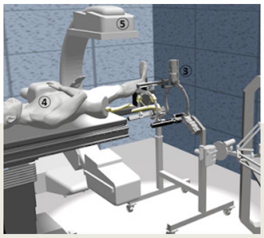
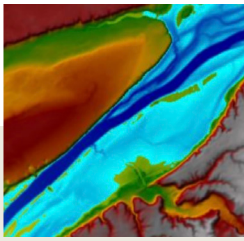
Rowan University

HENRY M. ROWAN
COLLEGE OF ENGINEERING





2023
CLINIC SHOWCASE BOOK

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MECHANICAL ENGINEERING

Preface

The Engineering Clinic Program is the hallmark of the Henry M. Rowan College of Engineering. Spanning the entire four-year undergraduate program, Engineering Clinics serve as a vital and continuous component of the curriculum. In the first-year and sophomore clinic curriculum, students acquire a comprehensive understanding of the art and science of design through an interdisciplinary approach. They skillfully translate engineering fundamentals into problem-solving best practices, culminating in the evaluation of projects and final presentations.

Throughout the junior and senior clinic program, students collaborate in small teams under the guidance of faculty and external sponsors to assimilate the knowledge gained from their coursework into practical engineering solutions.

Within this publication, we proudly present the meticulous work of 629 students, encompassing 135 clinic projects. These students have actively contributed to the betterment of their communities while engaging in rigorous academic study. Each clinic project serves as a testament to the exceptional talent and perseverance of our students, the remarkable quality of our engineering education and research programs, and the caliber of graduates we produce.

We trust that you will derive as much enjoyment from learning about our students and their projects as we have from sharing them with you.

Sincerely,

Giuseppe R. Palmese, Ph.D.
Dean, Henry M. Rowan College of Engineering

Focusing on Transitions

Junior and Senior Engineering Clinics strive to create engineers that solve real-world problems. In the process, our clinics create opportunities for our engineers to practice their entrepreneurial skills and become well-rounded students as they make the transition to being professionals.

The last two years of clinics are projects designed to push our understanding and technology forward. The projects are pitched by faculty but the students have a choice of projects to work on. Junior and Senior Engineering Clinics allow students to choose the path that best fits their interests and ambitions. While solving the technical problems, the clinic projects facilitate practice in professionalism, communication, project management, and teamwork. In short, these clinics projects become training grounds for our students before they embark on their engineering careers.

Besides exposing our students to engineering practice, clinics are built with innovation at its core. Each project pushes the envelope on the current knowledge and design. Students can work on multiple clinic projects to gain a breadth of experience or dive deep into a single project if they choose to. Working closely with faculty or external sponsors, and their team, they develop long-term professional relationships. Students also communicate their work to a range of audiences and through a variety of media. With a wide-ranging projects, our students graduate with a broad skill set and are prepared to take on their next challenge. It is not surprising that potential employers use the clinic experience as a distinguishing characteristic of Rowan graduates.

The Engineering Clinic program is a signature program for the Henry M. Rowan College of Engineering. We are proud of its history and proud of the projects presented within this booklet.

Sincerely,

Dr. Smitesh Bakrania
Junior and Senior Engineering Clinic Coordinator

Biomedical Engineering

An in Vitro Model to Interrogate Adenocarcinoma Metastasis

TEAM MEMBERS
Aidan Curran

PROJECT MANAGERS
Dr. Peter Galie

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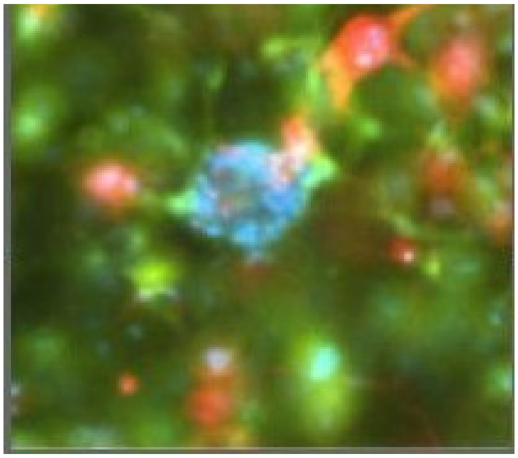
National Institutes of Health



The aim of this project is to advance the current understanding of metastasis of adenocarcinoma in breast cancer. Previously in our lab, we have used an inflammatory breast cancer model named MARYX, and showed that endothelial cells and pericytes are recruited to the surface of these spheroids in a three-dimensional collagen gel (Figure 1). We found that endothelial cells required the presence of pericytes in order to be recruited to the surface of the MARYX spheroids. Our current study involves creating spheroids of analogous size using the MDA-MB-231 adenocarcinoma cell line. Adenocarcinomas are cancers that form tumors in ducts. This semester, we have researched strategies to create spheroids from these cells using low attachment U-bottom well plates, prior to seeding these spheroids in collagen gels co-cultured with pericytes & endothelial cells. We will use this protocol to create the spheroids and characterize their size using brightfield microscopy. This research addresses a crucial health need, considering that in 2021, cancer remained one of the leading causes of death according to the Center for Disease Control and Prevention. Moreover, despite the survival rates for breast cancer improving over the last 100 years, the American Cancer Society estimates there will be over 300,000 new cases of breast cancer in 2023.

Automated Pipeline for Detection of Aortic Aneurysm using Deep-Learning

TEAM MEMBERS
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PROJECT MANAGERS
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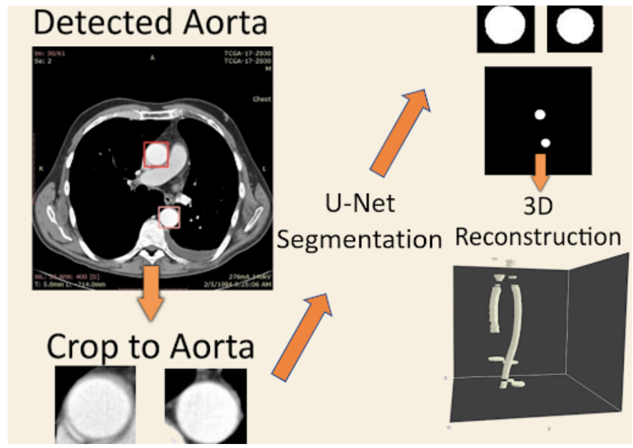
SPONSORS
Camden Health Research Initiative

Aortic aneurysms are the most common and deadliest type of aneurysms. These aneurysms are classified as the increase in diameter of the aorta by 50%, a result of the weakening of the walls surrounding the aorta. When ruptured, there is roughly an 80% mortality rate and is more susceptible to an older population. In recent years, development and progression of deep learning tools and software have foster innovation across many fields. We develop a novel deep-learning pipeline that will help doctors diagnose, monitor, and treat aortic aneurysms.



Automatic Detection of Bone Landmarks on X-Rays for ROBOSSIS Imaging Software

TEAM MEMBERS
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PROJECT MANAGERS
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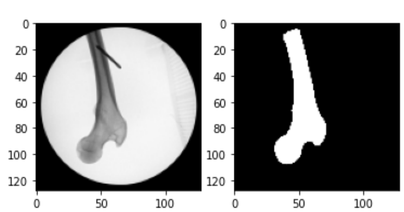

Results from Model. (Left) DICOM data as png which is the input to the model. (Right) Segmentation which is the output of the model.

Robossis is a surgical robot for femur fracture surgery which utilizes imaging software. The imaging software enables the robot to automatically align the fractured femur. However, currently, for alignment to occur, the aligned position of the bones must be recorded and then the fracture created and aligned. To align the bones without needing to record the aligned position first, the landmarks of the femur can be found on x-ray images and their relative spatial position with each other can be compared to the landmarks' relative position on an aligned femur. To do this by hand would be an arduous task, therefore, a machine learning model that can be fed x-ray images and output the landmarks needs to be created. A model which consists of 7 convolution layers, 6 batch normalization layers, filter argument of 256, 250 epochs, and a learning rate of 0.0001 was tested and found to be the best for the desired task. The model was initially tested on generated images of circles and lines to simulate x-ray images. Now, DICOM data that was turned into pngs are used to train and test the model. Currently, the model is able to segment the bone from the x-ray images. Further work still needs to be done for the model to output the landmarks on the segmented area.

Biomechanical Comparison of Native MPFL to MPFL Reconstruction using BioBrace

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PROJECT MANAGERS
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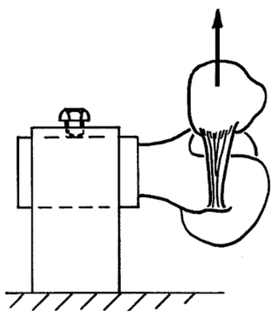
CONMED Corporation



CONMED Corp. has developed a reinforced bio-inductive implant called the BioBrace that is used to aid in the healing of an ACL or rotator cuff rupture. It strengthens the repair process by facilitating and optimizing healing through the biological scaffold, helps reduce tension by load sharing, and is naturally resorbing. Three clinical trials were conducted to demonstrate that the BioBrace MPFL reconstruction is comparable in strength to the native MPFL and show that it is more anatomically relevant compared to the current standard, MPFL reconstructions using a Semi-T autograft. These tests were held in Rowan University's Biomechanics lab. During testing, ~20 cm of the femur bone was removed with the patellar bone and native MPFL out of 8 different cadavers. Of these samples, half were tested alone while the other half the BioBrace was surgically implanted in the sample. The patella was then plotted in resin with carefully plotted screw holes to be placed onto a mechanical tester. Each sample is then placed into a femoral fixture that was engineered at Rowan University and tested on the Shimadzu mechanical tester for load versus displacement and ultimate tensile load. The parameters recorded included: max force, stiffness, elongation at failure, gauge length, and failure mode. In the most recent trial, great data has been recorded that show that the BioBrace MPFL reconstruction is similar in strength to the native MPFL.

BMP-2 Peptides within Degradable Hydrogels Enhance MSC Bone Differentiation

TEAM MEMBERS
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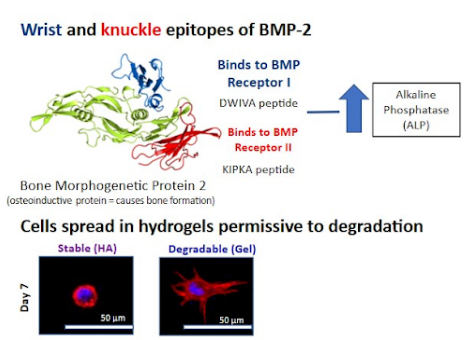
SPONSORS
National Institutes of Health, The Cooper Foundation, Camden Health Research Initiative



Osteoporosis is the most common chronic metabolic bone disease, is characterized by the progressive loss of bone mass, and leads to an increased risk of fracture. Current treatments to prevent bone fracture are systemic, rely on long-term use, and patient compliance is low. Bone morphogenetic protein-2 (BMP-2) is a potent inducer of osteogenesis, and KIPKA and DWIVA are two synthetic peptide sequences known to replicate BMP-2 activity. Additionally, mesenchymal stem cells (MSCs) have demonstrated cell spreading in 3D enzymatically degradable hydrogels which favors osteogenic (bone) differentiation. DWIVA peptide has previously shown substantial ability to increase osteogenic activity in 3D hydrogels, however the combined effects of DWIVA and KIPKA peptides are unexplored. Since both peptides are known mimics of BMP-2, combining them at an ideal combination should amplify their osteogenic effect. The effect of allowing 3D cell spreading in the presence of DWIVA and KIPKA is also yet to be investigated. This study will demonstrate how combining biochemical and biophysical signals can augment the osteogenic affect of DWIVA alone towards advancing the development of strategies to locally induce bone formation in high-risk sites prone to osteoporotic fractures.

