing process to reduce the number of scrapped parts while maintaining safety standards is critical. A key issue when machining is the formation residual stresses. Relaxation of these created residual stresses can lead to distortion of a part.

Typically, heat treatment is used to remove or reduce residual stresses within the material. However, the required precision for each part does not allow aerospace components to be heat treated after machining. Understanding how residual stresses are introduced during machining is a crucial component in optimizing the entire manufacturing process and could allow residual stresses to be controlled during machining.



In this project residual stresses were introduced into a titanium alloy, Ti6242, by machining. The vertical and horizontal cut depths were varied to examine the impact different tool paths had on residual stresses. X-ray diffraction was used to determine the magnitude of residual stress at the cut surfaces. Various other characterization methods including electropolishing, optical light microscopy, and scanning electron microscopy were also used to examine the surface and subsurface damage.

MATERIALS SCIENCE ENGINEERING

TEAM 8

Marissa Abyazi
Ryan Pinto
Michelle Such

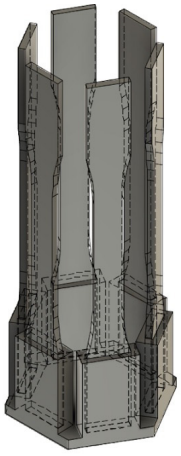
ADVISOR

George A. Rosetti, Jr.

SPONSOR

Collins Aerospace

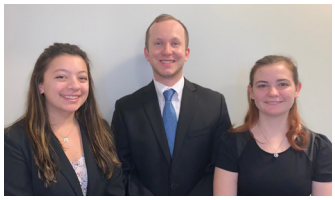
Process Optimization for Fused Filament Deposition of Polymers



Additively manufactured thermoplastic parts are used to help alleviate extra weight in aircrafts and decrease the cost of part production. Additive manufacturing produces lightweight, highly durable parts through the more efficient and economical process of 3D printing. Parts created through machining, injection molding, blow molding, and extrusion are being replaced as these processes require long lead tooling. Fused Filament Deposition (FDM) of thermoplastics is becoming a widely used process within additive manufacturing for the aerospace industry. During the FDM process, parts are printed by selectively depositing heated feedstock plastic filament out of the printer's nozzle on the developing material in a chosen path. In order to shift production of small fixtures and other parts to 3D printing, the FDM process must be examined further and relationships between printing parameters and mechanical properties must be quantified.

This project investigates the statistical significance of the correlation between a print's build orientation and raster angle and the ultimate tensile strength, compressive strength, flexural strength, and burst strength of the print. As additive manufacturing is limited by layer adhesion within a part, there is also an opportunity to produce optimal bonding by characterizing the effects of raster angle on layer adhesion. Producing optimal layer adhesion is expected to quantifiably increase isotropy, tensile strength, compressive strength, and burst strength. Success in this project will offer thermoplastic manufacturing industries the ability to reduce part cost, production time, and part weight compared with their metal counterparts, while meeting the necessary strength and durability requirements for aerospace applications.

MATERIALS SCIENCE ENGINEERING



TEAM 9

Cassidy Atkinson
Eliana Berney
Alexander Perkins

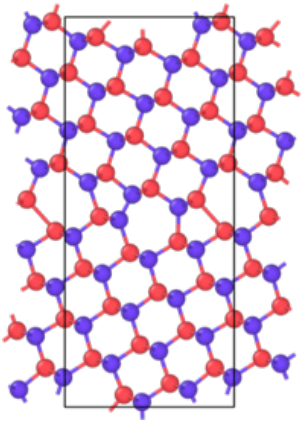
ADVISOR

Pamir Alpay

SPONSOR

DEVCOM ARMY RESEARCH LABORATORY

Grain Boundary Design in Silicon Carbide via Molecular Dynamics



This senior design project is sponsored by Army Research Laboratories (ARL). There is a strong focus on keeping soldiers safe by aiming to improve the body and vehicle armor used in combat situations. Silicon carbide is a material that is commonly used in body armor, and aluminum is commonly used in the vehicle structural and armor systems. Both of these materials are studied frequently, so a great deal is known about them. Grain boundaries are a common point at which materials fail. The aim of this project is to develop a metric to correlate the disorder in common grain boundary structures to the mechanical properties that the aforementioned materials exhibit through molecular dynamics. This study is important because it will play a role in building future generations of body and vehicle armor from the nano-scale up by understanding which grain boundary structures are beneficial and which grain boundary structures should be avoided during processing.

MATERIALS SCIENCE ENGINEERING

TEAM 10

Amanda F. Agui
Zubin J. Wadia

ADVISOR

Harold D. Brody

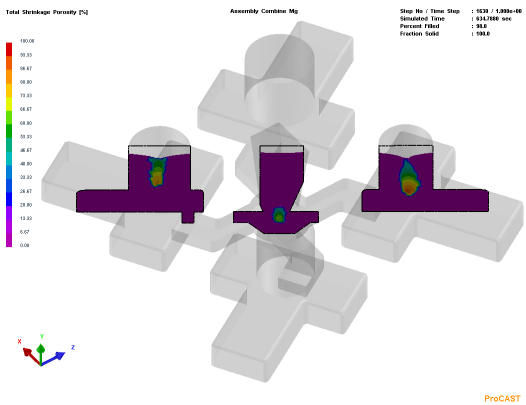
SPONSOR

YANKEE CASTING

AFRL

Improved Quality Predictors for Simulating Solidification of Magnesium Aerospace Castings

Improved predictors for AZ92, a large freezing range alloy, will be developed to ensure that the quality of the magnesium aerospace casting is radiographically sound after its initial production. Criteria will be utilized to tie together simulated casting parameters to the resultant quality indicators. ProCAST, an advanced casting simulation tool, will be used to develop improved design rules that Yankee Casting can follow in their foundry in order to continue producing quality aerospace castings for AZ92. ProCAST will allow the senior capstone design team to compare predictions to manufacturing data in order to pinpoint the location, type, and cause of the microporosity found in their castings. The individuals involved in this project are the senior capstone design team, faculty advisors, industry advisors, Yankee Casting, and the Air Force Research Laboratory, all of whom will be collaborating throughout the duration of this project.



MATERIALS SCIENCE ENGINEERING

TEAM 11

Arseniy Bazikov
Christopher Kelly

ADVISOR

Yuanyuan Zhu

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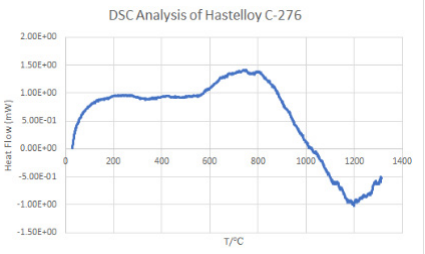
Heat Treating Optimization of Hastelloy Strip



C276 is a nickel-molybdenum-chromium superalloy that is commonly used in the superconductor industry as a substrate material, upon which the superconducting layer is deposited. Ulbrich supplies C276 strips which have been rolled to various thicknesses between 30 to 120 microns. The HTSC tape manufacturers sometimes encounter problems with deposition due to surface carbides which become exposed only after the C276 substrate undergoes electropolishing; these are believed to form as a result of Ulbrich's annealing temperature and duration. The goal is to develop a heat treatment schedule within Ulbrich's capabilities, such that the size of the carbide particles, as well as the overall density of the particles are minimized. So far, background research suggests that the diffusion rate of various impurities has a positive correlation with temperature. Testing done with DSC on C276 suggests that there is an exothermic reaction between roughly 900 C° and 1200 C°, which corresponds with precipitate formation. DSC results will facilitate the design of an optimized annealing schedule via annealing trials and quantification of the particles that may result.

MATERIALS SCIENCE ENGINEERING

TEAM 12

Eric Krementowski
Katelyn Whyte

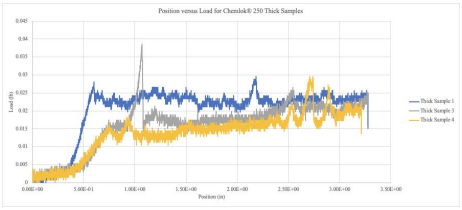
ADVISOR

Bryan Huey

SPONSOR

Marmon Utility LLC

Optimization of Adhesion Between Kapton Tape and EPR in Motor Lead Extension Cables for Use in Electric Submersible Pump Cables



Marmon is a leading company in high-performance, engineered electrical cables, especially for operating in harsh environments. For example, Marmon's Kerite® electrical submersible pump cables must endure high temperatures and extreme environmental conditions when buried up to a mile deep. A high-reliability adhesive layer between cable components is therefore critical. In particular, the copper core is wrapped by two layers of Kapton® film and coated with industrial adhesive before applying a layer of ethylene propylene diene monomer rubber (EPDM). Failure of this adhesive bond can lead to ingress of corrosive species, and thus accelerated degradation of this crucial electrical system.

The goal of this project is to assess the adhesion between Kapton® tape and EPDM rubber of Chemlok® 250, Chemlok® 6150, 3M® 4799, and 3M® Primer 94 with 3M® 9485PC adhesive tape with a T-peel test. Samples are fabricated by pressure heating strips of adhesive coated Kapton® tape with a layer of EPDM rubber at 350 F for 30 minutes, replicating the continuous manufacturing process. Multiple layers of adhesive coatings, as well as high temperature exposure to mimic in-service conditions, are also considered. Ultimately this work aims to identify the optimal adhesive, prioritizing adhesion strength while considering ease of use and safety issues.

MATERIALS SCIENCE ENGINEERING

TEAM 13

Quinten Arsenault
Lucas Enright

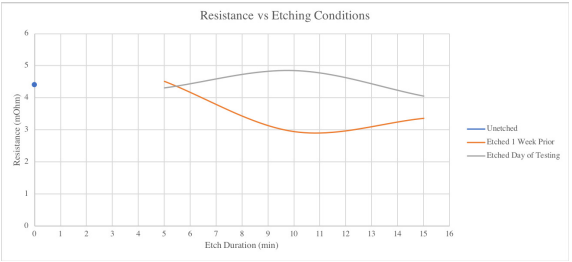
ADVISOR

Stefan Schaffoener

SPONSOR

nel

Etching of Etching Titanium for Electroplating Processes

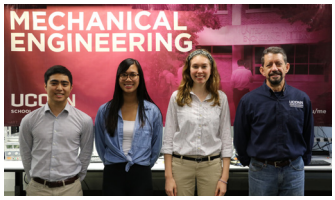


Nel Hydrogen is a global powerhouse in the hydrogen industry. One focus of Nel Hydrogen is onsite generation of high purity hydrogen gas through electrolysis of water in portable electrolyzer cells. The manufacturing of these cells currently utilizes hydrofluoric acid (HF) for etching of porous titanium electrodes. The goal of this project is to establish and optimize a replacement etching procedure that uses a less hazardous etchant to mitigate safety risks and manufacturing costs.

Our approach to this problem includes a combination of experimental work guided by factorial design and computational model through the Julia programming language. Performance of the etching process is measured through mass transport and resistivity through the porous plate. The new etching process must produce porous plates with equal or superior mass transport and resistivity properties to those created via the currently implemented HF-based process.

This project seeks to resolve economic and environmental challenges currently faced in the alternative energy industry. Hydrogen energy is a rapidly growing technological field, and improved manufacturing of electrolyzer cells could reduce the economic barriers currently faced by hydrogen for widespread implementation.

MECHANICAL ENGINEERING



TEAM 1

Cara Connors
Richard Ira
Ashley Sundara

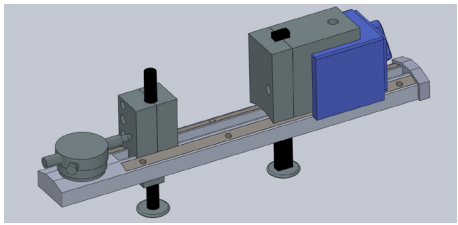
ADVISOR

Thomas Mealy

SPONSOR

AEROCISION

Design and Manufacture of a Cost Effective and Time Efficient Swing Gage



This project presents the research, design, and fabrication of a cost effective and time efficient diameter measuring gage for AeroCision LLC. AeroCision is a supplier of machined metal engine components for the aerospace industry based out of Chester, CT that emphasizes quality and precision in all of their facilities. The previous diameter measuring solution was a set of expensive purchased gages of different size ranges that measured diameter dimensions called out on customer component prints. This project's swing gage is one product that is adjustable within 2-20" inner and outer diameter measurements to replace the set of purchased gages. The re-designed swing gage reaches the goal of costing 25-33% of the previous models, has ⅔ of the previous calibration time, and maintains an accuracy within 0.0001". The manufactured product passes gage repeatability and reproducibility testing without marring component surfaces and the thermal structural simulations prove its competency within working environments between 65 and 80 degrees Fahrenheit. The design uses a combination of clamping, spring, and magnetic forces to perform measurements and maintain accuracy in conjunction with a dial indicator to record the reading.

MECHANICAL ENGINEERING

TEAM 2

Alicia Jackson
Ryan Murphy
Mihir Nene

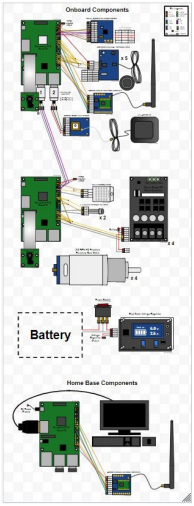
ADVISOR

Chengyu Cao

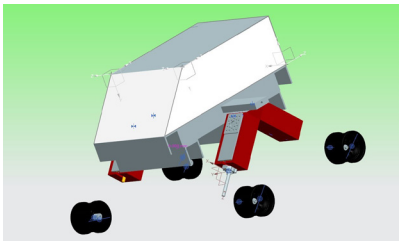
SPONSOR

agriVolution

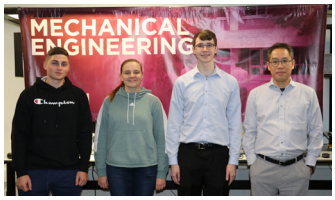
Development of A Field Agri-Robot for Crop Health Monitoring



The farming population is aging and dwindling; yet farmers need to be more productive with fewer hands to feed nearly 10 billion people by 2050. The objective of this project is to design an agri-robot prototype intended to assist small- to mid-size farms with that can be autonomously deployed with GPS navigation in a field or greenhouse to monitor crop growth and health in order to assist the farmers with daily operation. The prototype uses ultrasonic sensors for object avoidance, and additionally has on-board sensors to measure temperature and humidity. Our design uses two high resolution cameras to process images to analyze crop health (or lack thereof) to a home base operated by the user. Our design fits into a niche in the agri-robotics industry by being able to measure crop health with a ground-level robot, that has a large operational range, and is affordable economically.



MECHANICAL ENGINEERING



TEAM 3

Christopher Buckley
Kevin Mokarry
Riley Barnes

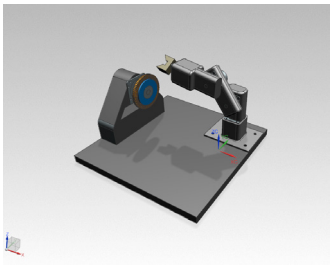
ADVISOR

Tai-Hsi Fan

SPONSOR

Barnes AEROSPACE
A business of BARNES GROUP INC

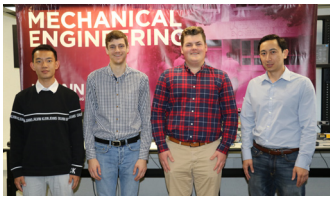
Design, Build, and Testing of an Abrasive Brush Test & Evaluation System



The objective of this project is to design and build a testing system that will evaluate the result of changes to variable inputs on the performance of abrasive brushes. Our sponsor, Barnes Aerospace, currently uses an automated robotic deburring system to finish their products. Some of the finishing performed by the robot is removing burrs and blending edges. There are several controlled parameters, including the rotational speed of the brush, the pressure applied between the brush and work piece and the temperature produced from friction. Our team created a testing rig prototype that Barnes will utilize to build a full-scale testing rig.

The design consists of a fixed brush attached to a mount and a six degrees of freedom robot arm that brings the work piece to the motor. The motor spins multiple types of abrasive brushes ranging in size from 4 to 14 inches in diameter. A force sensor attached to the robot arm measures the normal force experienced by the part when it is pressed against the abrasive brush. The speed of rotation of the brush, as well as the temperature of the area of contact between the part and the brush are also measured by the rig. Utilizing this data, Barnes will be able to optimize the deburring conditions, enabling their parts to be deburred faster and with the least amount of brush wear.

MECHANICAL ENGINEERING



TEAM 4

Chandler Boucher
Jinglin Jia
John Welch

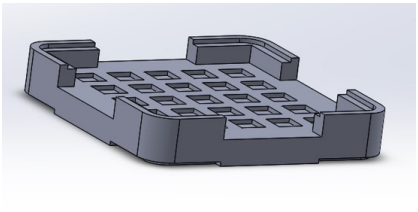
ADVISOR

Jason Lee

SPONSOR

BELIMO

Assembly Process Improvement with Co-bot

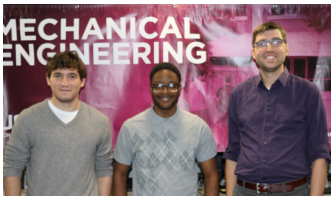


Belimo is a Swiss-based manufacturer and distributor of actuators, sensors, and control valves for heating, ventilation, and air conditioning systems. The MTO (Made To Order) Linkage department at Belimo's Danbury, CT facility is exploring the implementation of a collaborative robot into their assembly processes to improve their overall efficiency and quality.

It was identified that the manual sub-assemblies for linkages would see the most improvement through automation as they are relatively simple, produced in high quantities, and are time consuming. Our team is tasked with studying the feasibility of implementing a co-bot into these sub-assemblies.

One of the main challenges for this project is ensuring proper part orientation as visual aid software is not feasible. Our team decided that palletizing the parts before presenting them to the co-bot ensures proper orientation with high repeatability and stacking them within the co-bot's reach allows for longer periods of operation before downtime. The completed co-bot workspace design has improved the overall efficiency and quality while reducing the time needed to complete the chosen assembly processes.

MECHANICAL ENGINEERING



TEAM 5

Jevon Chambers
Alexander Davlos

ADVISOR

Bryan Weber

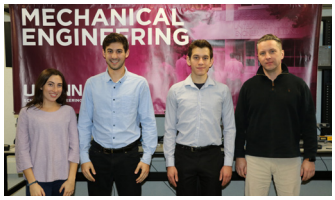
SPONSOR

BIOMASS CONTROLS PBC

Optimizing Biochar Production and Quality from Cow Manure and Food Waste

BioMass Controls is a sanitation company whose main focus is their biogenic refinery system. It is a system which processes waste, such as pressed manure, human waste, or other biomaterials.The waste acts as fuel and enters into the system by way of the fuel auger, and is then dropped into the pyrolysis pot where it is subject to a combustion-pyrolysis process. In this process, some of the fuel is combusted in order to create high temperatures which is necessary for the rest of the fuel to pyrolyze. Not only does this this process create a cleaner burn than regular combustion, but the smoke that it does create is filtered through a catalyst which reacts with the smoke cleaning it further. What you are left with at the bottom of the pyrolysis pot is biochar, which is mostly carbon and inorganic ash. This biochar is pulled out of the pot by the char auger, making room for more fuel to be continuously fed in. Currently BioMass is developing the final stage of the system, and our team has been tasked with the objective of optimizing the production of biochar and its quality. After researching key qualities in biochar as well as their system, our team concluded that the best approach to improving biochar quality could be found in the quenching component to their system.