Boron Based Small Molecules as Potential Anti-Cancer Agents

TEAM MEMBERS

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PROJECT MANAGERS

Dr. Subash Jonnalagadda (Rowan University CSM)

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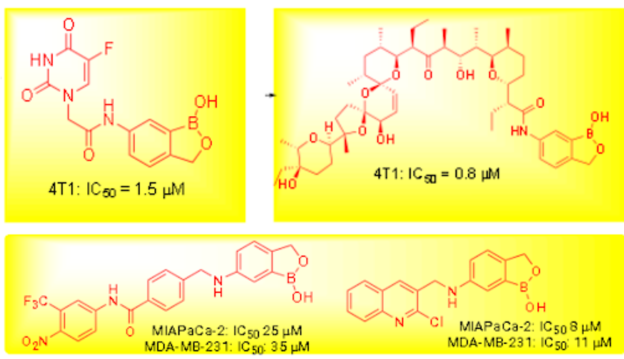
New Jersey Health Foundation, PAZ Pharma



The successful induction of bortezomib (Velcade®) for treatment of multiple myeloma has invigorated the exploration of boron based small molecules as therapeutic agents. Benzoboroxoles (cyclic boronic acids) have attracted significant attention because of their attractive therapeutic and biological profile. We have been working on the functionalization of the oxaborole ring of benzoboroxoles via a plethora of reaction pathways starting from o-boronobenzaldehyde as our boron precursor. While we have been routinely able to functionalize the oxaborole unit, much to our dismay, we found that these molecules did not exhibit any significant biological activity as anti-bacterial or anti-cancer agents. Accordingly, we changed our approach to functionalize the aromatic ring and we have prepared several aminobenzoboroxole derivatives employing a reductive amination protocol and further functionalized as N-nitrosoaminobenzoboroxoles, N-benzoboroxolylureas, and other N,N-dlakylated derivatives. These derivatives have been evaluated for their anti-cancer activity on human pancreatic cancer MIAPaCa-2 and human breast cancer MDA-MB-231 cell lines. Some of these derivatives also showed activity as anti-tubercular agents as well.

Control System Approaches to Synthetic Biology Applications in Cancer

TEAM MEMBERS

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PROJECT MANAGERS

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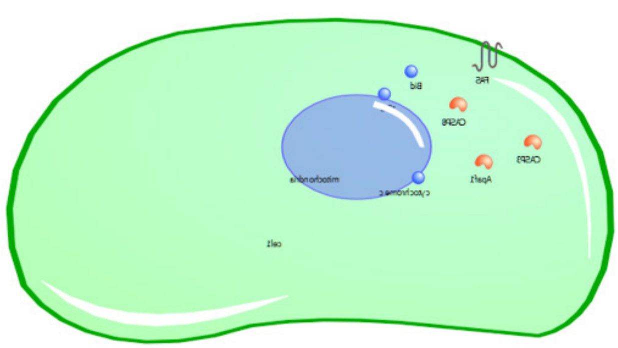

Cancer cells invade the microenvironment of healthy cells, and then prevent apoptosis, accelerate cell proliferation, and dominate a cell's natural machinery. Synthetic biology provides promising approaches that harness the body's natural pathways to fight cancer cells. Inserting these new solutions into a tightly-controlled environment requires a systems-level control system analysis both in the design of the novel synthetic biology approach and the integration of new approaches into interconnected systems. Furthermore, there are many different pathways to target in regards to preventing cancer cells growth, but one crucial method is via regulating cell apoptosis. Cell apoptosis (programmed cell death) is a naturally occurring homeostatic mechanism for controlling cell proliferation, yet certain cancerous cells evade apoptosis by modulating cellular signaling pathways. In particular, the FAS receptor signaling pathway has the ability to control apoptosis in type I and type II cells, in which type II cells use mitochondria-dependent apoptosis and type I cells do not. Within this pathway, it has been found that overstimulation of certain caspase proteins in the regulation cascade can hinder apoptosis, and cancer cells capitalize on this phenomenon. In our work, we seek to develop a quantitative representation of these effects and their underlying control mechanisms.

Controlled Chemotherapeutic Release from DNA Bioconjugated Gold Nanocarriers

TEAM MEMBERS
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PROJECT MANAGERS
Dr. Mark Byrne

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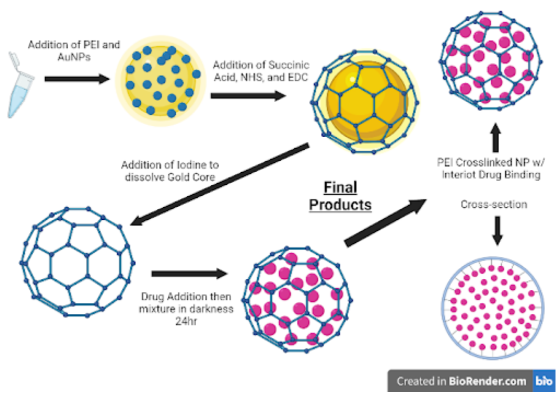

Structured nanoparticles have been engineered as therapeutic drug delivery systems. Creating hollow nanoparticles allows for increased drug loading and delayed release, with potential for other applications. Factors such as size, surface charge, and stability when the core is removed must be taken into account when designing hollow nanoparticles in order to achieve therapeutic delivery to a desired target. These characteristics were assessed through techniques such as dynamic light scattering and various structure property relationships. Starting with a gold nanoparticle template, polyethylenimine (PEI) was bound to the surface and then cross-linked through organic reactions. Iodine titrations were carried out to dissolve the gold core, and drug cargo was loaded into the PEI shell. Subsequent release studies showed controlled release based on shell characteristics and bioconjugation.. This work highlights drug release control of a new class of hollow PEI nanoparticles and strong potential for more efficacious chemotherapy.

Controlled Chemotherapeutic Release from DNA Bioconjugated Gold Nanocarriers

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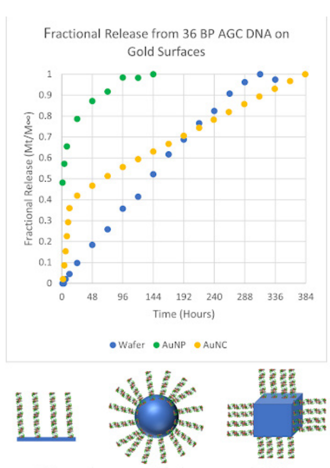

Cytotoxic drugs such as chemotherapeutics have significant side effects. To mitigate and eliminate these effects, treatment platforms with targeted delivery and controlled therapeutic release must be developed. Nanocarriers have emerged as a platform for which to achieve this targeted delivery, however achieving controlled release still poses a significant challenge. In this work, we manipulated self-assembled nucleic acid monolayers on gold nanocarrier surfaces to control drug release. Monolayers of designed double-stranded DNA molecules loaded with chemotherapeutic daunomycin were covalently attached to varying gold surfaces, including planar wafers, 15nm nanoparticles (AuNPs), and 30nm nanocubes (AuNCs). Cumulative drug release from gold surfaces was determined by measuring release media samples with fluorescent spectroscopy. Concentration dependent-release was observed on curved (AuNP) surfaces, while a more constant release rate was observed on planar surfaces (wafer and AuNC). Linear release was observed for the greatest time period on AuNCs, at just over two weeks. This work highlights the importance of intercalation mechanisms and surface curvature/associated free-volume considerations in controlling drug release. It additionally demonstrates that a biomimetic approach to nanocarrier development can yield platforms with controlled, delayed release of chemotherapeutics, giving potential to improve clinical outcomes.

Differential Gene Expression using RNA Sequencing and Statistical Analysis

TEAM MEMBERS
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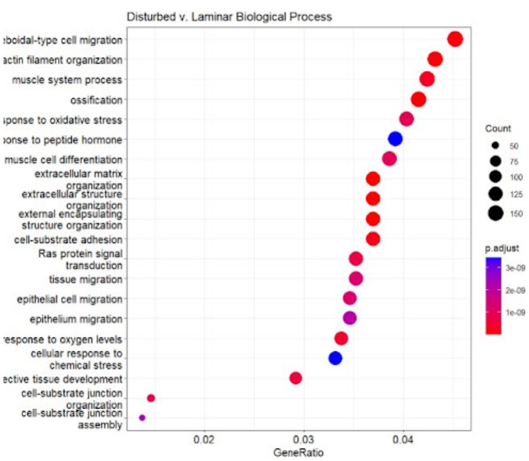
PROJECT MANAGERS
Dr. Peter Galie

SPONSORS
National Science Foundation



Our Lab has previously demonstrated that the permeability of the blood-brain barrier is altered by disturbed flow characteristics. This is important because blood flow through brain vasculature is altered as a result of stroke, Alzheimer's disease, and other neurovascular pathologies. As a result of increased blood-brain barrier permeability, various protein and cellular constituents are able to migrate into the central nervous system. This causes severe inflammatory immune interactions, which subsequently can cause fatal neurological events. In this study, we created a new RNA-sequencing workflow to determine what kinds of genes are being differentially expressed within the in vitro blood-brain barrier model exposed to different kinds of fluid flow. RNA sequencing quality control and trimming were performed, followed by transcript alignment to a human transcriptome and read count quantification. Differential expression statistical analysis was performed to quantify the changes in translation that occurred as a result of the disturbed flow profile. Functional enrichment analysis was performed to characterize the changes in gene expression. From this analysis, we determined that the altered flow characteristics changed the organization of actin filaments and muscle cells, initiated pathways involved in the ossification of blood vessels, and attenuated the integrity of cell-cell and cell-ECM adhesions.

Engineering a Synthetic Mammalian Cell-Based Serotonin Biosensor

TEAM MEMBERS
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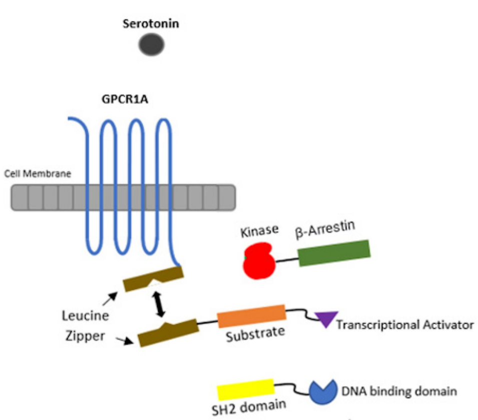
PROJECT MANAGERS
Dr. Nichole Daringer



It is estimated that 35% of all approved drugs target G-coupled protein receptors (GPCRs) due to their control over a wide variety of physiological functions. Synthetic receptors are novel transmembrane receptors that mimic native signal transduction pathways but are completely orthogonal. A post-translational circuit (PTC), a novel type of synthetic receptor, relies on receptor heterodimerization to activate the receptor and induce an intracellular mechanism similar to phosphorylation. Typically, PTC's encode a single-chain fragment variable (scFv), specific to the type of target ligand, as the ectodomain. However, PTCs have not been adapted to use with GPCRs, limiting their therapeutic implications, especially within the brain where most receptors are GPCRs. In this study, a biosensor that targets serotonin is being developed by expanding upon the PTC. To do this the scFv and transmembrane domain will be replaced with the serotonin GPCR 1A by molecular cloning. The application of Dr. Daringer's PTC is optimal for this design due to its ability to record real-time downstream signals at the fast speed necessary for neurons to process. Following preliminary testing in HEK-293 cells, testing in neurons will be conducted in collaboration with the Solesio lab at Rutgers University.

Functionalized Laminin Peptide Motifs to Promote Peripheral Nerve Damage Repair

TEAM MEMBERS

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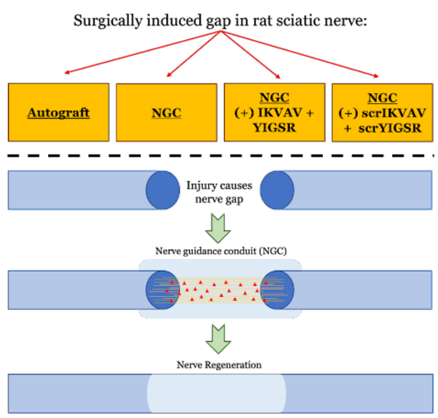
PROJECT MANAGERS

Dr. Vince Beachley, Dr. Sebastian L. Vega, Dr. David Fuller (Cooper Medical School)



Over 200,000 peripheral nerve damage procedures occur annually in the U.S. This work focuses primarily on neurotmesis, the total loss of continuity of the nerve trunk. While an autograft is the gold standard, it is also associated with complications such as donor site function loss. This project seeks to outperform the autograft in rat models using a composite biomaterial scaffold with functionalized laminin peptides. Here, aligned, electrospun polycaprolactone (PCL) pre-mixed with 10% w/v norbornene-modified poly(ethylene glycol) (PEG-Nor) nanofibers are dipped in a peptide solution and crosslinked under UV light. The peptides of choice were thiolated laminin motifs IKVAV and YIGSR that have previously been shown to promote cell adhesion and neural differentiation. Upon washing, nanofibers are stacked and rolled to form a nerve guidance conduit (NGC) that was implanted into the excised sciatic nerve of rats. Four groups were tested: autograft (gold standard), NGC (control), NGC + IKVAV + YIGSR (experimental group), and NGC + scrIKVAV + scrYIGSR (scramble, inactive peptide control). Rats will be tracked for 16 weeks for sciatic functional index (SFI) and gait analysis as well as endpoint electrophysical testing and histology. It is hypothesized that the experimental group will exhibit superior native peripheral nerve growth resulting in better gait performance and sciatic functional index (SFI) compared to the autograft.

Human Body Kinematics in Multiple Collisions

TEAM MEMBERS

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PROJECT MANAGERS

Dr. Daniel Mazzucco

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CBE Consultants, Inc.

There are approximately 15,000 car accidents per day in the US. Many of these collisions lead to injuries to vehicle occupants due to rapid acceleration of the head and neck. For this reason, researchers conduct tests to analyze the head and neck movements of occupants involved in motor vehicle collisions. Because automobile collisions cause vehicle damage that is expensive to repair, collisions at low speeds are often tested using bumper cars as an alternative. These amusement park vehicles provide an accurate representation of "real" low-to-moderate impacts and can be reused many times. While significant data have been generated on the effects of single collisions between two vehicles, there are no data evaluating the effect of occupants in multi-collision accidents involving three or more vehicles. The Rowan Engineering Team in association with CBE Consultants and Six Flags Great Adventure developed situations to simulate multi-collisions car crashes through the use of bumper cars in order to study head and neck accelerations. The team also explored different heights, weights, and genders to understand how these factors affect accident kinematics.

Hypoxic Culture of Trophoblasts to Model Preeclampsia (PE)

TEAM MEMBERS
Katelyn Sales, Peyton Patrick

PROJECT MANAGERS
Dr. Rachel Riley

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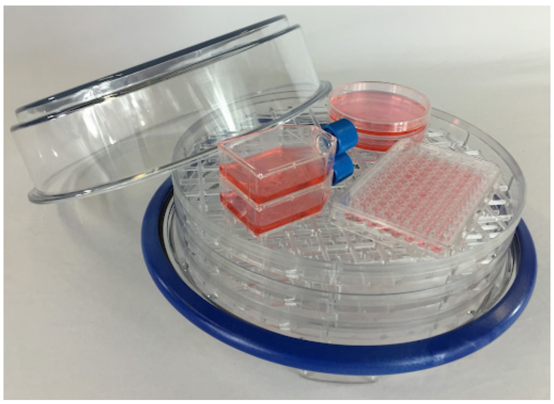
New Jersey Health Foundation



Preeclampsia (PE) is the most common condition during pregnancy characterized by newly onset hypertension after 20 weeks gestation. The only curative option for treating this disease is to induce a premature birth of the fetus, which can lead to both long and short term complications. One known cause of PE is uncontrolled secretion of anti-angiogenic factors from the placenta, such as soluble fms-like tyrosine kinase-1 (sFlt-1). There has been growing evidence proving a correlation between gestational hypoxia of the placenta and PE. In this project, our goal is to develop an in vitro hypoxia model to study trophoblasts, the most abundant cell type in the placenta, during PE. Towards this goal, we are developing a hypoxia incubator chamber to mimic preeclamptic conditions for the culture of trophoblasts. To induce hypoxia, an inlet tube from the chamber is connected to a mixture of gasses containing 1% O_2, 5% CO_2, and 94% N_2. To validate our system, we measure levels of Hypoxia-Inducible Factor 1 (HIF-1α) in the cells following incubation. We expect increased HIF-1 levels in cells kept in a hypoxic environment compared to cells incubated in a normoxic environment. Along with HIF-1α, we also measure sFlt-1 expression, as it should increase in hypoxic conditions compared to normoxia. Ultimately, our hypoxia chamber will be used to study drug delivery in trophoblasts in a hypoxic environment as an in vitro model of preeclampsia.

Identification of Sleep-Wake Cycle using Biosensor Biometrics

TEAM MEMBERS
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PROJECT MANAGERS
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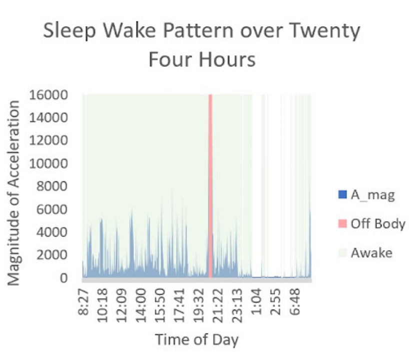
Strados Labs



A medical technology company is developing a biosensor used to assist medical professionals in the monitoring, diagnosis, and management of chronic conditions remotely. This wearable biosensor passively provides information about physiological function in real-time for medical professionals to analyze. To achieve beneficial results, the device must comply with different body types and activities while remaining comfortable when being worn without compromising its ability to perform. During recent development, the potential value of tracking a patient's sleep-wake cycle has emerged; feasibility is being investigated. The device has a built-in accelerometer and microphone which have the ability to record data for twenty-four hours. We are exploring the use of a combination of acceleration data, gyroscopically-determined positioning data, and auditory signals. Complex algorithms have the potential to analyze the accelerometer data synchronously with the gyroscopic data to determine if the user is awake or asleep. Rowan University engineers, in collaboration with Dr. Mazzucco, are exploring physiological data obtained from real use of the sensor and are generating a pathway to determine whether a patient is asleep or awake. These algorithms could be extrapolated to help diagnose sleep-related illnesses such as sleep apnea and nocturnal asthma.

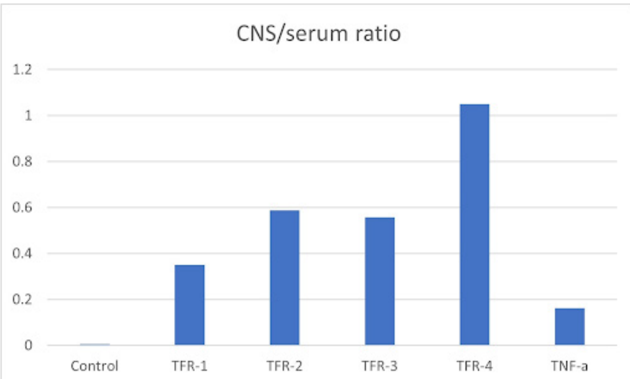
Identifying Transferrin-binding Receptors in a 3D Blood-brain Barrier Model

TEAM MEMBERS

Lauren Spalluto

PROJECT MANAGERS

Dr. Peter Galie, Dr. Luciano D'Adamio (Rutgers University)



The blood-brain barrier is selectively permeable, motivating strategies to facilitate transport to cross the barrier. Collaborators from Rutgers University have designed "nanobodies" that bind to the transferrin receptor to ferry cargo across the barrier. My project involves testing different structures of nanobodies to determine the optimal formulation to facilitate drug testing. I construct a 3D model of the blood-brain barrier, and then perfuse different nanobodies through the lumen of these model vessels. I collect the medium perfused through the vessel (labeled as "serum") and the medium surrounding the vessel (labeled as "CNS"), then ship these samples to Rutgers for processing. Figure 1 shows the different ratios of the nanobodies I have tested. A higher ratio of CNS/serum translates to more transport across the barrier. The control nanobody, which doesn't have any binding target, exhibits the lowest CNS/serum ratio. The nanobodies that bind to the transferrin receptor all have ratios greater than 0.2. An additional control is provided by a nanobody that binds to the TNF-alpha receptor. This nanobody also exhibited a small increase in transport, which motivates further research into the effect of binding to this receptor. Future work will involve testing these nanobodies in higher replicates to conclusively determine the formulation used in an animal model of blood-brain barrier drug delivery.

Injectable Hydrogel for Targeted Cell Depletion to Treat Cataract Opacification

TEAM MEMBERS

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PROJECT MANAGERS

Dr. Mark Byrne

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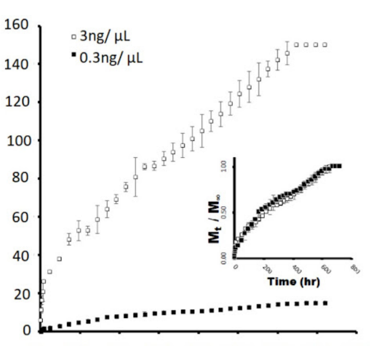
Cooper Foundation/OcuMedic, Inc.