MECHANICAL ENGINEERING



TEAM 6

Olivia Ivaldi
Juan Elizathe
Matthew Stojanov

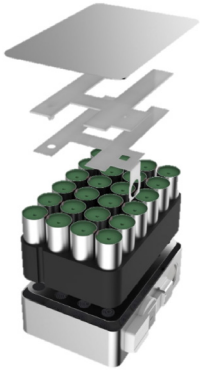
ADVISOR

Alexei Poludnenko

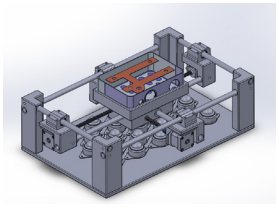
SPONSOR

Cadenza INNOVATION

Torsion Welding Automation Solutions



Cadenza Innovation is a Connecticut based company that designs lithium ion batteries. Cadenza's unique "supercell" battery design provides safe and high energy density batteries at a low cost. Cadenza manufactures supercells at their facility in Bethel, CT, where they are currently automating processes on their shop floor. Part of Cadenza's supercell manufacturing process is ultrasonic welding. Four tabs inside the supercell are ultrasonically welded to the outside housing of the battery to establish an electrical connection. This project replaces the previous manual alignment process for a supercell during ultrasonic welding. The solution is an automatic two-axis positioning system, similar to those used in 3D printers and CNC machines. The positioning system can automatically move the supercell at a speed of 100 mm/s to the positions where it needs to be welded. The system improves positioning precision to within 0.2 mm in the X and Y direction. The fixture can also withstand a vertical force of 750 N used to perform an ultrasonic weld. Ultimately, the implementation of this project reduces human interaction in ultrasonic welding, increasing the precision and speed of the welding process. These benefits ease the integration of ultrasonic welding into a large scale industrial application.



MECHANICAL ENGINEERING

TEAM 7

James DeMaio
Andrew Rowe
Reese McGowan

ADVISOR

Vito Moreno

SPONSOR

Charles Gray

Analysis and Design of a Ceremonial Cannon

For our project, we were asked to analyze a ceremonial Pyrodex cannon with a ½" dia. bore and then design and construct a new canon having a larger ¾" dia. bore with the objective of it being 50% louder. We measured the peak noise levels, rollback distances, and peak accelerations as a function of charge size and packing pressure to understand the dependencies. We then used this data in conjunction with research on the pressure characteristics of black powder to design, model and construct the larger bore canon with a similar factor of safety. Our new canon was then tested and the resulting data validated against our analysis model relative rollback, noise levels, acceleration, and the corresponding factor of safety.

MECHANICAL ENGINEERING

TEAM 8

Benjamin Bonvicini
Patrick Gorman
Edwin R. Roman, Jr.

ADVISOR

Thomas J Mealy

SPONSOR

Chapman MFG CO. USA Made SINCE 1936 PRECISION SCREWDRIVER SETS

Vertical Mill for New Product Production

Chapman Manufacturing is an American made company that creates hand tools for industry assembly, commercial services, and for precisionists. Located in Durham, CT, Chapman has been in service for over 80 years and prides themselves with manufacturing as many of their products in house as possible. Team ME08 was tasked with determining the best way to manufacture the body of a new palm ratchet and an insert for a new midget ratchet. Chapman manufacturing currently has no way to manufacture these products in house, so ME08 set out to compare automating a bridgeport machine already owned by Chapman with purchasing a new 3 axis CNC machine. Using financial analysis, production metrics, and manufacturing parts using each method, ME08 determined that purchasing a 3 axis CNC, specifically a Tormach 770MX, would be the best method for Chapman to manufacture the new products. The CNC machine was able to produce the same ratchet piece in one tenth of the time as the Bridgeport and produced a cleaner milling finish. The existing Bridgeport was limited by its spindle speed and the fact that it could only be automated in the X and Y axis directions, with the Z axis still needing to be manually controlled. Following the selection of manufacturing method, ME08 used a CNC to produce a functional prototype ratchet.

MECHANICAL ENGINEERING

TEAM 9

Jude Andrew Alaba
Justin Gallo
Kylie Kearney

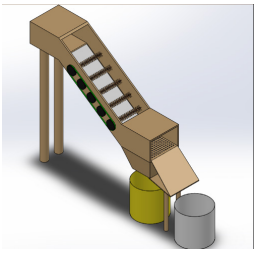
ADVISOR

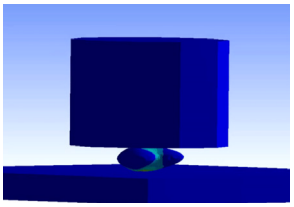
Anna Tarakanova

SPONSOR

Cloverleigh Farm

Design, Build, and Prototype Dried Bean Thresher





Cloverleigh Farm is a small farm located in Mansfield, Connecticut, with a focus on community supported agriculture and organic produce. Recently, the farm has begun producing dried beans, a traditionally difficult crop for small farms to manage. After harvest, these plants must be dried, then processed to remove the beans from their pods and the rest of the plant. Previously, this process was entirely manual, resulting in unnecessary labor that could be avoided. The goal of this project was to create a small-scale motorized thresher to expedite the process, resulting in more efficient production and increased profit for the farm. It was important that the device was constructed from inexpensive, locally sourced materials, so the design can be replicated by other small farms in the future. The design concept is derived from a conveyor-belt style mechanism historically used in dry bean threshers. In order to fit the simplicity and ease of maintenance desired by the sponsor, this was adapted into a passive gravity based system where the plants will slide down an angled sheet of UHMW-PE, a durable, low-friction plastic. The plants will then pass through a series of rotating threshers, continuing to an automatic sorting mechanism at the bottom.

MECHANICAL ENGINEERING

TEAM 10

Andrew Ardolino
Devon Webster

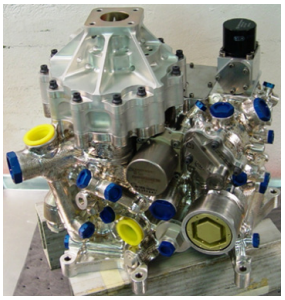
ADVISOR

Horea Ilies

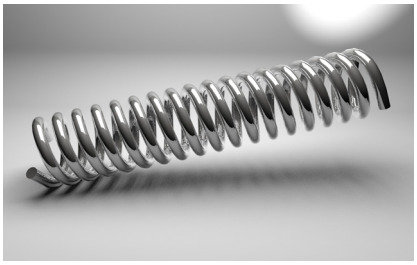
SPONSOR

Collins Aerospace

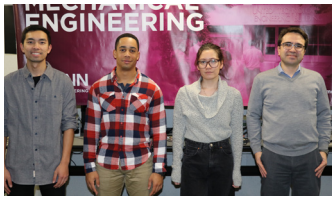
Model Based Auto-Draw



ME10 is a project sponsored by Collins Aerospace in Windsor Locks. This is a continuation project from last year. The overarching goal is to gain the ability to automatically generate a pressure relief valve for the fuel metering system. With the input of a few variables, a CAD model is generated with appropriately sized components. Last year's group laid the groundwork for the auto-draw program. We have expanded the capability from the previous program to include the iterative design of a mechanically sound spring. The spring is able to be optimized for external dimensions in order to allow greater versatility in valve design. As a result of this project, many manual hours of work per valve have been automated decreasing the cost of valve design.



MECHANICAL ENGINEERING



TEAM 11

Jonathan Petersen
Thinh Tran
Jenny Pham

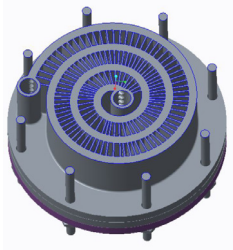
ADVISOR

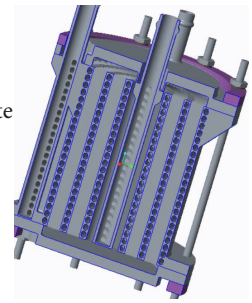
Ugur Pasaogullari

SPONSOR

Collins Aerospace

Additively Grown Phase Change Material Heat Exchanger with Single Fill Port





Collins Aerospace, created by the 2018 combination of United Technologies Aerospace Systems (UTAS) and Rockwell Collins, has helped shape the aerospace and defense industry for more than a century. UTAS designed the space suits worn by America's first astronauts, and Rockwell Collins provided the communications equipment used by every American astronaut.

In space, thermal management and heat rejection is critical. The goal of this project was to design, create, and test a functional and scalable single fill port Phase Change Material (PCM) heat exchanger (HX). A PCM HX is an effective way of storing thermal energy without increasing temperatures above its operating limits in the environmental control life support system (ECLSS) of a spacecraft. The newly designed PCM HX would incorporate a single homogenous PCM body created through the additive manufacturing process. The motivation for this design was the cost savings incurred by eliminating the time consuming braze step and wax fill process.

To validate the solution's accuracy, a model HX was 3D printed and then tested using varying coolant flows. These flows produced pressure drops as well as heat transfer rates which were used to determine overall thermal efficiency. Due to the model's scalability, all data collected can be further applied to a full scale model capable of handling the thermal demands of a spacecraft.

MECHANICAL ENGINEERING

TEAM 12

Bradley C. Carrano
Dhrumil M. Shah

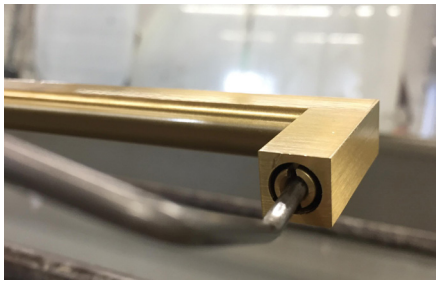
ADVISOR

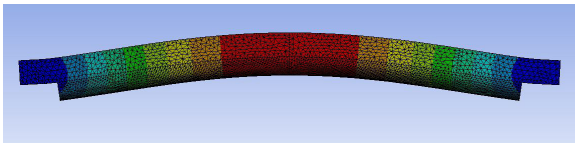
Vito Moreno

SPONSOR

Colonial Bronze Co.
FINE BRASS HARDWARE SINCE 1927
HANDMADE IN THE USA

Manufacturing and Assembly of a Configurable Handle

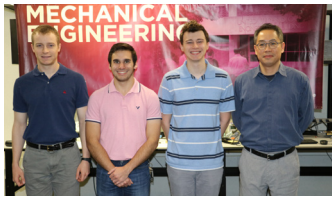




Colonial Bronze, based in Torrington, CT, makes customizable and affordable hardware out of individual components rather than one-piece forgings. This is a challenge for them because it allows finishing liquids to penetrate between the joined components causing stains which lead to part rejection. They desire to design a strong and reliable method of assembling components to make a handle that is durable, cosmetically appealing and prevents infiltration of liquids.

A model of cabinet handle 745, underwent a simulation to determine the required maximum load capacity of the new design. It was found that a small meniscus of the clear coat liquid was accumulating at the end of the blind hole of the leg. It was determined that the connection method needed to be redesigned in order to either stop the entry of clear coat, or to allow it to drain out with ease. Different tests were carried out on the clear-coating of parts with changes in design & manufacturing processes. A larger size blind hole on the shank and the bottom surface being sanded allowed the surface finish liquid to drain out easily. These changes reduced the number of rejects from a cosmetic point of view.

MECHANICAL ENGINEERING



TEAM 13

Thomas Chessman
Nicholas Fox
Mark Sullivan

ADVISOR

Tai-Hsi Fan

SPONSOR

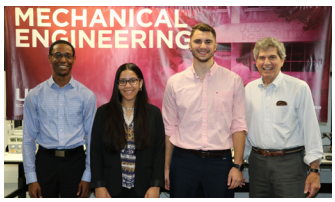
DIVE TECHNOLOGIES

Design of a Pop-Up Autonomous Underwater Vehicle (AUV) Antenna

Dive Technologies is a Veteran Owned Small Business with the goal of producing reliable deep-sea Autonomous Underwater Vehicles (AUVs) at a disruptive price point. Our team was tasked with developing a passively actuated "pop-up" antenna for use on their product. The antenna system is critical for communication with the AUV and must completely deploy while it is surfaced. Then it must automatically stow while submerged in order to minimize drag. This mechanism must work without the aid of fuel or electric actuation.

Several antenna concepts were developed to actuate using environmental conditions such as drag and pressure. Our final design is a vertically actuating system using a block of deep-sea diving foam and a cantilevered hydrofoil. At the surface, the antenna is extended using buoyant force from the sea-foam. While moving underwater, a hydrofoil assembly at the top of the antenna generates downforce. This downforce overcomes the buoyant force and moves the antenna into a stowed position. The lack of moving parts makes this mechanism easy to manufacture and adjust. The system is fabricated using sturdy 3D printed components and can operate in a wide range of ocean conditions.

MECHANICAL ENGINEERING



TEAM 14

Allan Bakker
Naiomi Medina
Tyler Zolciak

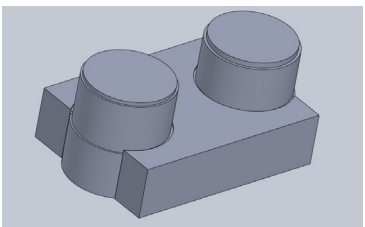
ADVISOR

Vito Moreno

SPONSOR

EAP

Feature Based Management and Inspection for Jet Engine Tube Fittings



EA Patten is one of the world's leading custom metal tube fabricators used by diverse industries. Our goal is to research, design, fabricate, and validate a prototype fixture that aims to reduce the cycle time needed to test similar features on jet engine tube fittings, while meeting the rules and regulations of the current inspection method. EA Patten inspects each part's specific measurements using tools such as verniers and micrometers to ensure that all are within specification. Thus, EA Patten manufactures jet engine tube fittings faster than they can inspect each part.Our purpose is to design a go/no-go type fixture that will test multiple parameters for multiple features covering more than one size. The motivation to decrease the time required to complete the cycle time for testing familiar parts is needed to keep up with the increasing demands of jet engines today. Intensive research was conducted on the current inspection process to develop prototype fixtures for the features currently being manufactured today. Using CAD software, we designed multiple fixtures and narrowed down the best ideas. The fixture was 3D printed, machined, and tested on current tube fittings. By creating test fixtures that are specific to the feature instead of the part numbers, the inspection process is expected to see a significant reduction in inspection time.

MECHANICAL ENGINEERING

TEAM 15

Reilly Enos
Brendan McClellan
Shaya Sosis
Matthew Stofko

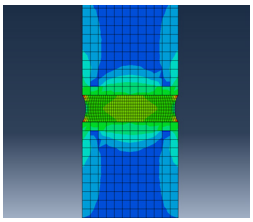
ADVISOR

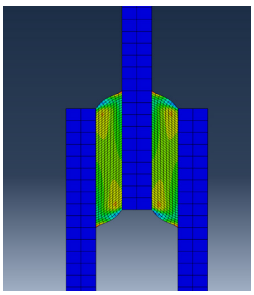
Ryan Cooper

SPONSOR

GENERAL DYNAMICS
Electric Boat

Alternative Joining Technologies

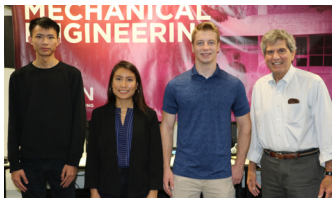




Structural adhesives have a wide variety of uses in a manufacturing environment to replace traditional forms of mechanical fasteners such as welding, bolts, and rivets. However, as they're less common, people are often unfamiliar with their uses, strengths, and properties. Electric Boat has recently taken an interest in using such adhesives for applications in their manufacturing processes. They have chosen 3M VHB 4991 double sided acrylic foam tape to be investigated for viability in the expected environments. The purpose of this project is to test the physical behavior of the tape and develop a model within Abaqus CAE.

This can be done by using material and contact property inputs in Abaqus. Both of these inputs use similar properties to describe the behavior of the adhesive tape. When using the material property two inputs are used. The first is an elastic property and the second is Maxs damage. The elastic property uses variables like Young's modulus, Poisson's Ratio, and a Prony series to describe the stiffness of the adhesive tape. The second property is the maximum nominal stress, Maxs, in the normal and shear directions. This is the point where the maximum stress is reached before failure in the tape occurs. Once this point is reached damage evolution takes over the failure process to visualize and describe how to tape debonds from the substrate.

MECHANICAL ENGINEERING



TEAM 17

Karen Guzman
Jon Pierce
Jiaheng Zhu

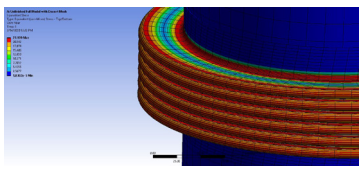
ADVISOR

Vito Moreno

SPONSOR

GE Power

Durability Study of Ash Drain Pipe for Circulating Fluidized Bed (CFB) Boiler



GE Power Creates energy and technologies of the future and improves the power networks that we depend on today. GE Power in Windsor Connecticut designs large boilers and fireboxes. One of the technologies that GE Power utilizes is a circulating fluidized bed boiler. In order to maintain combustion efficiency in the boiler an ash pipe and auger system removes dry fuel ash which is a byproduct of the combustion process. Improving the overall durability of the ash pipe will greatly benefit the customer of the systems that utilize this ash pipe.

The scope of this project is to identify alternative ash pipe configurations to reduce the amount of induced stresses on the ash pipe in order to increase its overall durability. This was accomplished by analyzing the current ash pipe configuration and running FEA simulations to identify stress concentrations and other flaws within the current design. The base simulation results, in conjunction with research and testing of alternative materials, coatings and pipe configurations, was utilized to identify design concepts to lower stress and increase overall durability. Following down selection, the final design will be simulated and directly compared with the current design. The final design should achieve lower stresses and higher durability while meeting the following requirements.

MECHANICAL ENGINEERING

TEAM 18

Hunter Linfesty
Douglas Phan
Hongli Tao

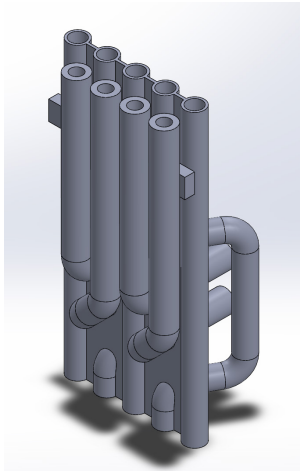
ADVISOR

Chih-Jen Sung

SPONSOR

GE Power

GE Power High Temperature Cycle Retrofit Superheat Wall Support Design



Our project for Senior Design is working with GE Power to retrofit an existing coal-fired boiler to increase overall plant efficiency. We are working with GE boiler engineers to design a new superheat radiant wall that will penetrate the existing furnace walls of the boiler. This new superheat radiant wall will be exposed to direct radiant heat from the fireball inside the existing boiler furnace, resulting in higher temperature working fluid and increased cycle efficiency. The structural integrity of the new superheat radiant wall is the most crucial part of the project if the retrofit is to succeed. This portion of the retrofit is the focus of our senior project. By implementing this retrofit, our team and GE Power engineers are confident that we can reap higher cycle efficiencies from the boilers without replacing them, which is significantly more expensive.