Cataracts are the second leading cause of blindness worldwide, with over 100 million cataract surgeries performed annually. The number of cataract cases is projected to double within the next ten years. Over 30% of adults and nearly all children develop secondary cataracts or clouding of the lens capsule following cataract surgery. Current treatment strategies are insufficient and pose severe adverse effects; therefore, a prophylactic treatment strategy delivered during cataract surgery is a considerable unmet need. Injectable stimuli-responsive gels were designed using FDA-approved poly(lactic-co-glycolic acid)-b-poly(ethylene glycol)) (PLGA-PEG-PLGA) triblock copolymers. These novel self-assembled gels are optically clear at physiological temperatures and were engineered by varying the lactic acid (LA) to glycolic acid (GA) ratio, and the PLGA/PEG ratio. Previous studies also showed preliminary specificity and cytotoxicity of gel-released nanospheres to myofibroblast precursors. The purpose of the current study is to compare release and therapeutic efficacy of different doses of a targeted nanocarrier loaded with cytotoxic doxorubicin to deplete cells responsible for posterior capsular opacification (PCO) from our novel sustained release formulation.

Innovated Skin Biopsy Device to Expedite Biopsy Processes

TEAM MEMBERS
Shruti Dalwadi, John Grasso, Adrian Martinez, Paige Tatus

PROJECT MANAGERS
Dr. Erik Brewer, Joshua Freedman, M.D. (Behemoth Technologies)

SPONSORS
Behemoth Technologies, National Science Foundation I-Corps

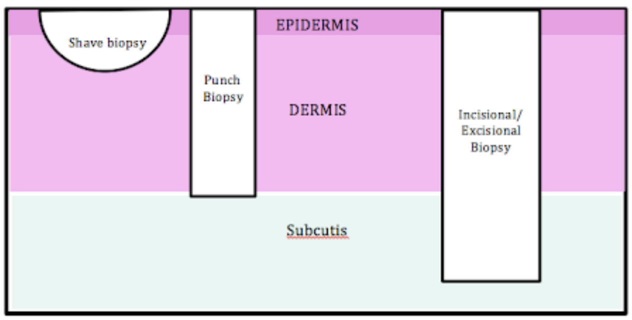


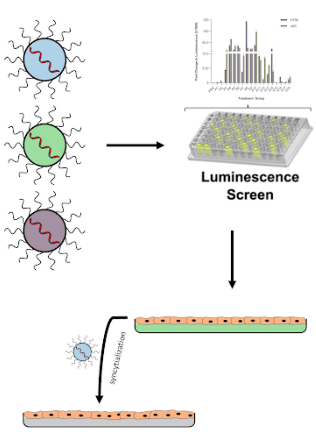
Figure 1: Areas that are sampled with various biopsy techniques

With approximately 9,500 diagnoses per day, skin cancer is the most prevalent type of cancer in the United States. 1 in 5 Americans are likely to develop it in their lifetime. The skin biopsy, an effective and relatively safe procedure, is the gold standard used by dermatologists to diagnose suspicious skin lesions. However, the procedural time required represents a rate-limiting step in diagnosing and combating skin cancer. Awarded funding from the National Science Foundation I-Corps program, Rowan engineering students aimed at designing innovations to mitigate limitations identified by a research study highlighting the demands and bottlenecks of each step in the biopsy process. 15 dermatologists and pathologists from different institutions were interviewed to provide insights. These interviews revealed time as a key limiting factor to the biopsy process. Currently, students are collaborating with Behemoth Technologies, a medical device start-up based in New Jersey, to develop novel innovative devices that could expedite and automate the current skin biopsy process. By utilizing multidisciplinary skills such as CAD software, 3D printing, and mathematical analysis, etc., they hope to engender a device capable of making skin biopsies more accessible and clinically beneficial to all by allowing the prevention, early detection, and treatment of skin cancers in the United States.

Investigating LNP Uptake and Transfection in Trophoblast Cell Lines

TEAM MEMBERS
Tara Vijayakumar

PROJECT MANAGERS
Dr. Rachel Riley



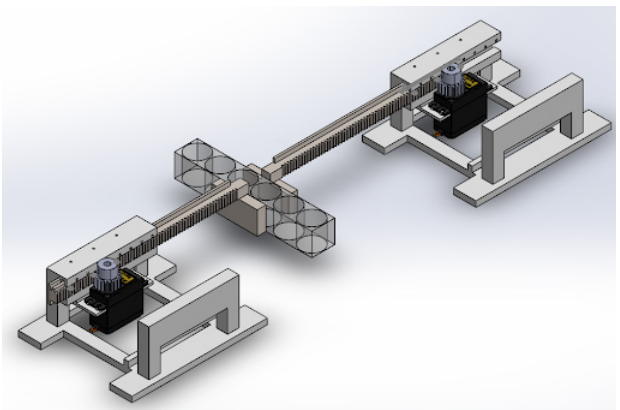
Lipid nanoparticles (LNPs) have emerged as a safe, effective delivery platform for targeted, controlled release of RNA therapeutics against a variety of diseases. Made of ionizable lipids, phospholipids, cholesterol, and PEG, LNPs allow for mRNA encapsulation and delivery, which is not possible freely. However, LNPs have not been thoroughly evaluated for use during pregnancy, either for safety or for treating pregnancy-related diseases. Our recent work explored how LNP design influences placenta-specific delivery and accumulation by delivering mRNA in LNPs to choriocarcinoma cell lines, then a healthy pregnant mouse model. In developing LNPs for use during pregnancy, it is vital to evaluate delivery to various in vitro placental models. Differences between mice and human placental physiology underline the importance of human cell lines giving insight into the cellular response to LNPs, representing different stages of pregnancy and placental development. Here, we evaluate LNP uptake and transfection using HTR8 and JAR cell lines. Screening yielded differing uptake, transfection, and cell viability in each cell line. LNP design features dictating high delivery in both cell lines were identified, including phospholipid type in the LNP formulation. Future work will explore LNP uptake mechanisms and utilizing cell lines to deliver therapeutically relevant mRNA to evaluate our platforms and probe treating diseases during pregnancy.

Magnetic Actuator Device to Dynamically Change Gel Stiffness

TEAM MEMBERS
Nikolas Greenberg

PROJECT MANAGERS
Dr. Peter Galie

SPONSORS
National Science Foundation



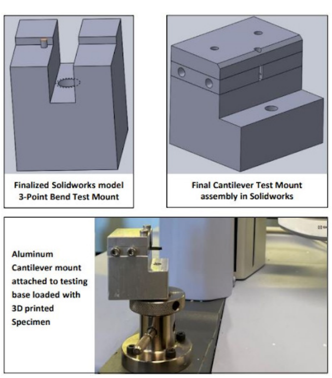
Keloids are thick, raised scars that form after an injury has healed due to excess protein deposition in the skin during the healing process. Analyzing cells from keloids is crucial for potential therapeutic applications in burn scar healing, particularly in cases of hypertrophic scarring, which often affects burn victims and takes extended periods to fully heal. A three-dimensional environment can be created by seeding normal human fibroblasts (NHF) and keloid fibroblasts into collagen gels, and incorporating magnetically active hydrogels. This enables the study of the effects of dynamic matrix stiffness on their cell response. Previous methods of altering the surrounding magnetic field to dynamically change matrix stiffness have required manual input from researchers. In my project, I developed a device to independently alter the distance of two permanent N52 neodymium magnets from a modified six well plate containing the magnetically active hydrogels. This was accomplished by utilizing a servo motor and Arduino technology to move the magnets to distances that achieved specific magnetic forces. COMSOL was used to model the system and determine the distance required to produce the desired magnetic field strength and forces on the system.

Mechanical Testing of a Polydioxanone Clip for Hysterectomy Applications

TEAM MEMBERS
Landyn Bacanskas, Andronikos Nouragas

PROJECT MANAGERS
Dr. Daniel Mazzucco

SPONSORS
ZSX Medical, LLC.



Zip-Stitch is a small, bioresorbable clip used to close the vaginal cuff in hysterectomy surgery, made of polydioxanone (PDO), a synthetic polymer with high tensile strength which allows for slow, controlled healing after surgery. Due to PDO's biodegradable nature, slow degradation of the polymer occurs in room temperature conditions before implantation. Because of this degradation process, we need to test and evaluate the mechanical properties of the clip, which will provide necessary information for determining the viability of the clip. Current ASTM standards which do not outline methods for testing this small sized specimen of PDO, so this project focuses on the development of a new mechanical testing protocol as well as the design and fabrication of mechanical testing mounts. To mitigate issues with non-uniform geometry of the specimen, testing is being conducted on the clip pin which measures 8.9x2x2mm. The optimal mode of testing was determined to be 3-Point Bending and Cantilever tests which place the specimen under both tension and compression, giving the advantage of added secureness to the mount. Initial design of the mounts were done with modeling clay before being translated into dimensioned, rigid models using Solidworks to be machined from aluminum. The aluminum mounts attach to a load cell which applies a force to the PDO specimen while tracking data regarding the specimen's mechanical properties.

Novel Biopsy Device to Support Matrix-Induced Autologous Chondrocyte Implants

TEAM MEMBERS

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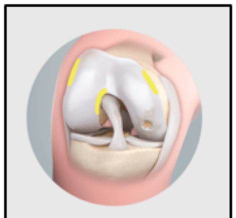
PROJECT MANAGERS

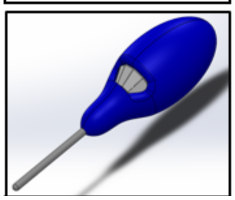
Dr. Erik Brewer, Al Intintoli (Trice Medical, Inc.)

SPONSORS

Trice Medical, Inc.



Areas where cartilage is harvested.



Total knee replacement is the standard for treatment of osteoarthritis, yet it presents several drawbacks. The Matrix-Induced Autologous Chondrocyte Implantation (MACI) procedure has improved outcomes for a less invasive procedure at a lower cost. However, the MACI procedure currently has a low patient compliance rate due to the invasive, multi-step tissue biopsy process. Consequently, Trice Medical given Rowan engineering students the task of designing a one-handed, sterile, disposable device capable of retrieving healthy cartilage under local anesthetic with arthroscopic assistance, allowing for an in-office MACI procedure. The group is pursuing four unique design pathways based on the previously identified device criteria. Utilizing 3D printing, laser cutting, and industrial machining, we intend to assemble and test each functional prototype. We are utilizing industrial manufacturing capabilities with the support of Trice Medical to create highly functional prototypes. Our designs will undergo a gradient testing scheme starting with preliminary resilience testing, benchtop testing, bovine biopsy, and a cadaver biopsy with arthroscopic aid. A critical objective data point to collect at all stages along the gradient is the number of passes needed to collect 200mg of equivalent cartilage mass. Moreover, valuable data will be gathered from our orthopedic surgeon partner as we develop the ergonomics of our device.