MECHANICAL ENGINEERING

TEAM 19

Tyriq Green
Kimberly Liang
Michael Rumbel

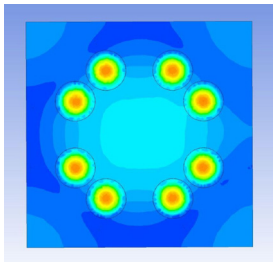
ADVISOR

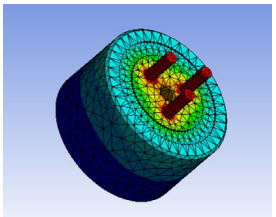
Bryan Weber

SPONSOR

gentex optics inc. AN ESSILOR COMPANY

Improving Heat Management for Injection Molding Process

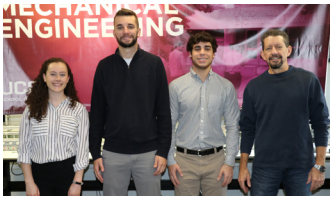




Injection molding a popular method in the manufacturing industry due to its ability to produce large amounts of products at once. This process is used to produce a variety of everyday objects, such as plastic food containers, toys, and water bottles. Our sponsor, Gentex Optics, currently uses this technique to manufacture polycarbonate lenses for eyewear. Its parent company, EssilorLuxoticca, owns over 20 luxury brands such as Ray Bans, Michael Kors, and Oakley.

The team's goal in this project is to reduce cycle time through investigation of the areas in the process that deal with the greatest thermal energy, and to identify methods to improve heat management of the process. The team found that 90% of the heat in the system is contained in the mold block, and 70-85% of the cycle time is attributed to the cooling time. Thus, the team created a design that modifies the interior of the mold block to allow the block to cool faster.

MECHANICAL ENGINEERING



TEAM 20

Jordan Amella
Katherine Defazio
Ryan Girardini

ADVISOR

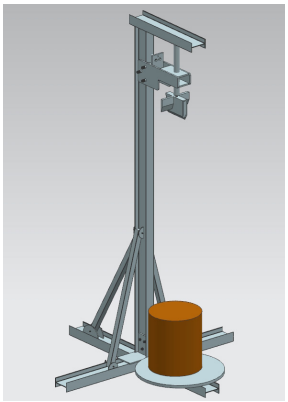
Thomas Mealy

SPONSOR

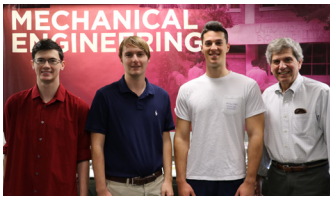
Reverge Anselmo

Guillotine Maul

This project is the design and fabrication of a manually operated guillotine maul wood splitter, which splits logs into 4 pieces in one drop, making firewood significantly faster than the hydraulic drive splitters in the marketplace. Adjustable weight falls from sufficient height using impact force to split the wood. It operates within an entirely mechanical system, eliminates a great deal of manual work, and uses no motor, electricity or fuel. The splitting head falls on a track system consisting of an I-Beam and rollers. The splitting head and weight are cranked by reduction gears to maximum height, held by a stop, and released by the pull of a trigger system. The impact splits the wood with 4 cuts-in-one without the need for an engine. Thus reducing the bothersome noise and exhaust, refills and leaks of gas, oil, and hydraulic fluid, and the constant back-bending work to reseat half-logs on the splitter. As long as gravity remains in supply, the guillotine maul is ready to process firewood wood.



MECHANICAL ENGINEERING



TEAM 21

Garrett Daly
Patrick Koloseus
Nathan Orsini

ADVISOR

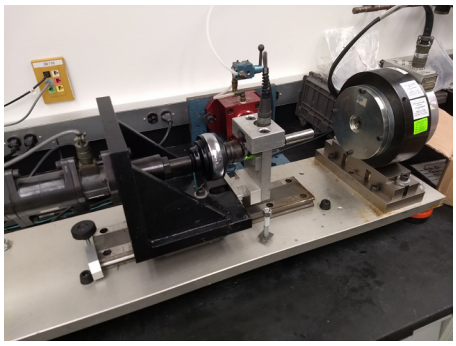
Vito Moreno

SPONSOR

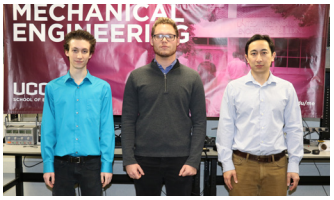
Henkel

Developing Torque-Tension Testing Capabilities

Henkel Corporation needs to collect data on a Torque-Tension Testing Machine. The data is useful because it allows them to guide their customers to determine how much torque on a fastener will become tension or clamp load. They manufacture and sell many threadlocking products that get used in various configurations so a lot of data is needed. The test unit consists of a load cell connected to an electric motor to give accurate values of clamping load, input torque and thread torque on a bolt assembly. This information can then be used to find thread and head friction and the K factor of the bolt, which is important to customers for accurate product data. Initially, the machine had reliability issues and its operation was not clearly understood. The team was tasked with understanding the setup and operation of the test machine, creating a reliable testing plan and production of documentation and a comprehensive training video for future users. A data set was created to verify the testing plan for accuracy and reliability when compared to other verified methods. The implementation of this new testing system gives Henkel more accurate results and the future training material will enable future testing to be conducted reliably by trained personnel.



MECHANICAL ENGINEERING



TEAM 22

Ryan Hunter
Alex Rasten

ADVISOR

Jason Lee

SPONSOR

HOLO-KROME®

Holo-Krome Improved Manufacturing Facility Layout

Holo-Krome is a critical application fastener manufacturer located in Wallingford, CT. Products manufactured at this facility are used in a wide variety of industries where material failure is not an option. The goal of this project was to improve the manufacturing facility from a relatively inefficient layout to a more condensed and effective layout that uses the factory floorspace more efficiently. Ranking the manufacturing cells on a scale of sales value per square foot identified which areas could use the most improvement. Through implementation of an agile manufacturing cell, machines with low utilization were consolidated to make room for machines that would utilize available floorspace in a more cost-effective manner.

MECHANICAL ENGINEERING

TEAM 23

Marieke Page
Syed Shahzaib Hussain
Logan Vidal

ADVISOR

David Giblin

SPONSOR

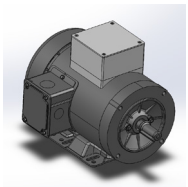
Munich RE

1866
Hartford Steam Boiler

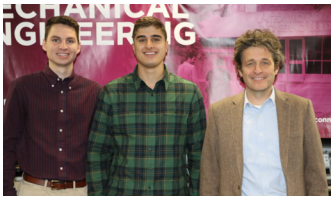
Wireless Motor Monitor for Deployment in Industrial Applications

Hartford Steam Boiler (HSB) is a speciality insurer under the parent company Munich Re. HSB is the largest provider of equipment breakdown insurance and inspection services in North America. The goal of this project was to develop an Internet of Things (IOT) sensor array to monitor industrial working conditions of an AC motor. The project focus was to help HSB's clients manage their risk profile of their AC motor run machinery by use of a non-intrusive and easy to install sensor array. Metrics monitored to achieve this include activation status, housing temperature, and vibrational state. The sensor array transmits the collected data using a LoRaWan protocol through a local gateway and into a cloud server.

To test and validate the performance of the sensor array we designed a test rig that is used to mimic an industrial environment. We built a water loop system that could be used to induce a variable load on the motor, and is modifiable to simulate non-ideal motor mounting conditions.



MECHANICAL ENGINEERING



TEAM 24

Alex Ghajar
Matthew Zujewski

ADVISOR

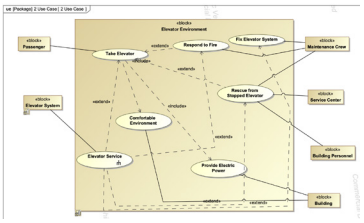
Horea Ilies

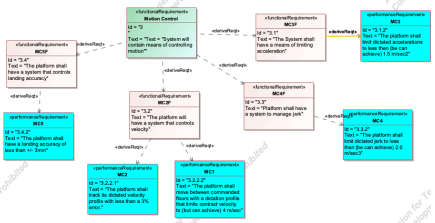
SPONSOR

OTIS

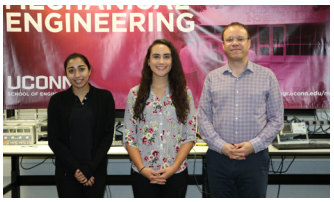
Self-Climbing Autonomous Robotic Motion Platform Design

The current OTIS elevator development process is document-based, limiting their ability to effectively model their systems. Utilizing Model-Based Systems Engineering (MBSE) principles, we sought to move the design process into a digital format. To achieve this, we are using SysML, a general purpose modeling software that allows analysis and verification of complex systems. In this digital modeling software, we were tasked with modeling a self-climbing elevator. Along with this model, a complete archival process was necessary to make development of future models faster and easier. Extensive research and understanding of current MBSE and SysML best practices were essential.





MECHANICAL ENGINEERING



TEAM 25

Gursimran Kainth
Elizabeth Soha

ADVISOR

Julian Norato

SPONSOR

PRATT & WHITNEY DEPENDABLE ENGINES

GO BEYOND

Modelling and Optimization of a Dual-Bore Oil Debris Monitoring System

The objective of this project is to model and prototype a dual-bore Oil Debris Monitoring (ODM) system for use in Pratt & Whitney's engines. The ODM sensor detects debris particles in engine oil and helps prevent engine failure. The current ODM used by P&W consists of a single assembly in which the pressurized lubricant flows through a single channel to one sensor. The proposed dual-bore ODM minimizes electromagnetic interference between the interacting coils' magnetic fields while optimizing the sensor's ability to detect small particles with high accuracy while remaining operable with a split flow path. ANSYS Maxwell and Fluent are used to model the electromagnetic and fluid properties of the dual-bore ODM, respectively. Maxwell model iterations are tested and analyzed with respect to varying coil properties and debris particle placement. Results show that under tested operating conditions, neighboring ODMs could be placed within close proximity with minimal magnetic field interference. The current running through sensing coil (dictates the sensor's ability to detect debris particles) increases when a particle is present. Fluent model iterations are simulated with a single and split flow path to verify operable flow behavior and pressure conditions.

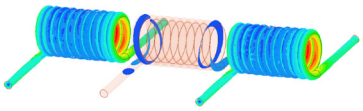


Fig. 1: Contour Plot of the Magnetic Field intensity on the Single-bore ODM coils (Computational Electromagnetics Model)

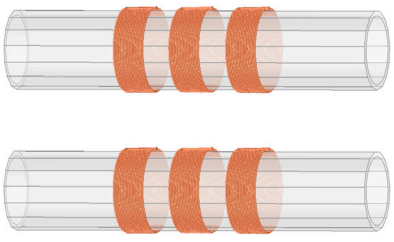
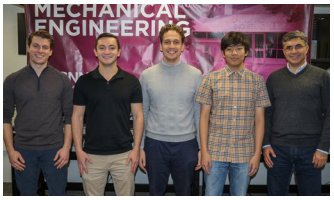


Fig. 2: Geometry of the Dual-Bore ODM (Computational Electromagnetics Model)

MECHANICAL ENGINEERING



TEAM 26

Jeremy Bronen
Michal Ciebielski
Nicholas Topor
Wei Wan

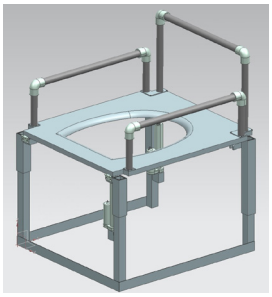
ADVISOR

Reza Sheikhi

SPONSOR

Timothy Krupski

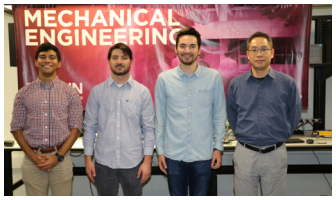
Power Assisted Toilet Lift



The sick, elderly, and disabled can often struggle getting on and off of the toilet. Both in senior care facilities and in personal households, there is a considerable risk of falling, caregiver injuries caused by the strain of lifting patients, and lack of independence for the user. NSH Solutions LLC, started by UConn alum Timothy Krupski, is aiming to provide an affordable and ergonomic solution to this problem.

Our team was given the task to design and fabricate a new lifting device prototype that can be used in nursing homes and private households alike. Through the use of linear actuators and gas springs, our group has designed a chair-like device that both lifts and tilts the user on/off the toilet. During the design process, our team used ANSYS simulation software to run analysis on the load distribution in order to validate the integrity and safety of the product. After building the prototype, we tested various loading scenarios and measured the experienced stresses with strain gauges, further validating the safety of the design. In addition to building a device that simply lifts patients on/off of a toilet, our team took into consideration its ease of cleanliness, ease of installation, adjustability, and ergonomic efficiency. Our project has accomplished the goals and has provided our sponsor with a next generation prototype ready for further development.

MECHANICAL ENGINEERING



TEAM 27

Ryan Crisanti
Dhruv Kekare
Kurt Zarba

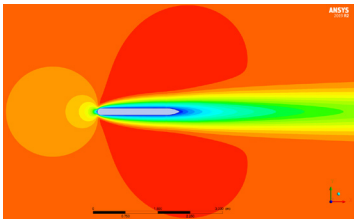
ADVISOR

Tai-Hsi Fan

SPONSOR

LBI

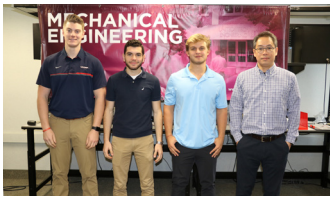
Hydrodynamics Optimization for Unmanned Underwater Glider



LBI is a small marine engineering company located in Groton, CT. The company has done work with the US Navy, NOAA, Electric Boat, and the Office of Naval Research, among others. The project at hand is the optimization of an unmanned glider, known as the Hummingbird glider. The Hummingbird glider utilizes a bladder system that allows for the control of its buoyancy. This, in conjunction with a set of hydrofoil wings, allows for the glider to move through the water in a sinusoidal-like travel path without the use of a traditional propulsion system. This allows the glider to take on long-range missions because very little energy is required.

Our team was tasked with optimizing the geometry of the glider in order to improve performance and extend the range of the glider. This process started with building computational fluid dynamics (CFD) models of the glider components and progressed forward with the creation of an overall system model, as well as experimental validation of our CFD results. With our validated CFD models and the system model, suggestions were made that improved overall glider performance.

MECHANICAL ENGINEERING



TEAM 28

Bryan Nelson
Anthony Nucerino
Klajdi Sosoli

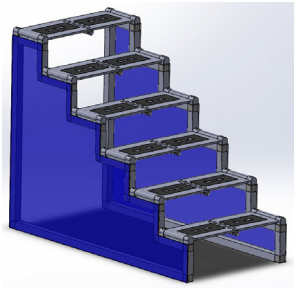
ADVISOR

Tai-Hsi Fan

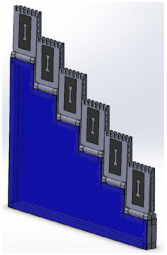
SPONSOR

LEFTY EQ
SWEET · SMART · DIVINE

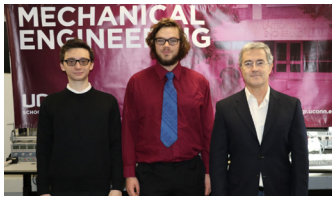
Design and Fabrication of Compact, Foldable Pet Stairs



Lefty EQ is an innovative startup managed by Gabrielle Shoshan out of Princeton, New Jersey focused on developing products to combat everyday problems. Gabrielle's love for dogs inspired her to seek the development of convenient pet stairs that support the needs of aging or injured pets. Through research she found that current designs for pet stairs are bulky, unappealing, heavy, or don't collapse. For these reasons, ME28 was tasked with designing and fabricating a set of compact, foldable pet stairs. The stairs are required to hold up to 200 lbs and weigh between 5-10 lbs. The design needed to be lightweight, easy to assemble and disassemble, and be visually appealing to the average consumer. ME28, in collaboration with a team of MSE students, came up with a unique way to fold the stair assembly from 16 inches wide to just 3 inches. This allows the pet stairs to easily be stored under a bed or in the trunk of a vehicle, without taking up much space. ME28 analyzed multiple materials to fabricate the steps out of, and tested different step designs in order to maximize strength and minimize weight. These stairs are designed to accommodate use by both small and large pets, with the increments between steps being optimized for both sizes. The forgiving surface on top of the steps also acts as a grip for the pet's paws, and ensures that they are comfortable when using the stairs.



MECHANICAL ENGINEERING



TEAM 29

Nicholas Manos
Thomas Rivet

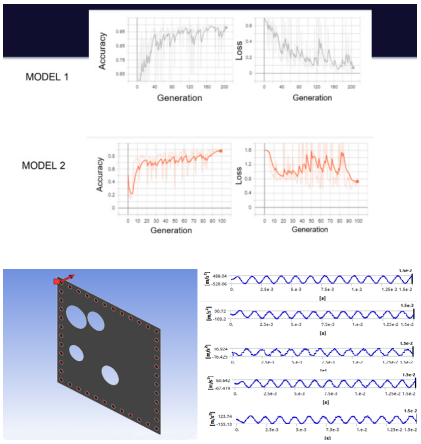
ADVISOR

George Lykotrafitis

SPONSOR

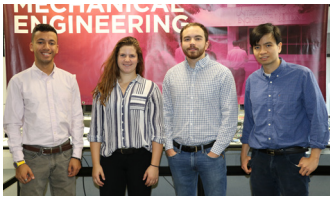
UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

Deep Learning Algorithms for Predicting Deformation and Failure of Underwater Shell Structures



This project explores alternative methods to monitoring and predicting dynamic loads of underwater shells. There is a pressing need for quality health monitoring systems for underwater structures due to the catastrophic nature of unplanned failure. Although other autonomous methods exist, neural networks excel in picking up features that might otherwise be missed through direct programming and mechanical methods. Machine learning with neural networks has already shown greatly improved results over the current state of the art in foundation crack detection. In our project, we develop finite element simulations of shell structures with which we extract "ground truth data". This data is used to develop machine learning algorithms, and train models capable of analyzing the structural integrity of a shell structure, and further predicting probable failure.

MECHANICAL ENGINEERING



TEAM 30

Devon Casazza
Clark Giraldez
Daniel Osborn

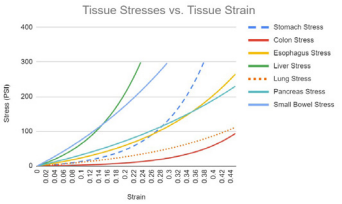
ADVISOR

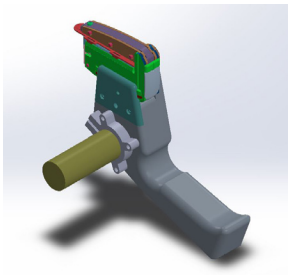
Thanh Nguyen

SPONSOR

Medtronic

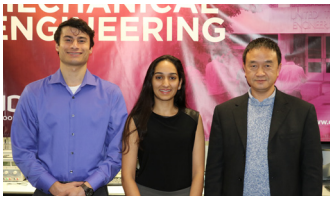
Mobile Hand-Held Tissue Compressor Tester





Medtronic is a global leader in medical device design that creates devices to assist in surgery and patient recovery. ME 30 was tasked to design and build a handheld compression test device capable of determining the material properties of tissue. This project focused on fixing the design issues of their existing prototype. ME 30 updated the drivetrain of the device to allow the use of a single motor to achieve different linear clamping speeds, replaced the existing strain gauge with a force sensor to allow for accurate measurement, and redesigned the packaging to allow the electronics to be housed within the handle of the device. This device will be used to create a database of tissue properties that will be used to inform surgical stapling procedures. To design the prototype, elementary mechanical design equations were used to update the existing gear train design and choose a new motor. A miniature compression load cell was chosen to measure the stress-strain properties of the tissue sample. All components are internalized in a 3-D printed handle. To validate the prototype, testing was completed at UConn and on-site at Medtronic with a material with known characteristics. Comparing the results from the prototype with the data from the device allowed the design to be validated. This project is a joint project with ECE.

MECHANICAL ENGINEERING



TEAM 31

Noah Del Coro
Hima Patel

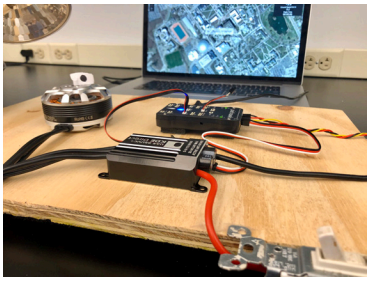
ADVISOR

Chengyu Cao

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

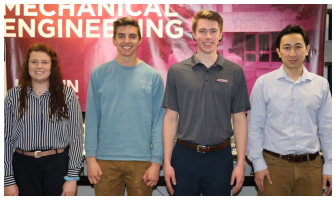
High Power Electronic Speed Controller Integration for Drone Flight Control



NASA is an interested party in this project due to the potential in improving drone flight. A crucial aspect of drone research is the electronic speed controllers (ESCs) that power its rotors. The goal of this senior design project was to conduct a comparison between two well-known ESCs and implement closed loop control on the chosen ESC with NASA's flight hardware.

We began the build process by constructing a robust testbed and running experiments on the KDE ESC and the VESC. We compared the results by analyzing the step response, latency, and bandwidth. To achieve closed loop control, we wrote driver code for NASA's F Prime flight software framework that implements the CAN duplex protocol. This code measures the rotor's rotations per minute (RPM), then uses that to calculate the rotor's thrust vector and command the motor with their respective power. Physical tests were used to quantify the potential performance improvements, as thrust vectoring is hypothesized to lead to more efficient flight.

MECHANICAL ENGINEERING



TEAM 32

Ethan Belisle
Andrew Fuller
Anna Tobiasz

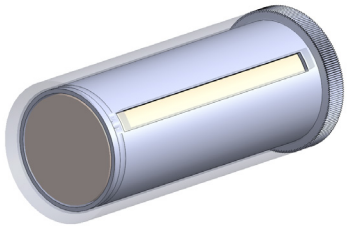
ADVISOR

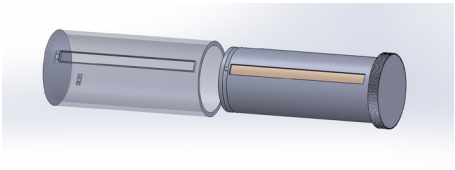
Jason Lee

SPONSOR

Reverge Anselmo
Erika Sather

Development of a Sanitary Product for Public Surfaces





Mr. Anselmo, an ardent supporter of Senior Design, partnered with Erika Sather to co-sponsor Natrium. Both sponsors found public surfaces aren't cleaned regularly. Natrium was tasked to develop a container to enclose and dispense sanitary barriers.

The container has been optimized through the iterative design process and container optimization calculations and showcases an easy to use locking system. It's comprised of two cylindrical parts with friction fitting preventing entry of small particles proven to prevent entry of small particles utilizing cycle and sand testing. The sanitary barriers located inside the container provide proof of concept as they are 100% recyclable and biodegradable while also indented and lavender scented fulfilling all sponsor requirements. Overall, Natrium has satisfied all requirements and created a unique product providing the public with an option to an unclean surface.

MECHANICAL ENGINEERING

TEAM 33

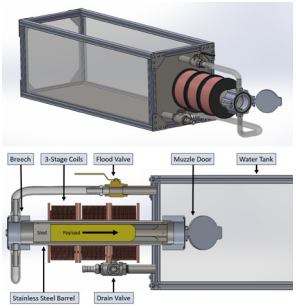
Joshua Dupont
Patrick Haggerty
Nickolai Serebriakov

ADVISOR

Jiong Tang

SPONSOR

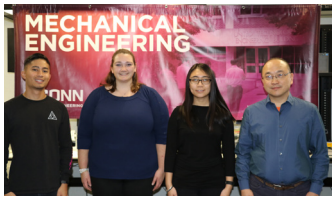
Electromagnetic Expulsion of a Cylindrical Body from an Outer Tube



The Naval Undersea Warfare Center (NUWC) is a full spectrum research, test, development, engineering, and support center for the US Navy. They have mentored this project with the goal of researching and building a method of launching an Unmanned Undersea Vehicle (UUV) electromagnetically. This project is a continuation of a project, initiated last year, and must feature a metal launching tube and watertight hatch doors at each end of the barrel. This project is also a joint project working with ECE 2020, who is responsible for creating the electromagnetic method for launching the UUV.

Following joint efforts by both teams we determined that our project would be a 3-Stage Coil Gun, featuring a 316 stainless steel barrel, and hinged, aluminum hatch doors on the breech and muzzle of the barrel. The barrel material was chosen to minimize electromagnetic interference while maintaining acceptable structural integrity. The breech-side hatch door is connected by tubing to flood and drain valves to fill the loaded barrel with water to equalize pressure when opening the muzzle door for launch, and then to drain the water in the barrel for reloading. This design also features internal rails to fit and launch the same 2inch projectile from last year's project. The non-ferrous projectile will be launched out of the barrel using a cast iron, consumable sled. We determined this design would be an acceptable iteration to last year's design to meet the goals set by our mentor.

MECHANICAL ENGINEERING



TEAM 34

Marco Agudo
Lauren Knapp
Jiayuan Shen

ADVISOR

Tianfeng Lu

SPONSOR

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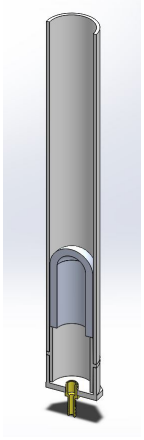
1869 - 2019
Naval Undersea Warfare Center
Undersea Superiority ★ Yesterday...Today and Tomorrow

Expulsion of a Cylindrical Body from an Outer Tube by Explodable Volumes

The Naval Undersea Warfare Center is the U.S. Navy's full-spectrum research, development, test and evaluation, engineering, and fleet support center for various naval structures and systems such as submarines and autonomous underwater systems. The ability to launch an object from an outer tube in an underwater environment continues to be of interest in the marine community. Such technology currently relies on an external power source to deploy an object. However, if an underwater vehicle loses power, it would not be able to launch objects that have the potential to save lives, such as an emergency beacon. This project involves developing, building, and testing a system that is able to launch a cylindrical body from an underwater launch tube utilizing an explodable volume without the need of an external power supply. CO_2 cartridges were chosen as the means of explosion by utilizing the impulse generated from the sudden release of CO_2 gas inside of the launch tube. This provides enough force to expel the cylindrical object from the tube. The prototype design consists of a vertical standing PVC tube with an attached regulator that controls the flow rate of CO_2 gas. The cylindrical object rests at the bottom of the tube and is forced out by the gas. From this setup, it is possible to obtain the impulse force and exit velocity required to expel the cylindrical object from the tube.



MECHANICAL ENGINEERING

TEAM 35

Eamon Costello
Joshua Leffingwell
Adriana Turkson

ADVISOR

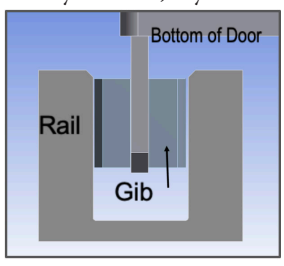
Julian E. Norato

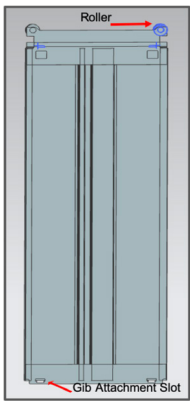
SPONSOR

OTIS

Building Pressure Effect on Elevator Door Operation

Otis Elevator Company is the leading manufacturer of safe and efficient elevators throughout over 200 countries and territories. In certain regions with high temperature differentials between the inside and outside of a building, a large pressure differential is created across the envelope of the elevator doors. This condition (known as the stack effect) is a result of colder, more dense air entering on the bottom floor while warmer, less dense air rises through the elevator shaft and exits at the top floors. This applied pressure creates friction when small plastic stoppers known as "gibs" are pinned against the channel running along the bottom of the door. This added frictional force can prevent the elevator door from closing. In an industry where consumer confidence in the product's safety is absolutely essential, any problem undermining the normal operation of the elevator must be solved. By changing the material of the "gibs" to a very low friction material, the worst-case frictional force would no longer cause stalling. In order to minimize cost, a MATLAB code was created to identify the cheapest material that would prevent stalling on a floor-by-floor basis. These material requirements are automatically calculated based on the specifications of the building being analyzed.





MECHANICAL ENGINEERING

TEAM 36

Devin Coperthwaite
Zachary Mangold
Aidan Wilkinson

ADVISOR

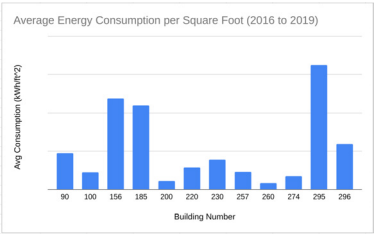
David Giblin

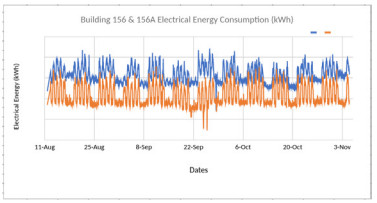
SPONSOR

Pfizer

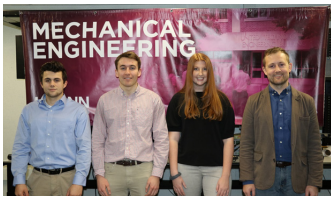
Process Development for Energy Consumption Analysis

Our joint engineering team completed an energy consumption analysis on a selected building on the Pfizer Groton campus. Pfizer seeks to make significant reductions in energy consumption by the year 2023 through reductions in thermal and electrical energy usage on their campus. In order to do so, they will need a process with which they can apply to various buildings throughout their campus to determine energy currently being consumed and calculate energy savings through a variety of alterations to building systems and company energy policies. This process provides Pfizer with a methodology to calculate energy savings by analyzing building systems that consume large amounts of energy. This process includes analysis of building air exchange through HVAC systems, electrical consumption savings by upgrading existing lighting systems, reduction of water consumption, as well as simulation modeling of existing building conditions via eQuest modeling software.





MECHANICAL ENGINEERING



TEAM 38

Tyler Howser
Amanda Renaud
Michael Rocchetti

ADVISOR

Ryan Cooper

SPONSOR

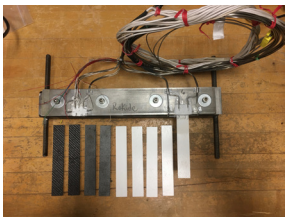
PRATT & WHITNEY
DEPENDABLE ENGINES

GO BEYOND

CMC Sensor Adhesive Strain Capacity Evaluation

Pratt & Whitney is constantly seeking to advance the technology for gas turbine engines. Ceramic matrix composites (CMCs) are a class of materials being developed for the aerospace industry because of their light weight and ability to withstand the extreme temperatures present in gas turbine engines. In order to study the performance of these materials, specialized adhesives are required to bond various sensors to the CMC components. A commercially available adhesive has been found that performs satisfactorily for this application. The goal of this project was to gain knowledge about the strength of the adhesive's bond and its failure mechanisms.

This project started with the analysis of a cantilever beam test rig using Finite Element Analysis software (ANSYS). An experiment was designed to evaluate the strain experienced by the bond at the point of its failure. A fixture utilizing a power screw was designed and fabricated by the team to apply a known displacement to the CMC beams for comparison to classic beam-bending equations. Qualitative results were obtained with a microscopic camera capturing delamination. Quantitative results were gathered from strain gauges bonded to the CMC beams and relaying strain readings to LabVIEW. A consistent strain limit was determined for each CMC and this failure point and mechanism was provided to Pratt & Whitney.



MECHANICAL ENGINEERING

TEAM 39

Kevin Barragan
Paige Didona
Jessica Primiano
Lucas Vannie

ADVISOR

Jiong Tang

SPONSOR

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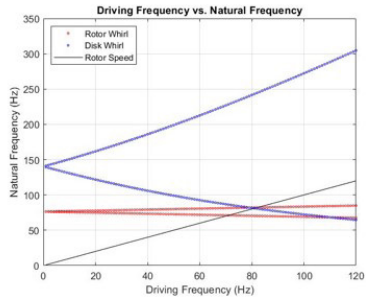
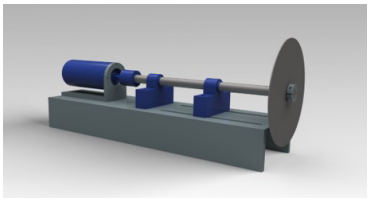
GO BEYOND

Delineation of the Rigid-Shaft Assumption in a Coupled Rotor System





Critical speeds are an operating condition in which the spin speed of a rotor equates to its natural frequency. At this condition, synchronous excitations such as imbalance can cause resonance, which in turn reduces the lifetime of the system. Due to this, rotating systems such as jet engines are designed to either (a) avoid operating near the critical speeds, or (b) mitigate the response.

Accurately predicting system critical speeds is paramount to avoiding their detrimental effects. Traditionally, critical speeds are predicted in an uncoupled manner. The rotor dynamics are analyzed assuming that the disk is rigid and the disk dynamics are analyzed assuming that the shaft is rigid. However, introducing lighter materials, more flexible rotors, and higher operating speeds raises a new concern that the modes of the disk and shaft may interact. This interaction can invalidate traditional assumptions regarding disk-rotor coupling.

The purpose of this project is to demonstrate shaft-to-disk coupling on the overall system critical speeds. It is hypothesized that coincidence between the disk and rotor natural frequencies changes the critical speeds and their predictions. This relevant coupling regime is delineated by constructing and analyzing an overhung rotor rig. The rig tunes different coincidences into or out of the regime by adjusting the bearing location.

MECHANICAL ENGINEERING

TEAM 41

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Leopoldo Moore
Omar Soliman

ADVISOR

David Giblin

SPONSOR

PRATT & WHITNEY
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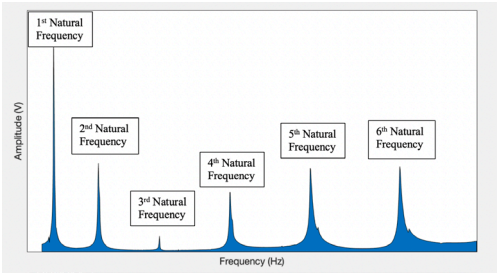
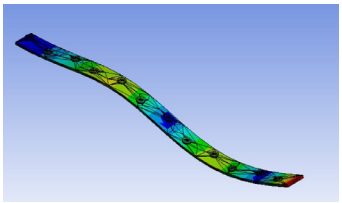
GO BEYOND

Friction Damping in Bolted and Riveted Connections



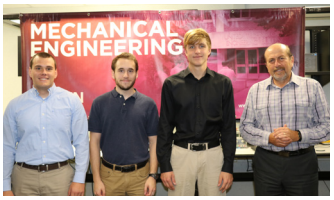
Pratt and Whitney is the sponsoring company of this project, and they design, manufacture, and service aircraft engines both commercially and militarily. They are seeking out additional information regarding the comparison of a previous year's data to better understand the relationship of bolt preload and damping.

The primary objective of this project is to provide Pratt and Whitney with analytical design iterations rather than testing on physical materials which will save significant time and money. A test specimen was provided by the company, and various bolt preloads will be compared to riveted joint connections to aid in developing the required analytical model.



As a result of creating a test matrix for the analytical model, it provided a deeper understanding to which bolt preloads were optimal due to running low to high frequency sweeps at several amplitude setpoints. By using the Half-Power Method and taking measurements of the frequency response, it became evident that the damping ratio decreased at higher frequencies as expected. In order to provide to Pratt and Whitney the developed model was accurate, ANSYS simulations were conducted to ensure validation, and therefore it was confirmed to be a working model.

MECHANICAL ENGINEERING



TEAM 42

William Broding
James Kenefick
Matthew Madar

ADVISOR

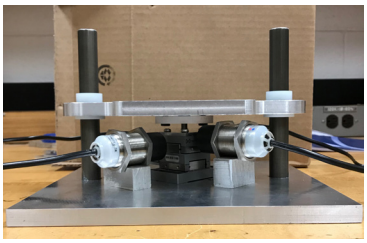
Nejat Olgac

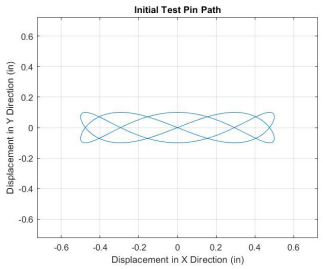
SPONSOR

PRATT & WHITNEY DEPENDABLE ENGINES

GO BEYOND

Tribology Test Rig for Multiple Wear Mechanism Testing





Pratt & Whitney is a global leader in the design and manufacturing of jet engines for commercial and military applications. The company utilizes a large number of resources to conduct wear, or tribology, testing of components in these engines. The goal of this project was to improve testing capabilities to better replicate wear patterns seen in field component hardware. The current test rig in use is capable of testing a single wear mechanism due to relative motion of test specimens being constrained to one axis. A new test rig would introduce a second axis of orthogonal motion to allow for the desired multiple wear mechanism testing. A small-scale prototype for this new test rig was constructed using a commercially available motorized linear XY stage to provide the two axes of relative motion. The normal force needed for wear to occur is provided using a known load above the XY stage surface. Preliminary test runs utilizing the prototype test rig yielded force, displacement, and frequency of motion data for sample multiple wear mechanism tests. This data was utilized to recommend the feasibility of scaling up the prototype design to meet the force, displacement, and frequency of motion requirements needed to fully replicate wear patterns seen in engine field hardware.