Novel Oxyphenonium Hydrogel Contact Lens for Delaying Myopia Onset in Pediatrics

TEAM MEMBERS

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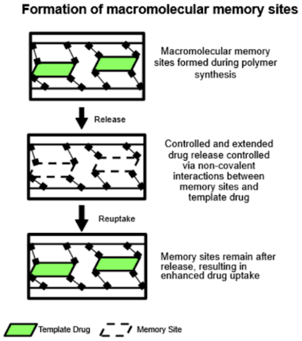
PROJECT MANAGERS

Dr. Mark Byrne

SPONSORS

OcuMedic, Inc.

Formation of macromolecular memory sites



Myopia is a disease that is characterized by an abnormal shape of the eye that results in improper refraction of light in front of the retina, leading to blurriness in vision and headaches (in severe cases). It is estimated that 30% of the world's population suffers from Myopia, and an estimated 50% of the population will be myopic in 2050. Myopia is treated via application of topical drug solutions, which are an inefficacious method of ocular drug delivery due to issues such as poor bioavailability (only 2-8% of applied drug to the target site). This research focuses on the synthesis of therapeutic silicone-hydrogel extended wear contact lenses that release a therapeutic drug at a controlled and extended rate for the duration of wear. Drug release is controlled via the polymer engineering technique known as molecular imprinting, which involves the addition of drug molecules to the prepolymer formulation along with functional monomers that non-covalently bind the drug, resulting in formation of macromolecular memory sites during polymer synthesis. The monomer to drug template ratio is used to control release rate based on the amount of chemistry within the polymer and degree of memory site formation, resulting in a therapeutic lens that has the potential for a more efficient and bioavailable treatment of myopia.

Restoration of Intervertebral Biomechanical Properties Using HYDRAFIL Treatment

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PROJECT MANAGERS
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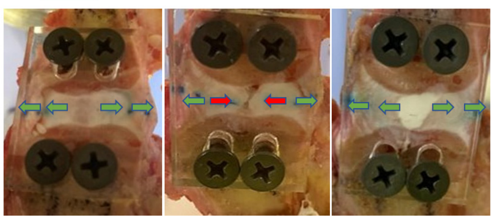
SPONSOR
ReGelTec, Inc.

ReGelTec



Healthy Degenerated Implant

403 million individuals globally are estimated to have degenerative disc disease (DDD) that caused some form of low back pain and involves the unavoidable appearance of degenerative changes in intervertebral discs (IVDs). As a result, the nucleus pulposus (NP), the inner core of the IVD, loses its ability to absorb water, decreasing its ability to bear load. At more advanced stages of DDD, the disc may completely collapse, resulting in loss of disc height and disc biomechanics. The biomechanical properties of an IVD can be quantified to determine functionality. One of these metrics, stiffness, has been used to measure the ability of the NP to bear the brunt of the load between vertebrae in the spinal column and act as a "shock absorber". Contemporary treatments for DDD involve limited efficacy interventions such as epidural steroid injections and physical therapy, or highly invasive surgical treatments like spinal fusion procedures. Biomaterial-based devices have been developed to restore the ability of the disc to resist compressive loads and prevent disc collapse. Of these devices, HYDRAFIL, a hydrogel-based, minimally invasive polymer blend, has been developed to replace the degenerated, nonfunctional NP. HYDRAFIL is expected to restore the ability of the disc to resist compressive spinal loads by restoring stiffness and disc height to healthy state values, thereby preventing herniation, endplate grinding, and degeneration.

Reverse Engineering the Planarian Response to Light Stimuli

TEAM MEMBERS
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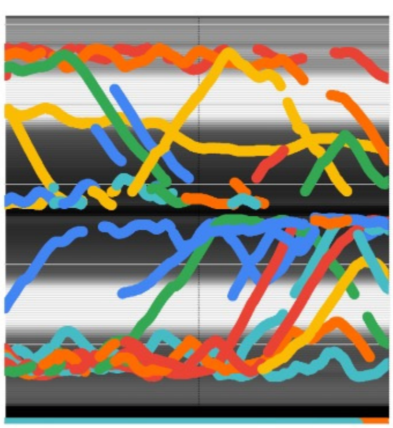
PROJECT MANAGERS
Dr. Mary Staehle

SPONSORS
National Institutes of Health



Planaria are small flatworms that are recognized for their regenerative capabilities. With a nervous system strikingly similar to humans and simple cerebral eyes, planaria are often used to study neurological function and regeneration. Notably, planarian cognitive abilities are assessed via their innate photophobic behavior - their ability to avoid light. However, relatively little is understood about planarian photophobia, and a more comprehensive understanding is critical before assuming this behavior is an appropriate metric of cognition. We hypothesize that by engineering light stimuli and analysis metrics, we can reverse engineer the light avoidance response and determine whether planaria flatworms aimlessly swim away from light (photophobia) or actively seek the dark (nyctophilia), and thereby we can characterize the level of cognitive processing involved in this behavioral response. We utilize a custom high-throughput device that provides spatially-controlled light stimuli and records behavioral responses. We found that the planaria show photophobic behavior with nyctophilic tendencies. Thus, referring to planarian behavior as photophobic may be misleading, as our results suggest that planaria are willing to swim through light to find the darkest available location. This has implications for the use of light avoidance as a measure of cognitive function, and enables further research in planaria neuroregeneration.

Robotic Surgery Training: A Virtual Reality Approach for an Effective Practice

TEAM MEMBERS
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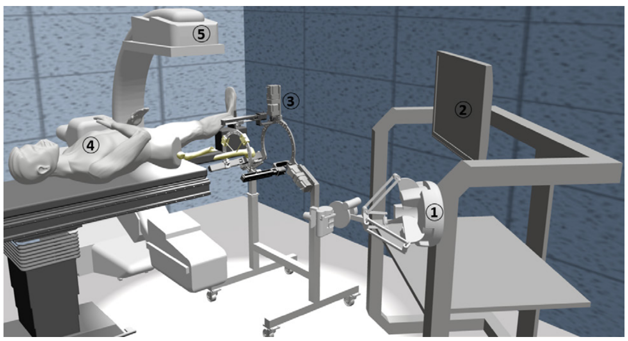
PROJECT MANAGERS
Dr. Mohammad H. Abedin-Nasab

SPONSORS
National Science Foundation, New Jersey Health Foundation



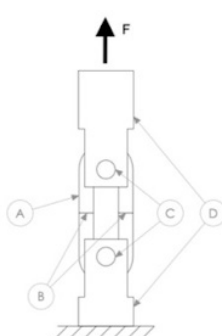
Developing a novel surgical robot can enhance the accuracy and effectiveness of femur fracture surgery. However, extensive training is required to utilize the robot effectively. To address this issue, a virtual reality (VR) environment has been created that allows surgeons to practice safely and effectively using the Robossis surgical robot. The VR environment is based on a previous cadaver experiment and uses the Gazebo simulator and the sigma.7 haptic controller to interface the user's hand motion in a virtual environment. The VR environment was designed to include (1) a haptic controller, (2) a surgeon workstation, (3) the Robossis surgical robot, (4) a cadaver patient, and (5) a C-arm X-ray machine. Simulation tests have confirmed that the Robossis robot can precisely mimic the theoretical joint angles generated theoretically in the Gazebo simulator, and the force feedback model effectively confines the haptic controller's motion within the robot's joint space limits. This approach offers surgeons a safe, efficient, and cost-effective means of practicing with the surgical robot, ultimately increasing their familiarity and confidence with the operating room environment-robot interface. Overall, our system model integration and VR simulations are beneficial tools for training surgeons at a low-risk and low-cost to enhance surgical outcomes.

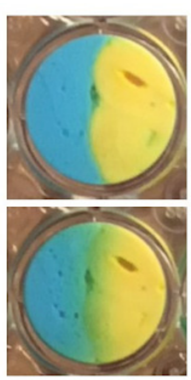
Self-Healing Properties of Augmented Injectable Hydrogels Over Time

TEAM MEMBERS
Connor Castro

PROJECT MANAGERS
Dr. Erik Brewer, Zachary Brown (ReGelTec, Inc.)

SPONSORS
ReGelTec, Inc.





Injectable hydrogels have been a heavily researched class of biomaterials with many applications, though one common issue is the mechanical wear properties they exhibit. To increase the life time of these types of implants is by utilizing the unique material property that some polymers and materials have, which is self-healing. In collaboration with ReGelTec, a novel injectable hydrogel used for spinal implants was studied to understand its self-healing properties over time. This was accomplished using both mechanical and visual studies. For clinical relevance, the hydrogel was studied at multiple different timepoints to understand how its self-healing capability changes as the hydrogel transitions from a liquid state to a solid state, and how a more solid piece of hydrogel can successfully self-heal with a fresh, liquid piece of hydrogel. In testing, a single piece of hydrogel was compared to the self-healed pieces of hydrogel to compare and observe any possible mechanical differences, as well as any potential interface differences between the self-healed pieces over time. The results showed that as the hydrogel became more solid, there was a negative impact in the interface strength with the fresher piece of hydrogel, however mechanically, there was no statistically difference between the single piece of hydrogel compared to any of the self-healed pieces of hydrogel.

Sensor System for Joint Surgery Recovery

TEAM MEMBERS
Vikas Addanki, Noah Goldman, Alyssa Matro

PROJECT MANAGERS
Dr. Erik Brewer

SPONSORS
Goniotape, LLC., National Science Foundation I-Corps

By 2030, the demand for total hip arthroplasty is estimated to grow by 174% and total knee arthroplasty will grow to over 600%. After these surgeries, patients are often given strict guidelines to allow for complete recovery of the respective region. When patients fail to follow these post operative guidelines, this can lead to reinjury and costly revision surgeries. It has been seen that there is no way to track these patients' adherence to their precautions outside of medical facilities. Rowan University students have partnered with the medical device startup Goniotape to create a device capable of monitoring patients' post-joint replacement adherence to the precautions set in place by the operating physician. This durable and flexible motion tracking device is aimed to alert the patient, via a connected watch or app, if the joint is moved beyond the post operative limits. The team started with entrepreneurial research through the NSF I-Corps training program where they interviewed Doctors, Physical Therapists, Occupational Therapists, and Patients. Their feedback was incorporated to alter the design criteria of the device and its variable functions. They further researched into the field of I2C sensors and Kalman Filters to prepare for, and begin working on, a minimally viable Arduino prototype. The team's overall goal is to create a minimally viable prototype suitable for clinical trials.