MECHANICAL ENGINEERING

TEAM 43

Cameron Garrelts
Clara Ramirez
Jacob Robison

ADVISOR

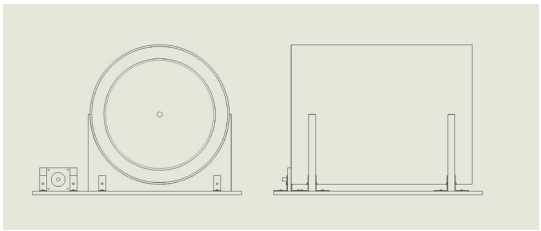
Xinju Zhao

SPONSOR

PRATT & WHITNEY DEPENDABLE ENGINES

GO BEYOND

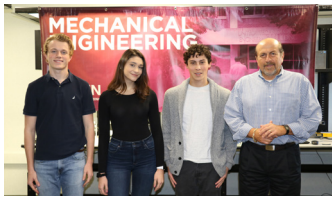
Rotating Disk Heat Transfer Coefficient Determination



This project aims to produce a test rig capable of determining heat transfer film coefficients on rotating disks operating under Reynolds number conditions that simulate a standard gas turbine engine. Previous rig designs were capable of producing a Reynolds number associated with a rotational velocity of 7,500 rotations per minute. To improve the capabilities of the rig, modifications were made to increase the rotational velocity beyond 12,000 rotations per minute, producing greater Reynolds numbers. Corresponding numerical simulations in ANSYS Fluent are used to evaluate and validate the coefficients determined experimentally. The team also developed and proved a heat film transfer coefficient applicable for this rotating disk.

The modifications planned and researched for this rig are primarily increasing the power of the motor, transitioning to a new power transmission system with a more feasible pulley/gearing system, considering disk geometry, composition alterations and constructing a rig steady frame. The rig implements the same pyrometer included in the previous design iteration.

MECHANICAL ENGINEERING



TEAM 44

Enoc Escobar
Griffin Liebel
Megan Zindell

ADVISOR

Nejat Olgac

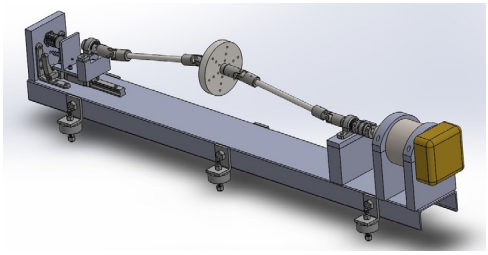
SPONSOR

PRATT & WHITNEY
DEPENDABLE ENGINES

GO BEYOND

Effects of Geometric and Mass Imbalance on Rotor Assemblies

The purpose of this project is to develop a method to identify and quantify the effects of mass imbalance, as well as the effects of geometric imbalance, in a rotor assembly. The design and prediction of the response of rotor assemblies to these geometric and mass imbalances is desirable in order to guarantee the overall safety and durability of the engine. Our team will be examining the relationship between the respective imbalances and resultant forces, shaft deflection, and frequency of vibrations at the supports. A test rig was built by last year's team, and this problem was studied analytically to begin to understand the relationship between imbalance and response, however the simulation of geometric imbalance proved to be challenging. Improvements to the method for generating this geometric imbalance will be investigated as part of this project alongside the overall testing and analysis of the forces generated by both geometric and mass imbalances as a function of rig spinning speed.



MECHANICAL ENGINEERING

TEAM 45

Ian Hancock
Linh Quach
Jillian Scherpa

ADVISOR

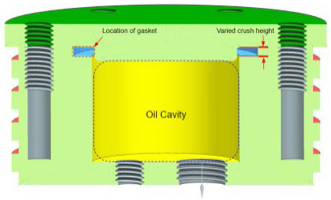
Ryan Cooper

SPONSOR

PRATT & WHITNEY
DEPENDABLE ENGINES

GO BEYOND

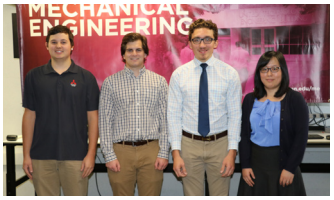
Thermal and Vibration Testing of Static Carbon Graphite Flange Seals



Our goal is to simulate flight effects on the gasket by performing vibration, thermal, and pressure testing. The vibration test will vibrate the seal at a frequency of 100 Hz at an acceleration of 10 g's for 150 hours. The thermal test will heat the seal from 100 °F to 500 °F for 3000 cycles. Lastly, the pressure test will load the seal from 0 to 500 psi for 1000 cycles. During each test, the gasket will be torqued down inside a test rig designed by the team; utilizing six test rigs that torque down the seal at different crush heights ranging from .015 - .040 inches.

The success criteria will be found during the pressure test after the seal undergoes thermal and vibration testing. When a seal fails during pressure testing, oil leakage is seen with a UV flashlight through the use of fluorescent dye mixed into the oil. If a graphite seal goes through each test without leaking, there is evidence to support its ability to adequately replace the currently used spiral wound graphite with metal backed gaskets.

MECHANICAL ENGINEERING



TEAM 46

Maxwell Marchetti
Colton Moore
Andrew Suter

ADVISOR

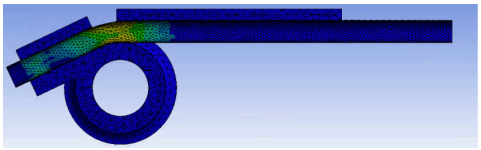
Dianyun Zhang

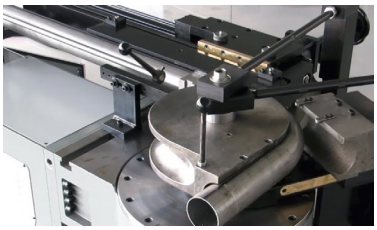
SPONSOR

PRATT & WHITNEY
DEPENDABLE ENGINES

GO BEYOND

Tube Bending Process Optimization





Pratt and Whitney, head quartered out of East Hartford, is an American manufacturer of aircraft engines and auxiliary power units. The goal of our project, assigned by Pratt and Whitney, is to create a simulation capable of providing accurate cross sectional deformation values in bent tubes.

Within turbine engines there are numerous bent tubes which are responsible for the transportation of fluids such as fuel, oil, and high pressure air. Any unexpected weak points in these tubes can create a possible hazard due to their stress levels. The most susceptible areas for weakening are within the tube bends. This change in strength is due to phenomena that occur within the bending process, deforming the cross sections.

To account for all deformations, an accurate simulation of the tube bending process was created. The simulation runs within ANSYS software, where the program mimics all the forces present during bending. The geometrical contents of this simulation were created using Siemens NX software, where each mandrel bender component was modeled individually. To ensure the accuracy of the simulation, the output data was compared to real pipe bend data provided by E.A Patten, a Connecticut metal forming company. This data was then used to calibrate the simulation. The final product is able to provide cross sectional deformation information for given bend inputs.

MECHANICAL ENGINEERING

TEAM 47

Lucas Farrell
Joseph Lee
Alec Schmidt

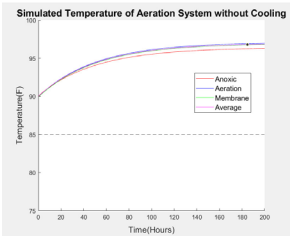
ADVISOR

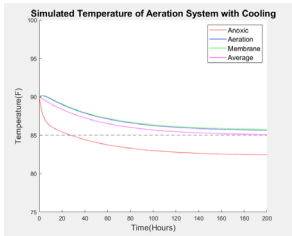
Baki Cetegen

SPONSOR

QUANTUM BIOPOWER

Spiral Heat Exchanger for Food Waste Recycling Plant





In 2017, Quantum Biopower opened Connecticut's first anaerobic digestion facility, which breaks down food waste to create biogas that is burned in a combustion engine to produce electrical power. During the heat of the summer months, the Aeration System in their facility overheats, in turn making the food waste digestion process significantly less efficient. In order to ensure proper performance year-round, ME Team 47 had been tasked with designing a method of cooling the Aeration System, namely a heat exchanger. It was decided that a spiral heat exchanger would be the most suitable device for this application since the spiral shape decreases clogging and fouling. The problem was then approached by determining the amount of heat that enters the system on the hottest possible day, factoring in various sources of heat such as radiation and conduction. This maximum amount of heat was calculated to be 146 KW. This value will be used to properly size a heat exchanger in order to prevent the system from overheating.

MECHANICAL ENGINEERING

TEAM 48

Matthew Cone
Mason Freund
Dereck Li

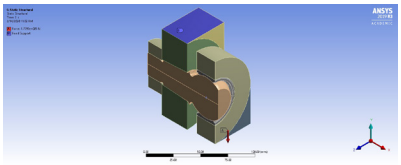
ADVISOR

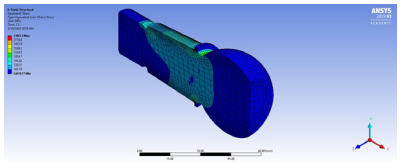
Nejat Olgac

SPONSOR

RBC BEARINGS

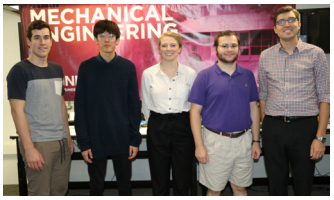
Analysis of Ultimate Strength within the Modeled Plasticity Region for Steel Ball Stud Bearings





RBC Bearings is an industrial ball bearing manufacturer that engineers bearing solutions for various systems in the industrial, aerospace, and defense markets. This project provides an approach to effectively predict the stress-strain structural behavior of a steel ball stud bearing. Obtaining the knowledge of this behavior through a simulation software will reduce the resources needed to repeatedly complete numerous physical tests. The results will allow RBC Bearings to accurately and precisely anticipate the ultimate and failure stresses of the bearings in their production. The final non-linear material behavior design has been verified by both analytical tests and physical tests in order to prove its repeatability. To achieve the completed design, the process had to include the stress-strain curve of the 4340 steel material, the physical test results, and the ANSYS simulation of the ball stud with contact surfaces and non-linear properties. The simulations combined the principles from tests using purely elastic properties with tests using plastic properties. The physical test result of failure loads determine that the ANSYS simulations are congruent. These calculations, designs, and simulations provide us the necessary data to predetermine the ultimate and fracture strengths of the bearing to a true relative error of 5% accuracy.

MECHANICAL ENGINEERING



TEAM 49

Chase Harmon
Ashley Oakley
Justin Schroeder
Nathan Wu

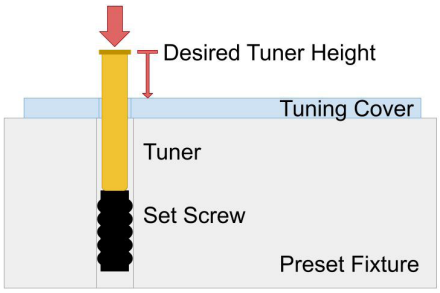
ADVISOR

Bryan Weber

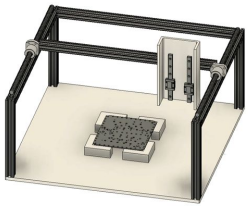
SPONSOR

RFS RADIO FREQUENCY SYSTEMS

Automation of Tuning Cover Preset Fixture

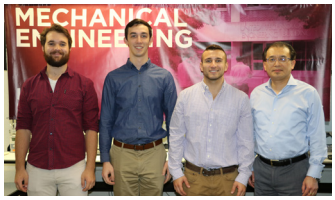


Radio Frequency Systems (RFS) is a leading, world-wide provider of radio frequency solutions including microwave and base station antennas and various communications cables and connectors. The goal of this project was to design and build a machine that automatically places height restrictors on preset fixtures. The preset fixture is a template used to produce tuning covers for a radio frequency (RF) filter, a key component in communications devices. RF boards use deep-drawn brass tuners for signal processing; the height of the tuners is what creates the desired signal output. By setting the preset fixture depth through a mechanical system, versus the current manual methods, RFS can reduce fine-tuning time of RF boards by roughly 50%.



Set screws were chosen to be the height restrictors for the preset fixture. The required vertical tolerance of ±0.005" was achieved via a photoelectric time of flight sensor laser mounted above the drive system. Confirmation of the machine's tolerance and repeatability were conducted by precise measurements of a test preset fixture. Shaker table testing was conducted on the selected screw to ensure expected preset use would not shift the screws beyond allowable tolerances.

MECHANICAL ENGINEERING



TEAM 50

Sean O'Bannon
Jack Pashayan
Keith Prior

ADVISOR

Chih-Jen Sung

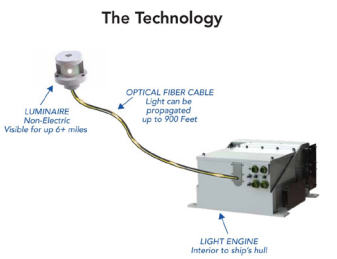
SPONSOR

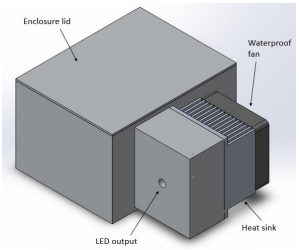
RSL®
Advanced Lighting Technologies

Portable, Lightweight Fiber Optic Illuminator for Marine and Industrial Applications

The objective of our project is to design and manufacture a portable, lightweight fiber optic illuminator for our sponsor, RSL Fiber Systems. We are basing our designs off of previous products made by the company. Current designs consist of three (3) isolated sections: a powerful, wall-mounted light-generating unit, a fiber optic cable to transport the light, and a non-electric optical diffuser for the user to control the operation of the light. Separating the system into discrete units adds to the device's operability at the user end, eases maintenance, and protects the electric units from exposure to harmful outdoor conditions.

We will be improving on previous designs by including an independent battery in the unit, which will give the device its portability. Because of the military use of the product, strict technical qualifications for the unit must also be met. It must be waterproof rated to IP 65 qualification, it must pass shock test requirements, and it must not be susceptible to EMI (electromagnetic interference). All of this will be achieved while also reducing the weight and size of the device by using more specialized components during design and construction. This device should be an improvement in every way, with as little compromise as possible.





MECHANICAL ENGINEERING

TEAM 51

Ermin Behremovic
Andrew Frosti
Justin Tiu

ADVISOR

Jason Lee

SPONSOR

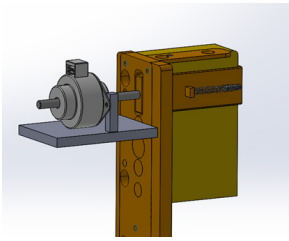
SONICS®
SONICS & MATERIALS, INC.

Improved Ultra Sonic Wire Splicer

Sonics & Materials, Inc., is a pioneer and leader in the field of ultrasonic welding and ultrasonic liquid processing. Sonics' ultrasonic metal welding product line is used for bonding conductive and dissimilar metals, such as copper, aluminum, brass, gold and silver. This project focused on Sonics' 20 kHz wire splicer. Both the gathering tool and the anvil mechanism on this machine were identified as areas for improvement.

By analyzing the machine's weld process, the wire splicer was evaluated for manufacturability and reliability. A mechanical model of the wire splicer was created to understand the function, cost and manufacturing complexity of each component. This allowed the team to meet the project objectives by developing a variety of solutions. To reduce the overall complexity of the machine, the gathering tool and anvil mechanism designs were simplified.

The team improved the gathering tool by upgrading from a rotary pneumatic system to a linear spring system. This modification significantly reduced the number of components in the assembly, resulting in a 32% cost savings, and simplified the manufacturing process by reducing or eliminating complicated alignments. The anvil mechanism was improved by upgrading the air cylinder to deliver greater force. This modification prevents wire debris from jamming the assembly, improving serviceability and reliability.



MECHANICAL ENGINEERING

TEAM 52

Keegan Dostie
Zhenyu Li
Rachel Scott

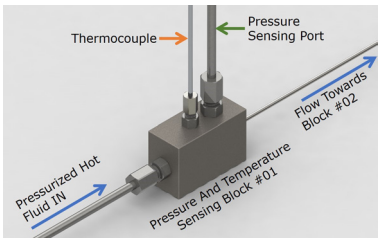
ADVISOR

Georgios Matheou

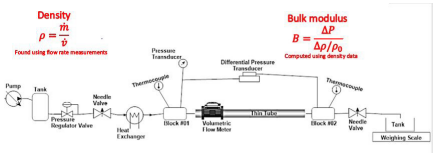
SPONSOR

Stanadyne

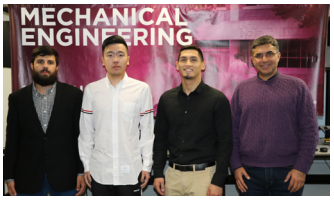
High Pressure and Temperature Densimeter (Fuel Characterization Project Part 1 of 2)



Stanadyne LLC is a global leader in fuel systems technology. Much of their current research and development involves low and high-pressure gasoline and diesel fuel pumps and fuel injectors. Within the development process of these fuel pumps, Stanadyne utilizes hydrodynamic fuel simulations to analyze their designs. The quality of these simulations depends on the accuracy of the fuel properties assigned as engineering data in the simulations. Specifically, density, viscosity, and bulk modulus are critical properties of fuel in the design and development of fuel systems technology. Temperature and pressure both have considerable effects on these properties. This project aims to measure the density and bulk modulus of working fluids at a maximum pressure of 34 MPa and at a maximum temperature of 200 °C to validate the hydrodynamic simulations and equations of state fuel models. The test device computes density using volumetric and mass flow rate measurements. Bulk modulus is computed using the collected data of pressure vs. density. The team completed the fabrication and validation of the test mechanism and acquired measurements. ME52 collaborated with team ME54, as they measure the viscosity using the test mechanism at the same pressure and temperature. A system design capable of withstanding 100 MPa at the same temperature for further experimentation has also been recommended.



MECHANICAL ENGINEERING



TEAM 53

Alexander Ney
Carlos Romano
Haozhen Tian

ADVISOR

Reza Sheikhi

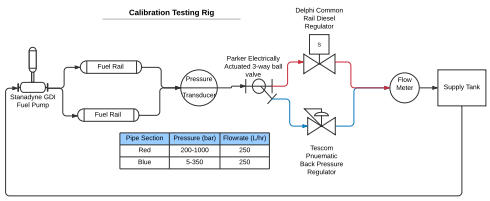
SPONSOR

Stanadyne

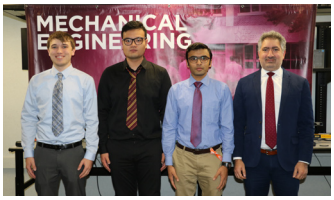
High Pressure Regulator Upgrade for Gasoline Pump Testing

Stanadyne is a major manufacturer of gasoline and diesel injection pumps with a testing facility located in Windsor, CT. Stanadyne is looking to increase their testing capabilities for their gasoline direct injection (GDI) pumps by replacing their current pressure regulators. The maximum pressure Stanadyne can test at is 350 bar. To understand the conditions in which their product fails, they requested an electrically actuated regulator capable of modulating pressures ranging from 5 to 1000 bar.

After doing extensive research of market offerings, it was concluded that multiple regulators would be needed to effectively cover the desired pressure range. A solenoid regulator used in common rail diesel engines was sourced due to their ability to handle high pressure. This will be combined with the low pressure regulator Stanadyne currently has installed in their test stands. A 3-way pneumatic powered diverter valve was added upstream of the two regulators to divert the flow based on the incoming pressure. This system will be installed in their durability and calibration test stands. A control protocol was then developed to allow the new system to integrate directly with their current testing software.



MECHANICAL ENGINEERING



TEAM 54

Eric Gillespie
Zihao Liu
Jeet Modi

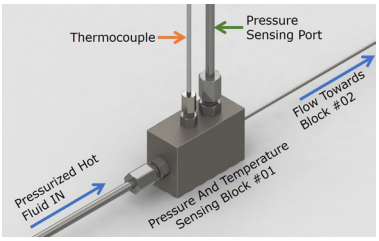
ADVISOR

Georgios Matheou

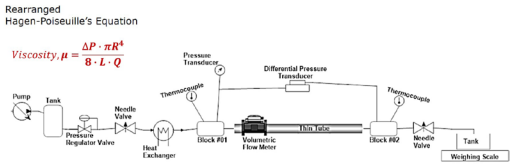
SPONSOR

Stanadyne

High Pressure and Temperature Viscometer (Fuel Characterization Project Part 2 of 2)



Stanadyne LLC is a global leader in fuel systems technology. The company's current research and development involves low and high-pressure fuel pumps and fuel injectors. Within the development process of these pumps, Stanadyne utilizes hydrodynamic fuel simulations to analyze their designs. The quality of these simulations depends on the accuracy of the fuel properties assigned as engineering data in the simulations. Specifically, density, viscosity, and bulk modulus are critical properties of fuel in the design and development of fuel systems technology. Temperature and pressure both have considerable effects on these properties.



This project aims to measure the viscosity of fluids at a maximum of 34 MPa pressure and a maximum of 200 °C temperature. The data acquired is used to validate the hydrodynamic simulations and equations of state from NIST's REFPROP fuel models. The test device is designed using the Hagen-Poiseuille equation for measuring viscosity. The equation utilizes constant length and radius of the tube and measured pressure drop and volumetric flow rate through the tube. A design capable of withstanding 100 MPa at the same temperature for further experimentation, has been recommended to Stanadyne LLC. The team has collaborated with team ME52, as they measure the density and compute bulk modulus at the same pressure and temperature conditions.

MECHANICAL ENGINEERING

TEAM 55

Eric Kostoss
Alden Lamp
Ethan Millette

ADVISOR

Chengyu Cao

SPONSOR

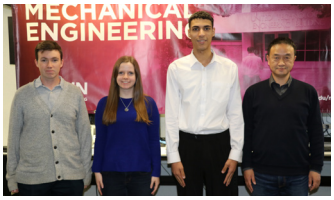
ThayerMahan

Autonomous Air Vehicle Operations from Mobile Host Platform—Air Vehicle Design

ThayerMahan is a leader in designing, manufacturing and (when desired by their customers) operating systems to collect acoustic and electronic information on the world's oceans. The goal of this project is to develop a rendezvous system, both the hardware and software, that enables an unmanned air vehicle (UAV) to land on Team ME56's unmanned ground vehicle (UGV). This project is focused on the required electronics and software to accomplish said task with a secondary focus on the vehicles themselves. The main purpose is to identify and resolve the obstacles that impede accomplishing the goal.

The first system is an off-the-shelf component drone. We determined that the easiest way to get a drone that could support the tasks we require it to do was to build it ourselves. In this way, we can carry unconventional combinations of flight controllers, sensors and computers that permit us more leeway in our method to land than buying a pre-built chassis. The second system is the Real-Time Kinematics (RTK) GPS setup. We favored this system over vision-based and traditional GPS landing methods due to the error in the sensor's reported absolute position being approximately a centimeter. By using pymavlink, we are able to dynamically set waypoints for the drone to follow and ultimately land on the UGV.

MECHANICAL ENGINEERING



TEAM 56

Cody Corey
Marwan Ghellai
Julia Oppenheimer

ADVISOR

Chengyu Cao

SPONSOR

ThayerMahan

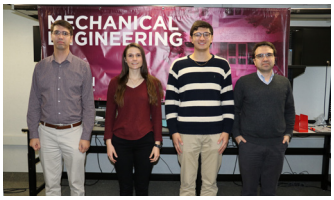
Unmanned Ground Vehicle for Simulating Unmanned Air Vehicle Landing

ThayerMahan is a world leader in maritime surveillance, designing, and manufacturing systems which collect acoustic and electronic information from the world's oceans. The company uses unmanned air vehicles (UAVs) for collecting data, however there are currently no efficient methods of retrieving UAVs once they have been sent on water missions.

ThayerMahan has tasked ME56 to construct an unmanned ground vehicle (UGV) under the guidance of sponsor advisor Alex Lorman and faculty advisor Professor Chengyu Cao. The UGV is utilized to develop a method for autonomously landing a UAV on a stationary target without the risk of experiencing water damage before it attempts to land on an unmanned surface vehicle (USV) in the ocean.

ME56 addressed the problem by constructing the UGV from a sheet of plywood with two front wheels attached to a steering axle and two rear wheels each driven by a brushed DC motors. To prevent the UAV from sliding off the UGV once it has landed, legs were attached underneath the UAV that poke through a net suspended above the UGV's platform as a retention method. Both the UGV and UAV communicate through RTK (real-time kinematic) GPS to locate the ground vehicle with minimal error. ThayerMahan can then replicate the drone retention method and landing algorithm on their USVs out in the oceans, making the UAVs retrievable for multiple missions.

MECHANICAL ENGINEERING



TEAM 57

Michael Fusaro
Ian LeBlanc
Aimee Talbot

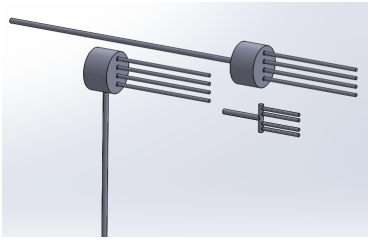
ADVISOR

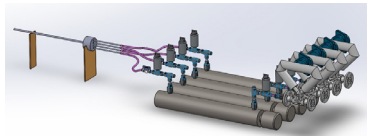
Ugur Pasaogullari

SPONSOR

Triumph Engine Control Systems
A Triumph Group Company

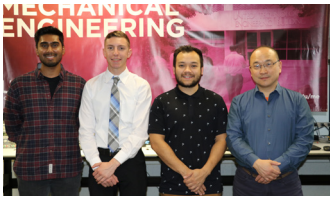
Experimental Study of Two-Phase Refrigerant Flow Distribution in the Evaporator Distribution System





Triumph Integrated Systems specializes in thermal management systems, such as air and liquid cooling systems. Triumph has developed a computational model to test the physics behind nonuniform distribution of two-phase refrigerant as it flows through three idealized evaporator distributors. Our project is to design, build, and run an experimental test that will create data to validate Triumph's computational model. This design is capable of adjusting the flow rate across the distribution manifold between 20 kghr and 120 kghr, as well as varying the vapor quality of the refrigerant entering the distribution manifold between 0.15 and 0.4. This allows Triumph to validate their numerical model against several different data sets. Temperature, pressure, and mass flow sensors are configured to obtain steady-state measurements from a computer-based data acquisition system to determine the vapor quality and mass flow rates of each outlet of the distributor for various inlet mass flow rates and vapor qualities. This design also has the capability to switch out various evaporator distributors of different orientations and lengths without completely altering the system or evacuating refrigerant from the entire system.

MECHANICAL ENGINEERING



TEAM 58

Steven Doan
Daniel Gavrilovic
Varun Yetukuri

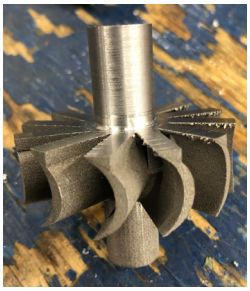
ADVISOR

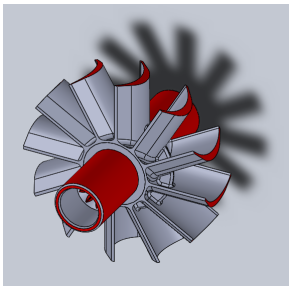
Tianfeng Lu

SPONSOR

Triumph Engine Control Systems
A Triumph Group Company

Side Channel Pump Development

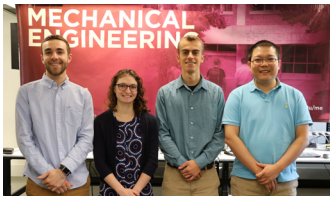




Developing an effective and reliable fuel pump for the aerospace industry is an issue brought to the University of Connecticut's Mechanical Engineering Department by Triumph Engine Controls. One of the biggest issues for aerospace fuel systems is multi-phase and multi-component fuel. A two-phase/two-component mixture and bubbles are formed due to the following factors: pipe friction, changes in elevation, various forces and g-forces. For consistent and reliable operation, the fuel needs to be in a liquid phase.

The LOLA is a fuel pump that takes this two-phase/two-component mixture and dissolves or condenses the bubbles to a liquid. At the outlet of the pump, this ratio is zero seeing how all the bubbles are condensed to a liquid. Once the V/L ratio reaches this limit, the pump will choke and lose its functionality due to such a low acoustic velocity. Triumph Engine Controls has provided the team with a baseline wheel and the team has further developed two design iterations based off of previous test data. Due to the complexity of this pump, computational fluid dynamics does not accurately predict the performance and choking point of the pump. Since casting is a very long, timely process, the team has been tasked with utilizing and investigating additive manufacturing as an option to create these wheels and test for research purposes.

MECHANICAL ENGINEERING



TEAM 59

Brent Avallone
Brittany Lydon
Isaac Talbot

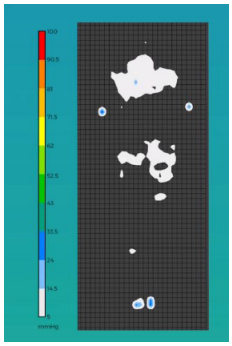
ADVISOR

Ying Li

SPONSOR

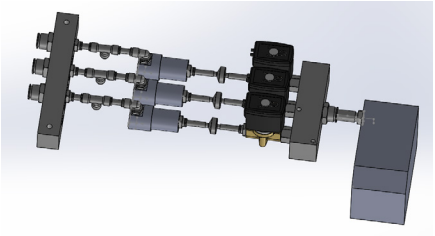
UNISOFT

Optimization and Development of an Alternating Pressure Mattress Pump

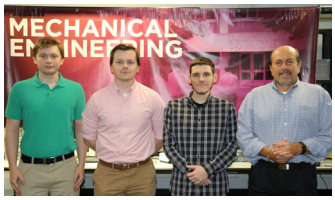


This project was initiated by Unisoft Medical Corporation, a medical device company that created the Unisoft One, the first single patient use therapeutic support surface. Unisoft ONE was developed to prevent and treat pressure injuries and eliminate the risk of infectious disease acquisition from contaminated reusable or rented healthcare mattresses. While the current pump paired to the Unisoft Mattress still outperforms its competitors, it is not optimized.

The project objectives were aimed at designing a more efficient pump which will not only inflate the mattress faster but will optimize pressure distribution for a multitude of different patients depending on size and weight. Research into multiple areas such as pumps, sensors, valves and controls was conducted. Various calculations of pressure output and losses were performed in order to create a theoretical model of the air flow through the mattress pump. A prototype smart pump system was designed and built with the ability to adjust the mattress to any weight and size input.



MECHANICAL ENGINEERING



TEAM 60

Nicholas Holden
Mathew Sargeant
Arthur Vitkovskis

ADVISOR

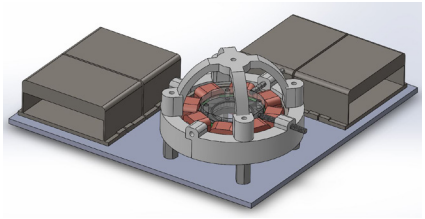
Nejat Olgac

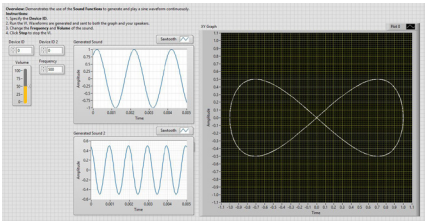
SPONSOR

United Technologies Research Center

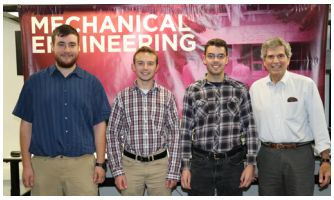
Developing a Method for High Frequency Wear Testing

The purpose of this project is to develop an efficient method of simulating different frictional wear patterns between two given surfaces at varying levels of frequency and amplitude. The test fixture we have developed is capable of multi-dimensional wear and has the ability to apply a variable vertical load on the given specimen. The fixture itself also uses an active magnetic bearing, of which we generate a magnetic field to either push or pull a center core whenever needed for a specific wear pattern. The core of the fixture includes a platform of which the specimen will wear against as the magnetic bearing quadrants are energized. To achieve the deliverable of reaching 1000 Hz of low amplitude mechanical vibration, we use a custom LabView file to control the input signal to the amplifiers powering the coils of the magnetic bearing, thus controlling the wear pattern, frequency, amplitude, and other functions for the test fixture. We have also added other data gathering capabilities such as displacement sensors to accurately measure the horizontal displacement of the center core and to verify the accuracy of how the input signal translates to mechanical frequency.





MECHANICAL ENGINEERING



TEAM 61

Seth Beecher
Benjamin Rakowski
Daniel Twiss

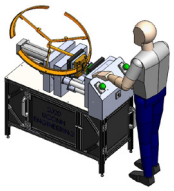
ADVISOR

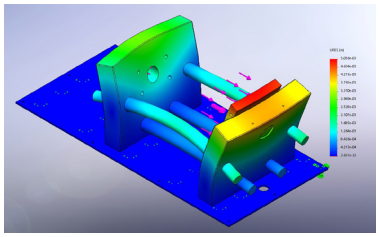
Vito Moreno

SPONSOR

Whitcraft EASTFORD

Right Sized Press with Quick Change Dies





Whitcraft is a respected leader in lean manufacturing producing formed, machined and fabricated sheet metal aerospace components and assemblies. They use a hands-on process called Moonshine to aid in rapid prototyping and to develop innovative problem solutions.

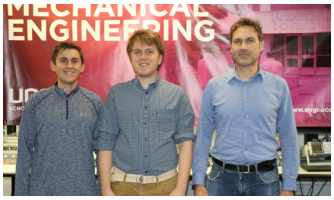
Our goal was to use the Moonshine process to design a right-sized press machine that shears military engine components. It would replace the existing circa 1950's press which was big, slow, and cumbersome to operate.

The press we designed is portable, easy to use, and fits within Whitcraft's production flow line, improving efficiency and product output.

The Moonshine process consisted of hand-sketching 7 different machine configurations. We chose the best 3 hand-sketches and constructed a cardboard or creform mock-up of each one to understand the basic size and operational limitations of the new design. Once we selected the best of the 3 mock-ups, we created a CAD model and began running simulations. The maximum bending deformation allowed was 0.010". Our press is 50% of this value, at 0.005" deformation.

Our OSHA compliant press machine is designed with a minimum safety factor of 3.5 to ensure proper operation over its lifetime, and features aesthetically pleasing side panels and lighting.

MECHANICAL ENGINEERING



TEAM 62

Carmen Ciardiello
Alessandro Fisher

ADVISOR

David M. Pierce

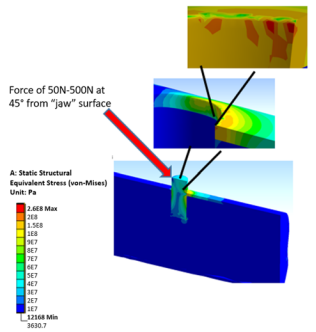
SPONSOR

WINDHAM AND GROTON DENTAL GROUP

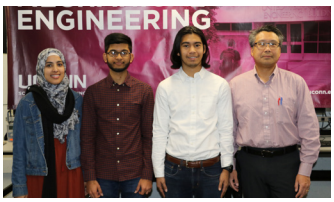
A Mathematical Formula For Clinicians To Determine The Feasibility For Immediate Implant Functional Loading

A typical dental implant takes approximately four to six months to undergo complete osseointegration. With correct physiological parameters (bite force, mandibular Young's modulus, mandibular cortical bone thickness, and implant diameter) immediate dental implants are a viable solution to this problem. Our objective is to build upon work done by previous senior design teams and build a mathematical model that uses patient-specific input values and can predict whether immediate dental implant loading is safe.

We built our mathematical model off data generated from finite element simulations of simplified mandibular models. We used data from these simulations is to build a formula. In this process we discovered that the output of the formula developed by previous senior design is based entirely on the implant diameter. Our analysis pointed to the factors mentioned above as important to determining implant failure, with bite force showing an especially meaningful p value. We validated the model with higher-fidelity geometries derived from patient CT-scans. By validating the mathematical model with the more robust mandible geometries, we are more confident in the model's output and predictive power and in turn safely determine whether or not a patient is eligible for immediate dental implant loading.



MECHANICAL ENGINEERING



TEAM 63

Jade Presley Lewis
Saumya Parikh
Hafsa Zahhal

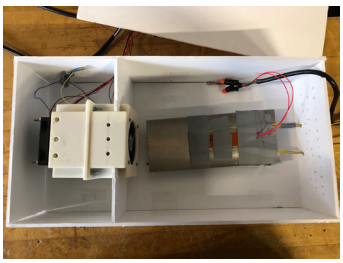
ADVISOR

Wilson K. S. Chiu

SPONSOR

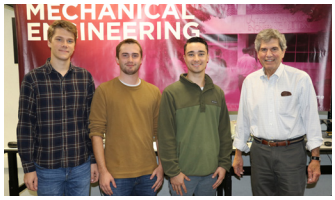
ZACHRY

Design, Development, and Fabrication of a 3D Laser Scanner Cooling System



Zachry Nuclear Engineering provides software, engineering, design, and project management services to commercial nuclear power plants throughout the United States and overseas. This sometimes involves modeling large portions of the plant for computer-based analyses and the design of plant upgrades and modifications. Zachry uses a 3D laser scanner (FARO Focus X330) to aide in this task. The X330 is only rated for a maximum ambient temperature of 104F, significantly lower than the average ambient temperatures in some areas of the plant during operating. The goal of this project was to design and build a cooling system that would lower the surrounding ambient temperature of the scanner within the acceptable range of operation to avoid failure due to overheating. This system was designed to lower ambient temperatures of 120F till within the acceptable ambient temperature range of the scanner (41-104F). Additionally, this project required the construction of a heat transfer mockup able to mimic the heat transfer properties of the scanner in order to test the efficacy of the prototype. Ultimately, the team produced a thermoelectric air cooling system that incorporates cooling fans, heat sinks, and Peltier Devices, reducing ambient temperatures by 25F and a 3D printed ABS plastic heat transfer mockup of the scanner equipped with a tripod motor to replicate the rotation of the scanner.