Synthesis and Photopatterning of Synthetic Thiol-Norbornene Hydrogels

TEAM MEMBERS
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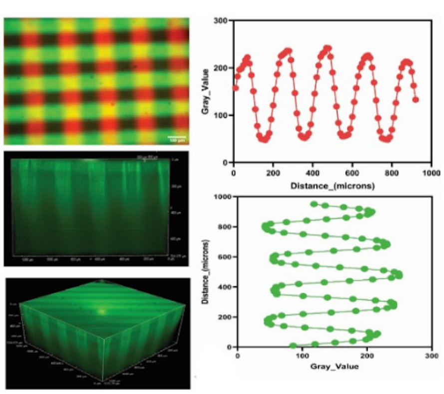
PROJECT MANAGERS
Dr. Sebastián Vega

SPONSORS
National Science Foundation



When used as cell microenvironments in biomedical applications, hydrogels can simulate multiple chemical and mechanical signals. To add heterogeneity to hydrogel properties, photopatterning can be utilized; yet current systems are constrained by the achievable range of gel characteristics and the decoupling of mechanical and chemical signals. In this study, a photopatterning system utilizing thiol-norbornene chemistry of available secondary reaction sites created comprehensive hydrogel modifications. Multiple signals were accounted for considering a large number of reactive handles available for secondary reactions. Norbornene groups were functionalized onto an 8-arm polyethylene glycol (PEG) macromer, which then reacted with di-thiols to produce non-toxic hydrogels with a variety of mechanical properties. PEGNor gels were created by controlling the initial degree of crosslinking, leaving norbornene groups that may react with thiol-containing molecules in the presence of light and an initiator as well as spatiotemporal control. Secondary reactions involving a di-thiol crosslinker altered gel mechanical properties; however, reactions involving mono-thiol peptides had no effect on the gel's elastic modulus. Multiple peptides were patterned into a single hydrogel using orthogonal chemistry sequentially thus proving the system's capability of producing intricate hydrogels.

Targeting Fibroblast Activation Protein In Solid Cancer Adoptive Cell Therapy

TEAM MEMBERS
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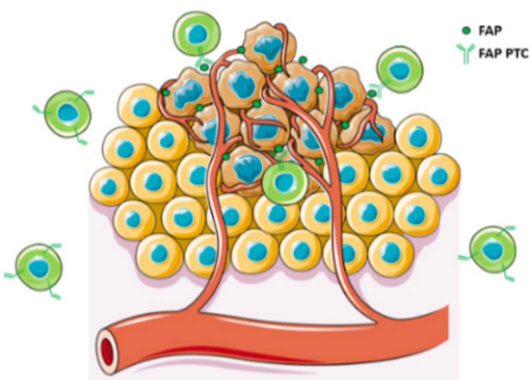
PROJECT MANAGERS
Dr. Nichole Daringer



Immunotherapy for cancer treatment is an exciting and rapidly growing field which allows for leveraging the patient's immune system to create an effective response. A subset of immunotherapy offerings personalized treatments is adoptive cell therapy (ADT). Adoptive cell therapy allows for leverage the patients' own T-cells, which can be genetically modified to target specific antigens expected to be present in the cancerous cells and areas. However, while successful in liquid tumors, limitations persist in solid tumors due to poor penetration, limited in vivo persistence, and a hostile tumor microenvironment. Advancements in synthetic receptor structure provide an opportunity to revisit some antigen targets with the promise of newly improved homing, persistence, and effector functions due to a better understanding of new downstream binding effects. Fibroblast activation protein, an antigen commonly upregulated in cancerous cells and correlated with poorer clinical outcomes, has been targeted before by ADT but due to these recent advancements, targeting it may now be more effective. As such, FAP targeting post translation circuits will be tested using flow cytometry for a better understanding of an improved structure that results in high affinity binding to human FAP.

Targeting IL-4 Signaling in Cancer with Synthetic Cell Receptors

TEAM MEMBERS
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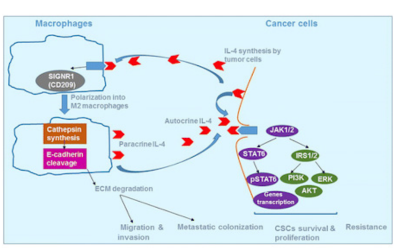
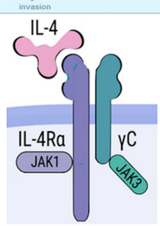
PROJECT MANAGERS
Dr. Nichole Daringer (Rowan University BME)





Synthetic cell receptors have emerged as powerful tools for the development of new cancer treatments. One potential application is the targeting of interleukin-4 (IL-4), a cytokine that plays a crucial role in the immune response and has been identified as a potential therapeutic target for cancer. IL-4 signaling induces polarization of macrophages towards the M2 phenotype. M2 macrophages are known to play a role in promoting tumor growth, suppressing immune responses and tumor metastasis. Synthetic cell receptors can be developed to either inhibit IL-4R or neutralize IL-4 in the tumor environment as a way to induce antitumor responses. Targeting IL-4 using synthetic cell receptors not only holds potential as a novel cancer therapy, but also provides a platform for studying the complex interactions between cancer cells, macrophages, and the immune system. This could lead to a better understanding of cancer biology and the development of more effective treatments that target both cancer cells and the immune cells in the tumor microenvironment.

Civil & Environmental Engineering

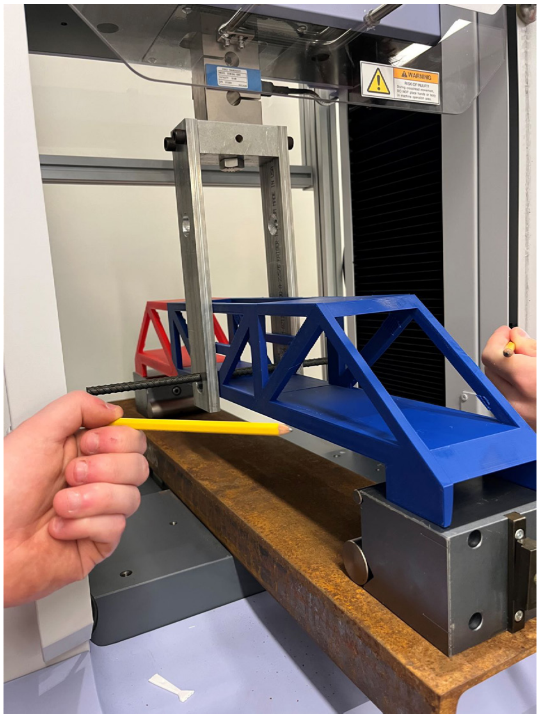
ASCE 3d Printed Bridge Competition

TEAM MEMBERS
Justine Williams, Julianna DiVentura, Rawy Moshier, Adam Cuevas, Zachary DeNuzzo, Nicholas Steel

PROJECT MANAGERS
Douglas Cleary

SPONSORS
ASCE Student Chapter

For this competition teams develop designs for 3d printed bridges and are judged on construction time, strength, stiffness, aesthetics, and accuracy of their calculations. In the initial stages of the project the team ran a test program to assist NJIT in trouble shooting the competition rules and suggested modifications. The team is now participating in the inaugural competition pilot competition as ASCE develops this into a national competition.



ASCE Concrete Canoe

TEAM MEMBERS
Matthew Eggink, Boramy Virya, Joseph Prancl, Daniel Lynch, Jake Block, Daniel Friend, Keegan Roche

PROJECT MANAGERS
Dr. Douglas Cleary

SPONSORS
ASCE Student Chapter

The team performs design analysis to create a canoe made of concrete that is entered in a regional competition with regional winners moving to a national competition. The project develops the student members' analysis, design, construction, writing, and presentation skills.

Bio-soil

TEAM MEMBERS
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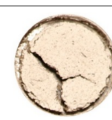
PROJECT MANAGERS
Dr. Cheng Zhu, Dr. Melissa Montalbo-Lomboy

SPONSORS
UTC (Rutgers)

This project aims to design and test a bio-mediated method for the improvement of soil collected from the shore of New Jersey. The research team used enzyme induced calcite precipitation technique to strengthen the mechanical and hydraulic behaviors of local soils, and also explore the potential of this technique for potential heavy metal contamination remediations.

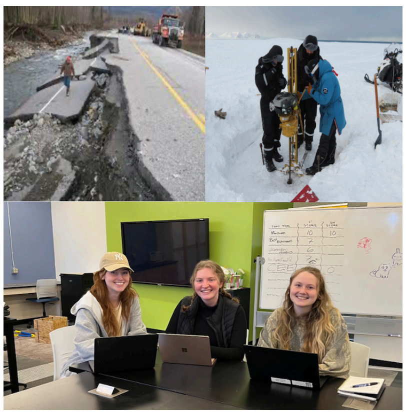
Cycle No.	Sample A	Sample B	Sample C
	100% bentonite	80% bentonite + 20% bottom ash	60% bentonite + 40% bottom ash
0 (water)			
1 (MICP)			
2 (MICP)			
3 (MICP)			
4 (MICP)			
5 (MICP)			

Climate Resilience and Permafrost Thawing in Arctic Region

TEAM MEMBERS
Bridget McDevitt, Alison McHugh, Kyla Rollo

PROJECT MANAGERS
Dr. Jagadish Torlapati

SPONSORS
DOE GAAN



The cryosphere, encompassing all things frozen, is an integral part of sustaining life functions on planet Earth. The cryosphere has many critical responsibilities, such as regulating global temperatures. One of the critical components of the cryosphere is the permafrost, which is the frozen ground existing in the high northern and southern latitudes. As anthropogenic factors cause global temperatures to rise, permafrost has been thawing at an alarming rate. In this clinic, we completed a thorough literature review to understand some of the consequences of thawing permafrost in the Arctic region. Some of the impacts of permafrost melt include damage to infrastructure, coastal erosion, and microbial changes. Although these direct impacts of permafrost melt are widely documented and studied, literature regarding the impact of carbon dioxide and methane emissions resulting from permafrost melt is limited. Estimates of the overall percentage of carbon trapped inside permafrost have been calculated, but a holistic view of the impacts of increased carbon concentrations as temperatures continue to rise. The primary goal of this study is to evaluate the potential pathways for the bioremediation of carbon present in the permafrost to preserve the resiliency of the ecosystems present in the Arctic region.

Concrete Shrinkage Cracking

TEAM MEMBERS
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PROJECT MANAGERS
Dr. Gilson Lomboy, Dr. Douglas Cleary, Dr. Cheng Zhu, Dr. Seth Wagner

Modern concrete mixtures used in transportation infrastructure can have a high risk of shrinkage cracking because of the high cementitious content, finer portland cement, low water-to-cementitious material ratio, and various admixtures in the concrete. The study's overall goal is to improve the longevity and performance of New Jersey transportation infrastructure by reducing the concrete shrinkage and cracking potential, which will prevent the ingress of water and other deleterious substances into the concrete. Fifteen high-performance concrete mixtures' autogenous shrinkage, drying shrinkage, and restrained shrinkage cracking were measured. Concrete mixtures with high shrinkage and cracking potential are being treated with shrinkage reducing admixture, shrinkage compensating admixture, surface coating, internal curing, fibers to mitigate the shrinkage and cracking of concrete in the lab. The hardened concrete properties, such as compressive strength, modulus, splitting tensile strength, and creep are also being tested. Mixtures with optimum dosages of admixtures will be tested under field conditions.