MECHANICAL ENGINEERING



TEAM 64

Jordan Arcangel
Jacob Fortin
Matthijs Hoesktra

ADVISOR

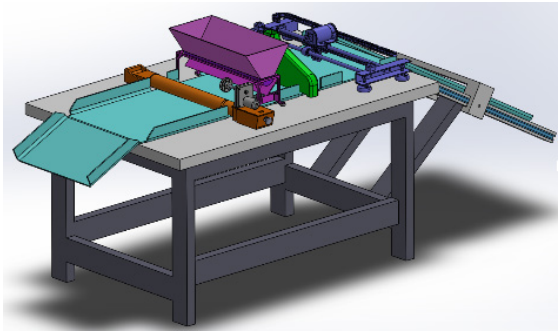
Vito Moreno

SPONSOR

RUBBER LABELS USA
TRUSTED SINCE 1916

Manufacturing Automation System

Rubber Labels USA is a manufacturing company that specializes in the production of custom-ordered rubber labels for various industries. The current production process includes several time consuming, labor-intensive, and highly repeatable tasks. The goal of this project is to implement an automated system to improve efficiency, eliminate waste, and reduce labor needs. Specifically, the role of the system is to guide rubber sheets out of a calendaring machine, apply powder to the rubber, and cut the sheets into manageable sizes. Since this is a custom-order production process, the calendered rubber can vary on an order to order basis. It is important that the system can be adjusted to account for variations including feed rate, thickness, powdered or no powder, cutting lengths, etc. The operator is able to set these parameters at the beginning of each batch to accommodate the specifications using a program made with an Arduino control system.



MECHANICAL ENGINEERING

TEAM 65

Tim Lynch

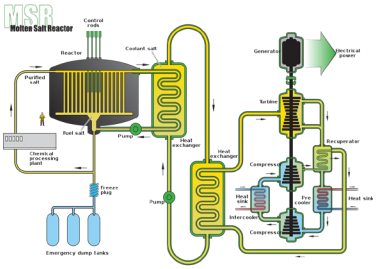
ADVISOR

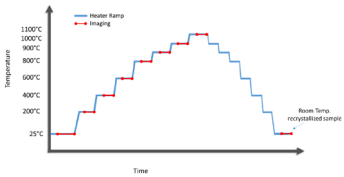
Wilson Chiu

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

In situ Measurement and Validation of Uranium Molten Salt Properties at Operationally Relevant Temperatures





Molten salt reactors (MSRs) were one of the nuclear reactor designs proposed in the Generation IV International Forum for electrical power generation. MSRs have unique design and safety advantages over traditional water-cooled reactors. Because of these advantages, the Department of Energy (DOE) has taken an interest in MSR technology and research. Several research projects focused on molten salts have recently been funded by the DOE. The research is mostly focused on determining the chemical and physical properties of the molten salt & actinide mixtures at operationally relevant temperatures (800 – 1000 C).

This project focuses on determining the efficacy of an experimental procedure for studying actinide containing salts using non-actinide model salts. To determine the properties of the model salts, we used synchrotron-based X-ray absorption fine structure (XAFS) spectroscopy. Using the entire extended x-ray absorption fine structure (EXAFS) we determined the local structure properties of the molten salts at operationally relevant MSR temperatures. A custom BN tube and aluminum stand was designed to perform the experiment. The results of these experiments were written in a published journal paper. For our upcoming experiments this Summer involving actinide salts, an improved BN tube was designed to contain the samples.

MECHANICAL ENGINEERING

TEAM 66

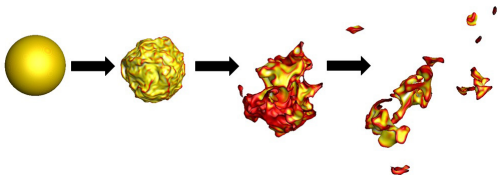
Patrick Meagher

ADVISOR

Xinyu Zhao

SPONSOR

Direct Numerical Simulation of a Turbulent Premixed Flame Kernel



Ignition and extinction of turbulent flame kernels are of practical importance to the safe and reliable operation of combustion devices. A flame kernel is a small spherical flame surrounded by fresh fuel/air mixtures. For a flame kernel developing in turbulent fields, flame propagation and local extinction are competing with one another at any instant, contorting, stretching and shredding the flame surface. The local extinction events are of particular interest here to reveal the interactions between turbulence and chemistry. Three dimensional (3D) direct numerical simulations (DNS) coupled with detailed chemical kinetic models can provide details of the full thermochemical states and flow fields with sufficient temporal and spatial resolutions, and are adopted in this study to provide unique insights into the turbulence-chemistry interactions in increasingly turbulent regimes.

First, fully-resolved 3D DNS of non-reacting turbulence was conducted to create the initial conditions for the flame kernels. Then, laminar and turbulent kernels were simulated, with full thermochemical and flow field data saved 20 times per eddy turnover. Finally, the flame surfaces were extracted from the terabytes of data collected. Animations and surface statistics were used to evaluate the evolution through time of the flame surface subject to intense turbulence.

MECHANICAL ENGINEERING

TEAM 67

Stephen Price

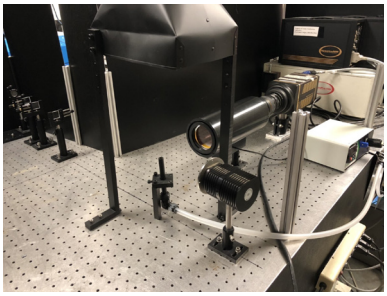
ADVISOR

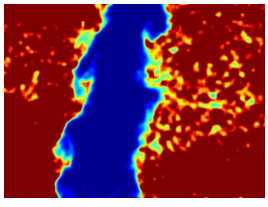
Baki Cetegen

SPONSOR

UCONN
SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

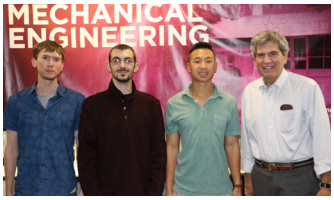
Implementation of Filtered Laser Rayleigh Scattering with Coupled Particle Image Velocimetry for Combustion Applications





In the Combustion and Gas Dynamics Laboratory, an array of complex combustion problems are studied experimentally to improve understanding of flame behavior. Flames are characterized by measurements of temperature, velocity, and some species composition using advanced laser diagnostic techniques such as Laser Rayleigh Scattering (LRS) and Particle Image Velocimetry (PIV). The purpose of this Senior Design Project was to implement filtered LRS and combine it with PIV measurements. The use of iodine filtration is applied to a CO2 jet seeded with small H2O droplets. Tuning of the laser frequency is optimized to coincide with an absorption line of the iodine vapor. Next, PIV is performed with LRS imaging. The CO2 jet flow is then replaced with a bunsen burner with propane as the fuel, which is seeded with alumina particles. Combined filtered LRS and PIV diagnostics are applied to this flame with the resulting images being processed, and flame properties determined with the in-house developed data reduction techniques. The results are planned to be validated and an error analysis is performed.

MECHANICAL ENGINEERING



TEAM 68

Ryan Champigny
Brandon Missino
Killian Yu

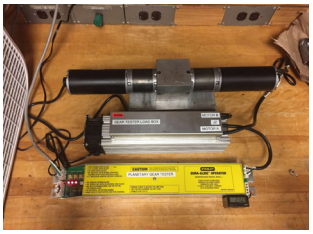
ADVISOR

Vito Moreno

SPONSOR

STANLEY Access Technologies

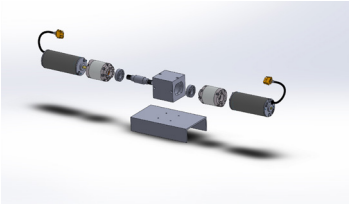
Magic Force Planetary Gear Evaluation



The Magic-Force system is responsible for creating the torque needed to open heavy doors. The planetary gears are the first to fail in the system. STANLEY Access Technologies aims to increase the lifespan of these gears. Gears undergo pitting, cracking and chipping. The grease within the gears also loses their lubrication through repeated use. These factors all contribute to a shorter lifespan of the system as a whole.

There are a number of causes that negatively affect the system:

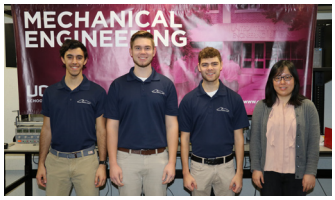
- Heat
- Improper lubrication
- Uneven force distribution
- Loose tolerances between parts



Our objective was to pinpoint the main causes of why the system fails and make modifications to the system to mitigate the losses. This was achieved by running multiple tests, with one variable modification for each test.

Through testing we were able to pinpoint the causes of failure within the planetary gear system. Thermocouple data revealed that temperatures exceeded the max allowable temperature for the current grease in production. Also, tightening the tolerance for dimensions of each part, reduced friction. The quantity of tests and data points supports that the modified systems consistently performed better than the control units. A formal test procedure was created, so STANLEY can rerun these tests to explore our variables further or to test new variables in the future.

MECHANICAL ENGINEERING



TEAM 69

Christopher Bedron
Matthew Germond
Cassius Pac

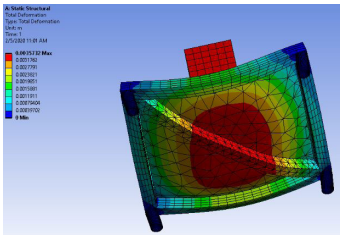
ADVISOR

Dianyun Zhang

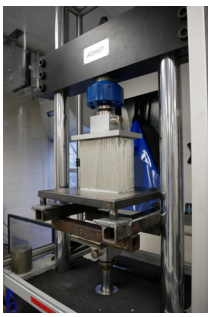
SPONSOR

GSS Global Steering Systems

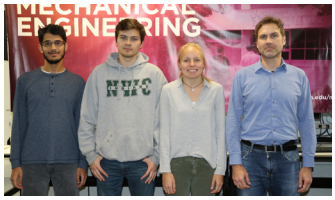
Design and Optimization of a Formula SAE Impact Attenuator



Formula SAE is a worldwide, collegiate competition in which students design, build, and compete with open wheeled, Formula style race cars. All of these vehicles are required to have an impact attenuator mounted to the front of the vehicle, an energy absorbing device that serves the same purpose as a crumple zone on a production car. The goal of ME69 was to redesign UConn Formula SAE's impact attenuator to make it both smaller and lighter while maintaining all safety requirements. To do this, material research and small scale material testing were conducted. This consisted of compression testing for energy absorption, as well as considering weight. Once key energy absorption metrics were calculated for each material, the team conducted simulation of the vehicle's bulkhead, the forward most chassis member, and it's interaction with the impact attenuator. This allowed the team to determine how well their new designs would work with the car. Ultimately, the use of new materials and strategic design has allowed ME69 to develop a lighter weight, smaller device, that still meets all Formula SAE rules.



MECHANICAL ENGINEERING



TEAM 70

Rachel Haviland
Jeremy Prema
Samuel Spak

ADVISOR

David Pierce

SPONSOR

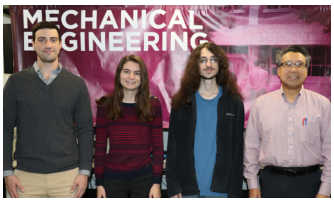
Encapsulate Cancer Solutions

Design of an Automated Cell Culturing Machine

Encapsulate is a startup company located in Farmington, Connecticut. Their goal is to revolutionize cancer treatments by designing technology to provide personalized treatment plans. The goal of this project was to design, build, and test an automated cell culturing machine to aid in the providing of personalized cancer treatment plans. This machine grows cancer cells outside of the patient's body for the purpose of testing the effectiveness of various chemotherapeutic drugs. The machine along with tumor-on-a-chip technology grows twelve microtumors over a two week time span, which allows for twelve different chemotherapeutic drugs to be tested as a time.

In order to properly mimic the functions of the human body, this machine maintains environmental conditions required for the growth of the cells. Three automated subsystems deliver cell growing media to the cells and analyze the growth of the cells by taking microscopic images. The subsystems are controlled by a single user interface, which also displays the cell microimages.

MECHANICAL ENGINEERING



TEAM 71

Julian Horvath
Sophie MacDonald
Aaron Marselli

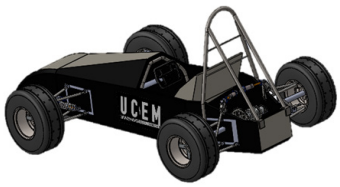
ADVISOR

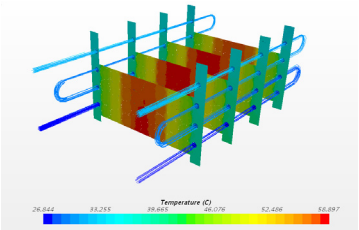
Wilson Chiu

SPONSOR

UCEM ELECTRIC MOTORSPORTS

Design of FSAE Compliant Heat Exchanger for High Voltage Electric Powertrain





The objective of this project is to develop a thermal management system capable of regulating the temperatures of a motor, motor controller, and battery of a high-performance electric vehicle. The sponsor for this project is UConn Electric Motorsports, a Formula Student organization that is in the process of constructing a vehicle to compete at official events. The designed cooling system complies with all regulations implemented by the Formula Student organization and is robust and easy to maintain.

To achieve the desired results, a two-part system has been developed: the motor and motor controller are cooled by a flow path incorporating a radiator and pump, with water as the coolant. The battery, split into four main blocks and housed inside an electrically insulated container, is air-cooled by a series of fans that draw power from the battery itself. The design makes use of cooling lines prebuilt into the motor and motor controller by their respective manufacturers and pre-existing gaps in the battery blocks to allow for airflow.

MECHANICAL ENGINEERING

TEAM 72

Joseph Mortimer

ADVISOR

Bryan Weber

SPONSOR

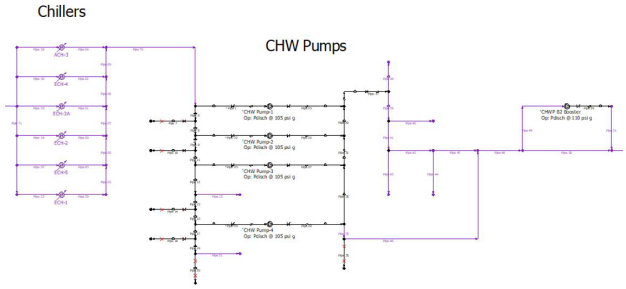
Collins Aerospace

Chilled Water System Modelling, Optimization, and Design

Our objective was to improve the operating efficiency of the chilled water [CHW] system at the Collins Aerospace Windsor Locks site. We analyzed and evaluated all components of the CHW system and proposed recommendations for improvement; thereby reducing energy consumption, increasing equipment lifespan, and reducing capital expenditures.

A hydraulic map and model were created to analyze the system's flow characteristics, and computational tools developed in MATLAB allowed for comparison and evaluation of CHW consumption and optimize the system's operating conditions and setpoints.

Recommendations had to satisfy the prerequisites that appropriate flow was maintained to the CHW user, and that a complete life-cycle cost/benefit analysis demonstrated a return-on-investment period less than five years.



MECHANICAL ENGINEERING

TEAM 73

Haohong Lin

ADVISOR

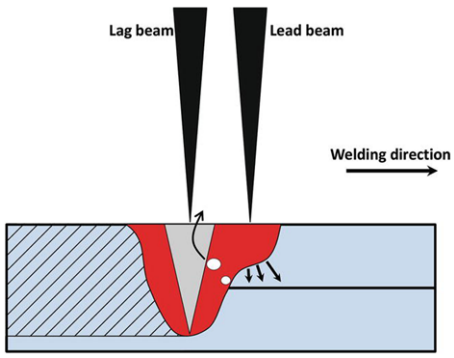
Tai-Hsi Fan

SPONSOR

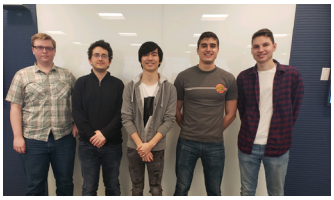
UCONN SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING

Inverse Heat Transfer Analysis on Dual Beam Laser Welding Process

Precision laser welding is an innovative manufacturing technology in aerospace, automobile, energy, and microelectronics industry. There is a great need of better understanding, theoretical and computational analysis, and experimental characterization to optimize laser-material interactions. Dual beam laser opertation is an advanced technique in laser industry. The secondary or auxiliary laser beam can be used for in-situ post processing of the material or better control of process temperature, which cannot be easily achieved by a single-beam operation, especially for additive manufacturing. This project focuses on predictive modeling and uncertainty analysis from the perspective of inverse engineering for temperature control during dual beam laser operation.



SYSTEMS ENGINEERING



TEAM 1

Alex Ghajar
Edward Han
Alex Samegulin
Glenn Thierfeldt
Matthew Zujewski

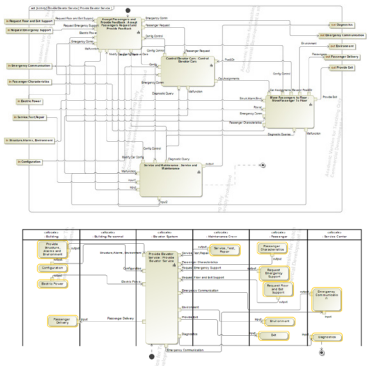
ADVISORS

Kiron Bhaskar
Ashwin Dani
Horea Ilies
Randy Roberts
Amy Thompson

SPONSOR

OTIS

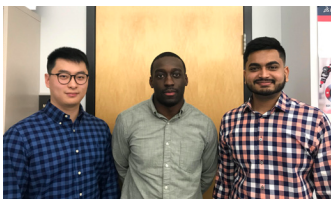
Model-Based Systems Engineering using SysML with Application to a Self-Climbing Autonomous Robotic Motion Platform Design



Otis' design practices are document-based processes for system engineering which limit ability to timely and consistently track changes in system and component requirements, design architectures, use cases, component basic data, enabling analysis models and simulation tools, and verification results. Two focal areas at Otis to pursue in order to address these challenges are product and component platforming and Model-Based System Engineering (MBSE). The underlying principle is to move our product design data and engineering documentation into a digital enterprise that facilitates and promotes component rationalization to reuse while enabling product innovation. An example application where such MBSE processes could be applied is a design and optimization of a self-climbing elevator.

Otis has piloted SysML in a few projects that has demonstrated its potential in connecting requirements, behavior, structure, and parametrics. The next step will be to develop a formal process and associated toolset to archive SysML objects into a reusable library to promote effective "catalog shopping" of existing Otis-developed components to reduce our product development time while supporting design innovations. The desired outcome is a SysML archival process to facilitate effective product design and demonstration of this MBSE process to the elevator design to verify its application.

SYSTEMS ENGINEERING



TEAM 2

Andrew Louis
Meet Patel
Xuanan Yue

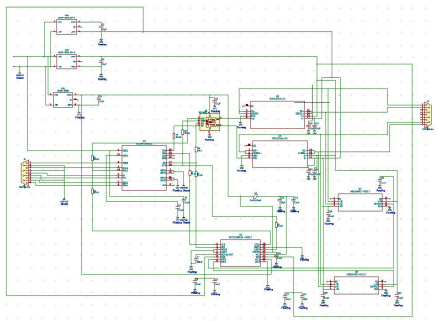
ADVISOR

Lei Wang

SPONSOR

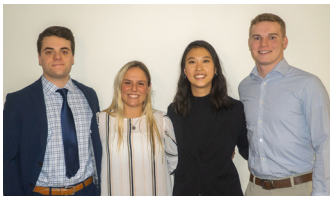
Collins Aerospace

Alternative Lightning Protection Solutions for an Airborne Embedded Controller



Our sponsor, Collins Aerospace has assigned us to come up with alternative solutions for lightning protection for an airborne controller. Our team reviewed possible alternative solutions including galvanic isolation methods to break lightning current loops, reducing TVS size and quantity, and considering the failure modes to ensure that loss of lightning suppression capability cannot fail undetectably. From the potential solutions, we determined that constructing a galvanic isolated circuit using SPI (serial Peripheral Interface) bus system to break the lightning current loop would be the most effective solution. Our main goal for this project was build a working prototype of TVS circuit on PCB (printed circuit board). To test the PCB, we will introduce the lightning simulation and test check the whole process with Raspberry Pi 3.

SYSTEMS ENGINEERING



TEAM 3

David Carelli
Annie Gao
William Rooney
Taylor Welsh

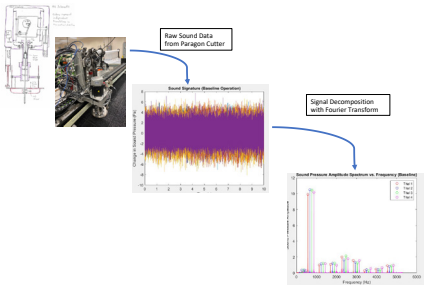
ADVISORS

George Bollas
Daryl Stein

SPONSOR

GERBER TECHNOLOGY

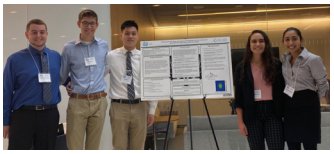
Predictive Maintenance for Computer Controlled Machines



Gerber Technology (Tolland, CT) is a leader in automated materials cutting for the apparel, graphics, furniture, and aerospace industries. The goal of this project was to streamline fault diagnosis in these automated machines by using signal processing techniques. The sound signatures of an automated cutting machine at various faulty operating conditions were modeled and compared to faultless operating conditions of the machine.

The Fourier Transform was applied to the system to translate the collected sound data to its constituent frequencies. Principle component analysis (PCA) was then implemented to reduce the data size and identify signal intensities and peak frequencies that were specific to each operating condition. The classification function of k-nearest neighbors (KNN) was then trained with the data that was analyzed through PCA. After the algorithm was properly trained, KNN was able to compare unknown sound signatures to the known data, labeled as either baseline (faultless-operation), loose knife, no knife, or no belt (faulty-operating conditions) to identify the operating condition they are correlated to. Implementing this fault-feature extraction system into the machines allowed faulty-operation to be resolved more efficiently than guess-and-check resolutions; resulting in safer-repair of the machine, as well as time and money saved by the company.

SYSTEMS ENGINEERING



TEAM 4

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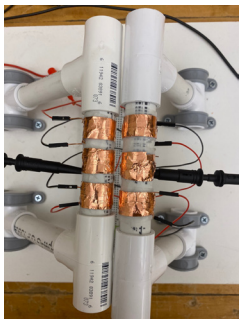
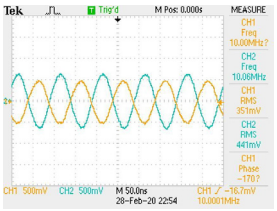
PRATT & WHITNEY DEPENDABLE ENGINES

GO BEYOND

Model Based System Design, Optimization, and Prototyping of Inductive Coil Based Oil Debris Monitoring System with Multiple Flow Passages

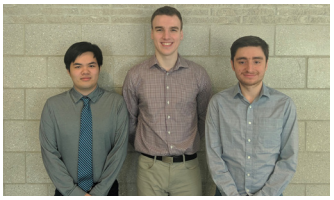




The objective of this project is to model and prototype a dual-bore Oil Debris Monitoring (ODM) system for use in Pratt & Whitney's jet engines. The ODM sensor detects debris particles in engine oil and helps prevent engine failure. The current ODM system used by Pratt & Whitney consists of a single assembly in which the pressurized lubricant flows through a single channel to one ODM sensor. The dual-bore setup minimizes electromagnetic interference between the interacting coils' magnetic fields while optimizing the assembly's ability to detect small particles with high accuracy. The dual-bore split flow path also serves to preserve feasible pressure conditions to ensure the reliability of the ODM sensors.

A single ODM sensor is created using three inductive coils. The outside coils are excitation coils being powered by a sinusoidal function. The middle coil is a sensing coil used to detect the electromagnetic field produced by the excitation coils. When ferromagnetic particles pass through the coils, they disturb the magnetic field. The resulting disturbance causes the sensing coil to observe a higher voltage. The dual-bore ODM setup is created by placing two ODM sensors in parallel. Interactions between the two sets of coils were analyzed to ensure reactions in the sensing coils only occurred when debris was in the corresponding ODM.

SYSTEMS ENGINEERING



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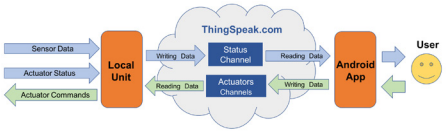
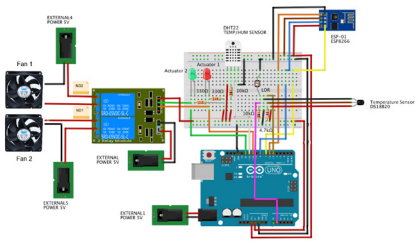
SPONSOR

Carrier
United Technologies

Verification Strategy and Tools for IoT Systems





IoT (Internet of Things) is a relatively new field that seeks to connect many common devices and machines we use today to a network, allowing us to easily control and/or monitor them remotely. In the past, these systems were only tested relative to their mechanical components and control systems. However, with the integration of this new IoT infrastructure comes new challenges, requiring more time to be spent testing and verifying the functionality of each device using different techniques. With this new generation of internet-connected devices, our sponsor, Carrier, requires verification methods and a testing architecture capable of being applied to their products.

In order to develop a testing methodology for IoT systems, we needed to design and build a simple IoT system to run tests on. For our system, we utilize ThingSpeak as our cloud platform due to its integration with MATLAB. Data from sensors is captured from the circuit and sent to ThingSpeak. An Android application reads and displays these values in real-time. The app is also able to control actuators on the circuit through the cloud. With this system, we are able to perform various performance, stability, and usability testing/analysis using MATLAB and other software tools, with an end goal of having an established verification methodology for IoT systems in general.

SYSTEMS ENGINEERING

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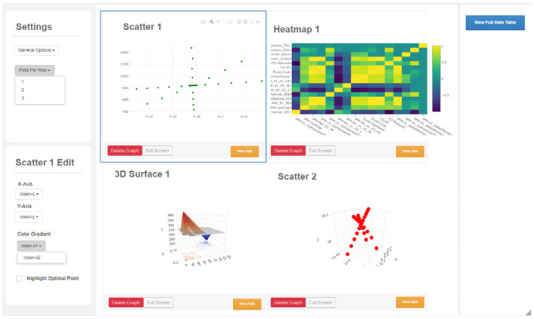
Model-Based Design HDF5 Results Interpretation and Visualization



The Carrier Corporation uses model based design (MBD) for their product development applications. One of the MBD tool sets, Sandia Dakota, outputs data into HDF5 file format. HDF5 files uses a versatile data model that can represent very complex data objects and a wide variety of metadata.

The Carrier team would like a data visualization application capable of reading/processing the HDF5 format and producing versatile visualizations to interpret the MBD results. There are currently a very limited number of tools available for visualizing HDF5 files and their capabilities are inflexible and limited. The envisioned data visualization application should allow the Carrier team to easily visualize the results of methods, compare and contrast variables, find optimal values, etc. The planned data visualization application should allow the user to create a variety of custom visualizations from the datasets contained within a wide-array of user provided HDF5 files. We are developing this HDF5 data visualization application using the Electron software framework, React and Bootstrap front-end components, and the h5py and plotly libraries for data processing/visualization generation.

SYSTEMS ENGINEERING

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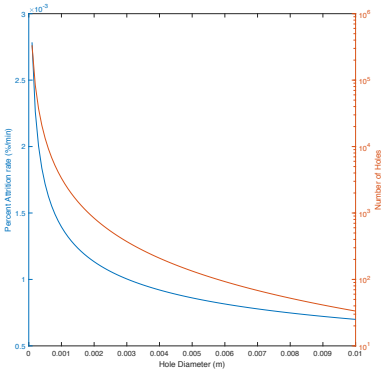
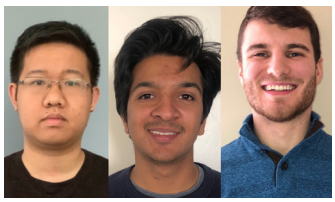
CABOT

Fluidized Bed Cell Plate Design

Fluidized beds are a novel process within the chemical engineering world, used in areas such as fluidized bed reactors, solids separation, and fluid catalytic cracking. Improvements in fluidized beds can have a substantial impact as more fluidized beds are implemented in various processes, replacing less efficient processes such as liquid-solid mixers with associated dryers. The goal of this project is to optimize the design for a grid plate within a fluidized bed in order to minimize attrition, the unintentional breakdown of particles. A fluidization software for modeling, in conjunction with Matlab will be used to theoretically calculate attrition rate. This will be done with multiple types of popular grid designs, such as perforated plates, pierced-sheet grid, and cap type. Results will then be compared with experiment. Carbon black has low to no carcinogenic effects, however mechanical irritation of the eyes, skin, and lungs can occur. Additionally long term inhalation of carbon black dust, produced after attrition of carbon black, causes lung disease. The impact of an optimized grid has the potential to decrease the dust produced with carbon black, therefore decreasing the chance of lung disease by carbon black, as well as decreasing waste as attrited material is generally disposed of.



SYSTEMS ENGINEERING



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SPONSOR

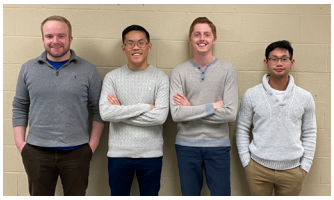
United Technologies Research Center

Software Defined Radio-Based Secure Wireless Networking

This project will examine the security issues of an existing Software Defined Radio based network which are a critical requirement for wireless communication systems. The threat to be explored is a man-in-the-middle (MITM) attack, where a third party disrupts the communications between two other parties. To combat this, a security algorithm will be added to the physical layer of the system that will identify potential attackers through fingerprints for identification. The fingerprint will be generated using a probing message that is defined by scanning the whole frequency band. This security algorithm will be investigated through experimentation before being added to the physical layer.

The proposed method will begin with two radios transmitting a predetermined message with high power components at known baseband frequencies. Each radio will then measure the received power at these locations to generate a secret key that is unique to the wireless channel being used. Subsequently, devices will be able to authenticate each other based on the secret key that is generated during the probing process.

SYSTEMS ENGINEERING



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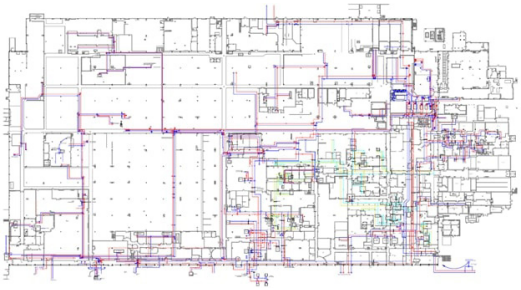
Collins Aerospace

Chilled Water System Modeling, Optimization, and Design



Collins Aerospace is a leading aerospace company with business interests in commercial aviation, space exploration, and defense. Various operational processes use chilled water throughout their Windsor Locks facility for cooling purposes; this is one of their most expensive utilities. Due to system age and augmentations, performance has become about 60% less efficient compared to that of the industry standard. The project goal was to recommend design changes to increase system efficiency, equipment lifespan, and ultimately reduce cost of operation. A hydraulic map of the chilled water system was first modeled within AutoCAD. This map was then used to create a hydraulic model within PipeFLO Professional. This model includes the operating characteristics of each component that influences flow within the system; this was a valuable asset when determining operational inefficiencies present within the current chilled water system. Within PipeFLO, varied parameters such as air handler speed, pump speed, type of coolant, etc. were adjusted to simulate varying operating conditions. Several cost saving improvements were recommended to Collins Aerospace from these simulation results.

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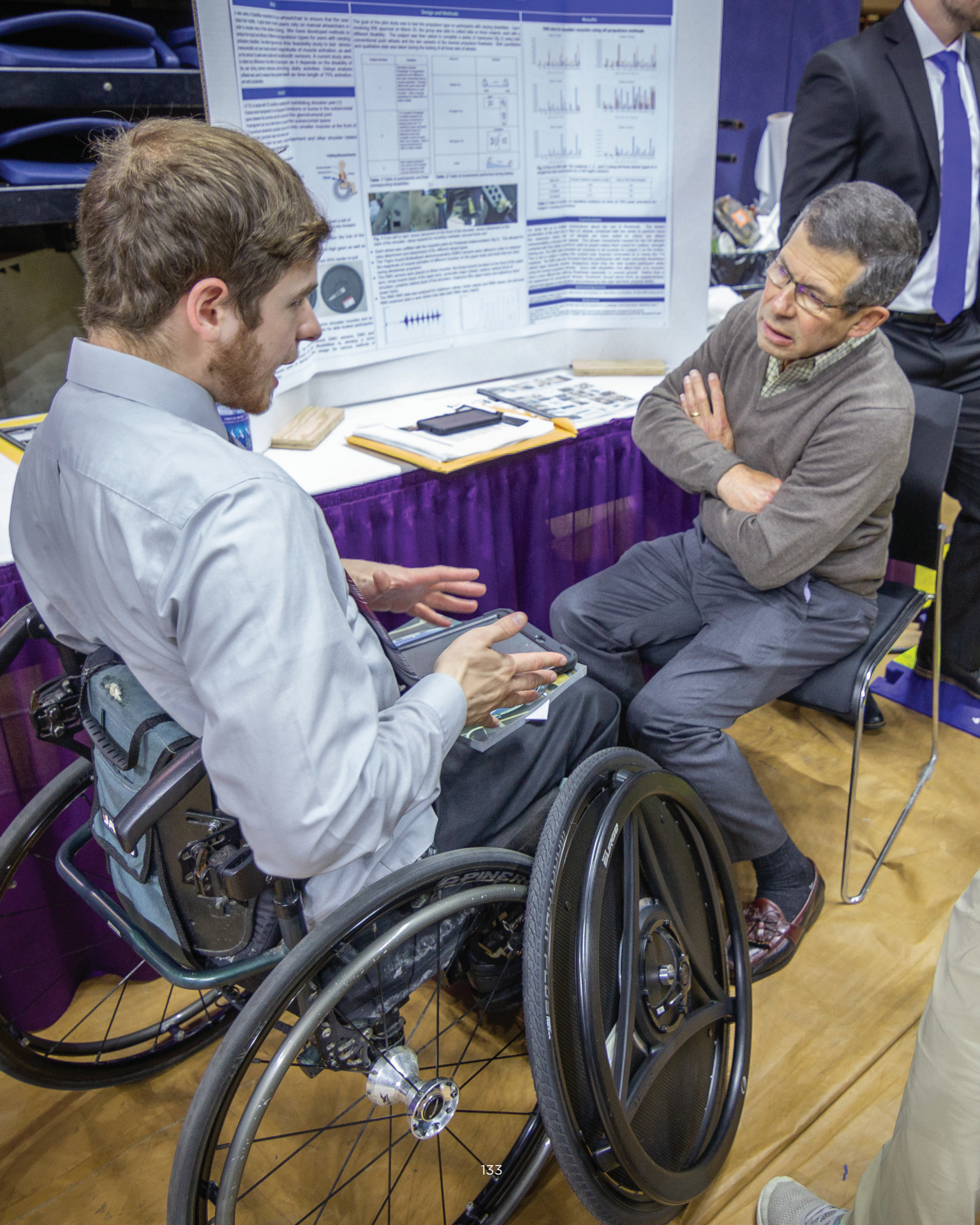

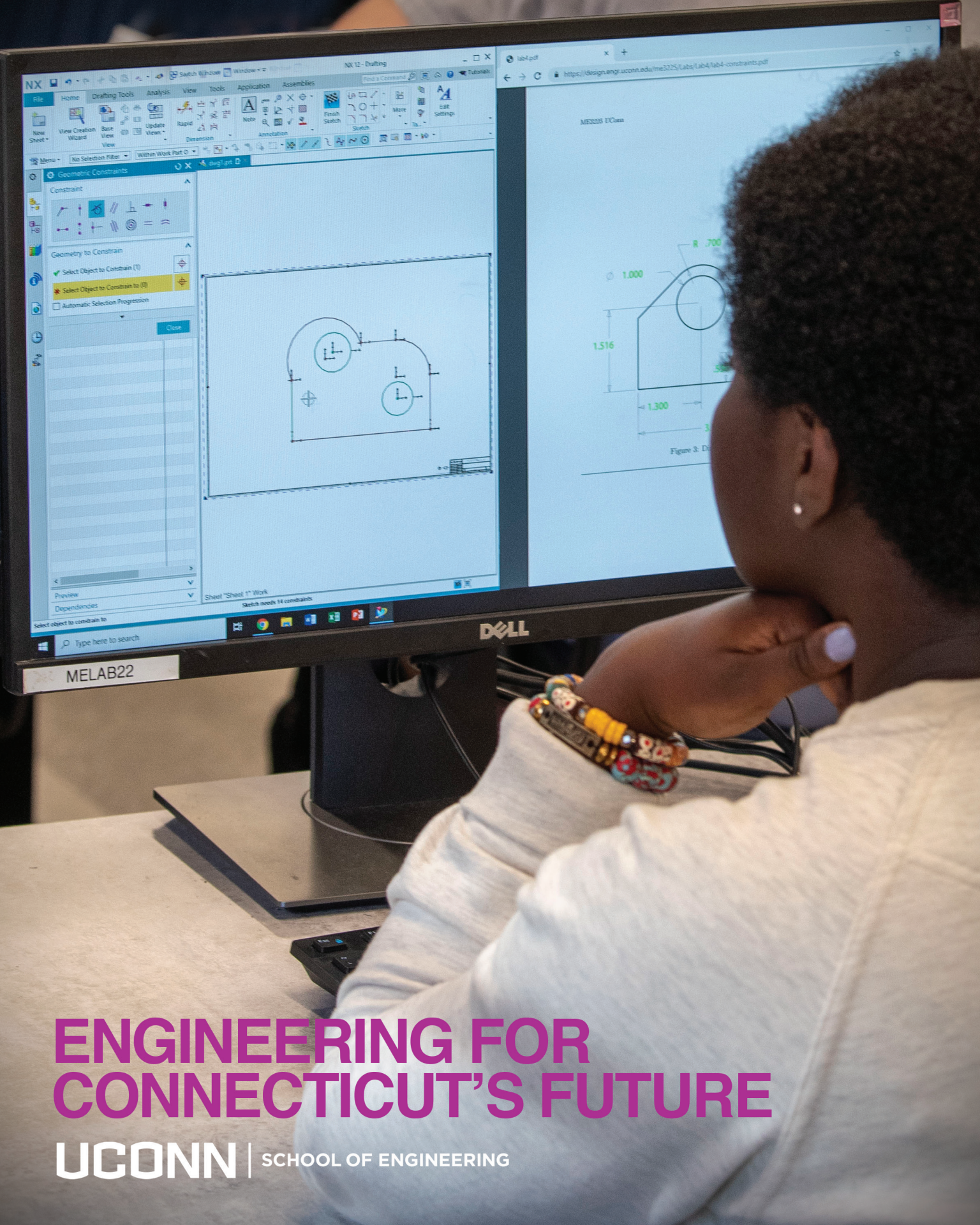

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