Design of Durable and Permeable Porous Asphalt Pavement

TEAM MEMBERS
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PROJECT MANAGERS
Dr. Yusuf Mehta, Dr. Abhary Eleyedath

SPONSORS
New Jersey Department of Transportation

Porous asphalt pavements are widely used as a best practice for storm water management. The top layer of porous asphalt mixes, lower aggregate layers and the uncompacted subgrade helps store storm water and facilitate its flow to the natural bedrock. The advantages include faster melting of snow and ice, mitigating heat island effects, recharging groundwater supplies, reducing the need for drainage structure in right-of-way, improving water and oxygen transfer to nearby plant roots, and reducing traffic noise. Despite these advantages, the application of porous pavements is limited to parking lots and low-volume roadways. Through the current research, NJDOT is interested in developing a nationally accepted approach for designing porous pavement structures for heavy traffic. In Phase I, the research team developed a draft pavement design specification and determined a set of NJ-specific porous asphalt pavement inputs for pavement design. In Phase II, the research team is validating the design methodology using full-scale accelerated pavement testing at the accelerated pavement testing facility at Rowan University. The outcome will enable the implementation of porous pavements on state-owned/managed roadways. This study will help NJDOT in its efforts to mitigate the negative impacts of climate change. Specifically, the use of porous pavements for addressing severe heavy rainstorms and localized flooding.

Developing a Pavement Management System for the City of Collingswood

TEAM MEMBERS
Murteza Hasan, Bekir Karbudak

PROJECT MANAGERS
Dr. Yusuf Mehta

SPONSORS
Center for Research and Education in Advanced Transportation Engineering Systems (CREATES)

The surface transportation system is critical for the efficient movement of users and commerce for any country, but maintaining and operating a roadway network requires extensive time and resources. Traditional methods for determining pavement condition index (PCI) involve expensive dedicated vehicles with cumbersome sensor setups. To address this challenge, a new process is developed using a mobile-based sensor that can be attached to any vehicle and an AI technique based on Convolutional Neural Network to detect cracks and potholes in road images. The model was trained on over 600 images of roadways and was able to predict the probability of deformations. This approach could significantly reduce the cost and time required for roadway assessment. The process includes data collection, distress detection, and PCI determination, which could be used to prioritize road maintenance. The proposed method is expected to provide accurate and reliable results, enabling Collingswood to make informed decisions about roadway maintenance while saving time and resources. Future work could include additional testing and refinement of the model to improve its accuracy in predicting the probability of deformations, making it an even more powerful tool for managing roadways.

Engineers on Wheels

TEAM MEMBERS

Jesselyn Marie Ablett, Andrew Philip Barbaro, Shane Thomas Flanzbaum, Eve H. Guttman, Mohamed Hassan, Nicholas Anthony Kelly, McKenzie R. Worley

PROJECT MANAGERS

Dr. Kauser Jahan, P.E.

SPONSORS

Catalent

Science and engineering are essential partners in paving the way for America's future through discovery, learning and innovation. Engineers on Wheels (EW) is a mobile K-12 outreach program to promote engineering careers. Vehicles with attractive wraps depicting various types of engineering disciplines are used for this program. The EW project is unique in that the program is delivered to school districts by engineering students and faculty. Engineering students develop and pilot the activities, lesson plans, and handouts. The program, has already reached out to numerous schools in the Southern New Jersey region with successful outcomes. Schools have limited money for educational field trips these days. Engineers on Wheels brings the 'field trip' to the students and also helps students learn about a possible career field. Activities are cost effective and visual. Care is also taken to develop and demonstrate activities that are appealing to all types of audiences. All core engineering disciplines at Rowan University are represented via the developed activities.

Engineers Without Borders

TEAM MEMBERS

Alex To, Patrick Kuchnicki, Erin Kennedy, Tyler Hubbs, Cole Caltabiano, Bill Gantz, Moira Smith, and Matthew Walter

PROJECT MANAGERS

Dr. Jagadish Torlapati and Dr. Yusuf Mehta

Rowan University's Engineers without Borders (EWB) Chapter is a team of multidisciplinary engineering students who coordinate with faculty and apply their curriculum to solve real world problems locally and internationally. The Ambuela community in Ecuador experiences water supply shortages throughout the year. During the dry season, the community purchases water from the capital that is delivered monthly. Our team conducted an assessment trip to the community on January 17, 2023 to test for water quality, collect GPS data of tanks and meters, identify potential new water sources, and conduct in-home surveys. We assessed alternatives to prepare for an implementation trip next year to implement a new water supply system for the community. EWB also works with nonprofit organization to improve community gardens. We have partnered with CROPS NJ (where we built an ADA compliant wheelchair pathway and raised garden beds to improve accessibility for the disabled community), Stand Up for Salem (where we extended the fencing of the garden and built a greenhouse to combat the food crisis in Salem City), Vietlead (where we partnered with Resilient Roots to improve the Camden community garden), Noyes Arts Garage of Stockton University (where we built raised garden beds, improved existing garden beds, and built a picnic table to provide fresh produce for its immediate multicultural community), and more. making it an even more powerful tool for managing roadways.

Equity in Transportation Systems

TEAM MEMBERS
Catherine Abacan, Robert Snyder, Anthony Carr, Austin Andrews, Nathan Hitchner

PROJECT MANAGERS
Dr. Mohammad Jalayer

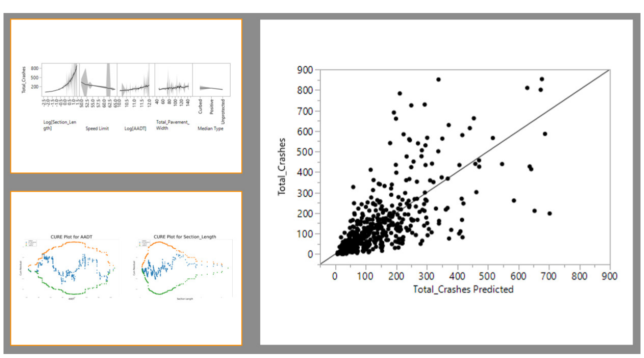
SPONSORS
UTC

Equity refers to the fair distribution of benefits and costs. Overburdened communities experience fewer benefits with a considerable share of negative impacts by means of transportation. Some of these inequities imitate a history of transportation planning and decision-making that has amplified disparities and resulted in divided communities. Transportation equity analysis is important and unavoidable; however, evaluating equity is complicated due to its different types, several impacts, measurement units, and categories of people to consider. In addition, the literature lacks a sufficient and comprehensive guide to evaluate transportation equity. Most of the current evaluation tools consider limited equity impacts on a specific group of people. This project aims to provide a rigorous method to define transportation equity, evaluate its impacts, and incorporate this evaluation into transportation planning and decision-making processes. To this end, specific objectives were defined, including conducting a comprehensive literature review of equity extent in transportation systems; defining performance indicators to measure equity in transportation systems; develop a flexible tool to evaluate equity in transportation systems. This research will provide valuable input in evaluating equity in transportation systems and prioritizing projects and implementations.

Evaluating Roadway Conditions for Freeway Crashes in New Jersey

TEAM MEMBERS
James Danielwicz, John McCleery, Steven Lange

PROJECT MANAGERS
Dr. Fahmida Rahman



Interstate freeways are highly traveled roadway facility in New Jersey (NJ). Every year, an average of 15000 crashes occur on these roads. Previous statistics show that 21% of these crashes led to fatalities and severe injuries. Therefore, it has become imperative to investigate the reasons that contribute to such a high number of crashes on the freeways of NJ. This study aimed at identifying those contributing factors by developing a statistical model. In the model, number of crashes was fitted against traffic, roadway geometric, and operating conditions. The model showed traffic condition, posted speed limit, and pavement width as some of the significant factors responsible for the crashes on NJ freeways. While the widely accepted safety assessment guidebook – Highway Safety Manual does not incorporate speed limit as one of the safety countermeasures for these roads, interestingly, this study revealed that speed limit should be considered to analyze the safety of freeways. The findings of this study can be adopted by the transportation agency and policymakers to better understand the reasons for NJ freeway crashes and come up with appropriate countermeasures to reduce such crashes.

Failure Theory for Civil Engineering

TEAM MEMBERS
Jack Peterson, Keith Evans, Alison McHugh, Garrett Shaner, John Malaszecki, Manjeet Deol, and Sydney Wright

PROJECT MANAGERS
Dr. Seyed Hooman Ghasemi

SPONSORS
NJEDA

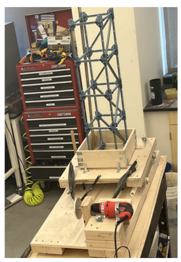
Failure Theory for Civil Engineering

Instructor: S. Hooman Ghasemi, Ph.D., P.E.
Students: Keith Evans and Jack Peterson

Build a shake table: The first goal is to build an educational shake table (4-5 weeks).

Build Systems: The second goal is to build various lateral resistance frames and investigate their responses behavior (braced and moment resistance frames) (4-5 weeks).

Failure Analysis: The third goal is to capture the failure patterns corresponding to the progressive collapse, local damage, and "experimental" resilience analysis. To do so, several vulnerable elements were removed or retrofitted. Accordingly, the frames' responses (visual failure pattern) were investigated. comprehensive results, and discussion reports (4-5 weeks).



Offshore wind turbines play a vital role in the renewable energy sector. However, their ability to operate in severe environmental conditions depends on their safety measures. To ensure their safety, it is necessary to have a reliable design philosophy. The Load and Resistance Factor Design (LRFD) philosophy is currently the most advanced method for designing structural components to ensure optimal safety. However, it is essential to note that the LRFD method relies on engineering judgment rather than precise calculations. In the Fall of 2022, The students provided a literature review to emphasize the need for LRFD-based design guidelines for wind turbine systems. They also propose very interesting innovations for the future generation of wind turbine configurations. In the Spring of 2022, the students constructed an educational shack table to capture the failure modes and patterns of the various 3D frames.

Flooding Vulnerability Analysis for Southern New Jersey

TEAM MEMBERS
Matteo Agresti, Ryan de la Cuesta, Thomas Gassaway, Brandon Jones, Dylan Torrance

PROJECT MANAGERS
Dr. Jeong Eun Ahn, Grace Watson (Ph.D. student)

SPONSORS
GAANN-GOSTARS fellowship

Flooding causes billions of dollars in property damage every year and can pose a serious threat to the environment and human life. The purpose of this clinic was to contribute to the development of a flood vulnerability index for the counties of southern New Jersey (i.e., Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, and Salem) in order to determine which areas are most vulnerable to flooding and the damage flooding can cause. ArcGIS was utilized in developing a flood vulnerability index based on exposure, susceptibility, and resilience. Datasets including roads and public transit, flooding inundation from major floods, storm surges, and sea level rise, and social and economic factors were used. ArcGIS was utilized to categorize roadway networks, evacuation routes, and public transit during flooding events in southern New Jersey for resilience. Several flooding scenarios were also analyzed using ArcGIS for exposure. A predetermined social vulnerability index developed by the CDC was considered for susceptibility. This team then combined resilience, susceptibility, and exposure to determine the flood vulnerability index.

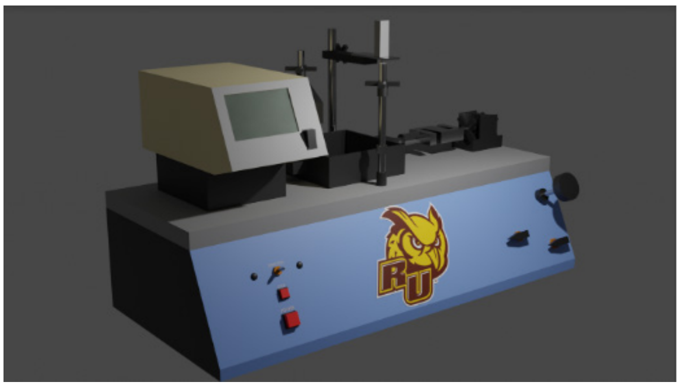
Geotechnical Game

TEAM MEMBERS
Weiling Cai, Chenchen Huang, Jonathan Sjaastad, Smith Damian, Deol Manjeet

PROJECT MANAGERS
Dr. Cheng Zhu, Dr. Ying Tang

SPONSORS
NSF

This project aims to design, develop and test a mobile app-based game for geotechnical engineering education. The cross-disciplinary student team worked together to design the game theme, game content, and various AR/VR components. Multiphysics geotechnical experiments were developed in the game for students to play and learn.

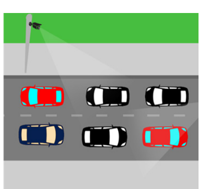


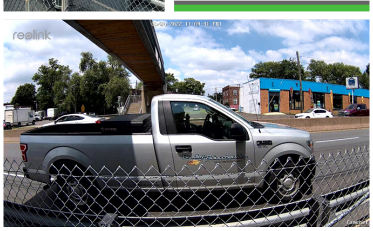
Identifying Distracted Drivers in New Jersey

TEAM MEMBERS
Luke Kvedaras; Frank Bonanno; Tamer Ozturk; John Meale

PROJECT MANAGERS
Dr. Mohammad Jalayer

SPONSORS
NJDHTS





Thousands of people die every year in the United States due to distracted driving crashes, with distracted driving accounting for 25% of all fatal traffic crashes in New Jersey. Various techniques (e.g., surveys, crash reports, videos, and simulations) were implemented by the transportation safety community to identify and evaluate distracted driving events. However, these methods collect data on individual subjects and do not provide the actual number of distractions on the road. To fill this gap, this study collected data on distracted driving events on high crash corridors in the state of New Jersey. The method involved a data collection crew continuously driving through the selected corridors to track driver distraction events by manual counting and video recording. Over the course of the past three semesters, the clinic team has done several things, including: collecting data on several routes in New Jersey; watching the recorded video meticulously to extract distraction and non-distraction events; manually annotating 21,000+ images for model training; and performing statistical analysis to determine the significance of variations in distracted-driving behaviors due to changes in temporal variability. The findings of this study are expected to aid state and local agencies in raising awareness of distracted driving in order to reduce the frequency and severity of distracted driving-related crashes.

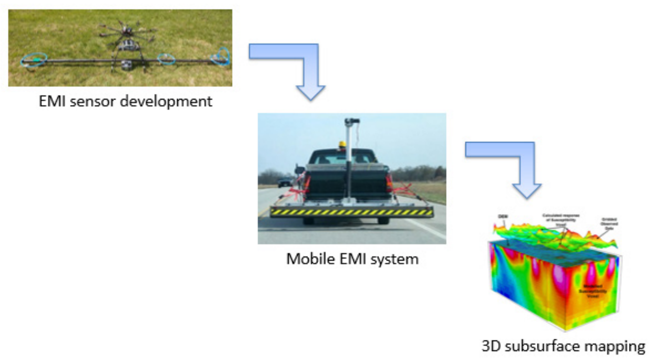
iFrost Mapper

TEAM MEMBERS
Rui Liu, Jim Kang, Ryan Ho, Agatha Seretni Uchi, Matthew Barna

PROJECT MANAGERS
Dr. Cheng Zhu, Dr. John Schmalzel

SPONSORS
DoD-CRREL

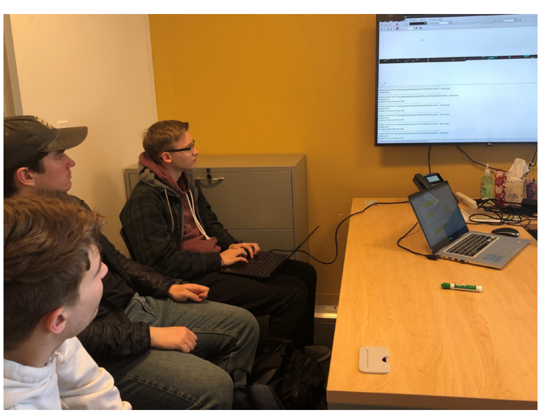
This project aims to develop a noninvasive technique based on electromagnetic induction for rapid characterization of permafrost in cold regions. Students work together on frozen soil experiments, study different electrical resistivity measurement methods, and extend laboratory-scale findings to field-scale applications.



Impact of Connected and Autonomous Vehicles on Work Zone Capacity

TEAM MEMBERS
Jack Bonham, Joseph Nadolny, Roche Keegan

PROJECT MANAGERS
Dr. Fahmida Rahman



Connected and autonomous vehicles (CAVs) have the potential to significantly impact work zone capacity. They can communicate with each other and with the work zone management system to optimize traffic flow through the work zone, reducing congestion and improving capacity. This study specifically focuses on quantifying the influence of CAVs on work zone capacity using various market penetration rates. Within the mixed traffic situation that includes human-driven vehicles, it is critical to find out whether these CAVs will act cautiously or aggressively. Based on their behavior, the capacity through the work zone can either go down or go up. Moreover, it is important to note that the widespread adoption of CAVs is still in the early stages, and there are many factors that could impact their effect on work zone capacity. For example, the degree to which CAVs can communicate with each other and with work zone management systems will impact their effectiveness. Additionally, there may be challenges with integrating CAVs into existing work zone management strategies and infrastructure.

Implementation and Assessment of Traffic Safety Campaign

TEAM MEMBERS
Genna Brunetta, Amelia Chan, Len Eslava, Sarah Morgan, Nick Papasso, Isabella Quimby, and William Voll

PROJECT MANAGERS
Dr. Mohammad Jalayer

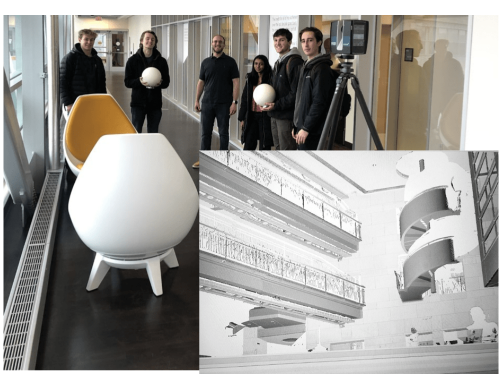
Rowan University is known to have a significant influx of pedestrian and commuter traffic on a daily basis- especially during the school year. With this large number of people trying to navigate the campus, which is divided by a high-traffic volume corridor: US 322, this study provides pedestrian and road user statistics collected on Rowan University Campus. To evaluate the safety campaign, data was collected prior to and after campaign implementation, followed by statistical analysis. The data in question consisted of measurement along four points throughout campus in the following subjects: proper yielding to pedestrians at crosswalks, pedestrian jaywalking, stop sign compliance, and distracted driving. In conjunction with the Brain Injury Alliance of New Jersey, Rowan University elected to highlight four key issues found most commonly on campus in their related awareness campaign: pedestrian safety through crosswalk use and paying attention, commuter cell phone use and overall distracted driving, impaired driving, and lastly cohabitation between cyclists, motorists, and industrial drivers.

Machine Learning for Structural Engineering

TEAM MEMBERS
Alec Bergman, Joshua Lamb, Michael Brown, John Hayes

PROJECT MANAGERS
Dr. Islam Mantawy, Dr. Adriana Trias Blanco, Issa Al Shaini, Naga Lakshmi Chittialli Ravuri

SPONSORS
USDOT through ABC-UTC



Machine learning is an AI technique that allows computers to mimic the learning processes of humans. It focuses on the use of data and algorithms to gradually improve its accuracy. Machine learning has emerged as a powerful tool for detecting and predicting structural failures in various domains. This clinic project focuses on using machine learning as a tool for assessing the strength capacity and damage levels of various structural elements. Existing work has consisted of using various deep learning models to create an algorithm for assessing concrete damage levels from image data. Current work utilizes LiDAR scans of bridge decks to create an algorithm for predicting damage level classification for bridges. LiDAR scans generate a 3D point cloud of the surface of the structure, which can be used to extract features and detect defects, with millimeter accuracy. CloudCompare, a LiDAR analysis software, is being used in order to create the heatmaps to train a machine learning algorithm for recognizing elevation differences that represent areas of damage on the deck. Future work aims to use damage assessment algorithms to predict causes of damage in structural elements.

Natural Building

TEAM MEMBERS
Grayson Fasolo, Tristan Letizia, Sivri, Sadik, Jacob Vazquez , Anna Kennedy, Dana Liberi, Daniel Horner, William Voll, Erin Kennedy

PROJECT MANAGERS
Dr. Jess Everett

SPONSORS
Lu Bivona (Home Builder)

Natural building involves using locally sourced materials to create homes to reduce their impact on the environment. This clinic focuses on determining the properties of materials used within this construction style and creating DIY tests that produce results like standardized tests for modern construction materials. Students proposed multiple DIY test kits and met with the client to identify test kits to create in Spring 2023. Using the DIY test kits people will be able to gather results and compare against standardized material properties to determine whether they would want to use this material for construction. The team hopes that accurate and inexpensive DIY test kits will aid natural builders obtain permission from building code officers to build homes in New Jersey.

Next Generation of STEM

TEAM MEMBERS
Zachary Cyrelson, Anna Kennedy, Dana Liberi, Evelyn Peralta Rodriguez, Alexandra Tatem, Qi Xu

PROJECT MANAGERS
Dr. Jeong Eun Ahn

SPONSORS
PSEG and Rowan-Rutgers Joint Board

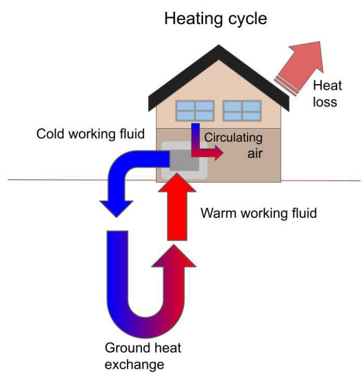
The objective of this clinic is to develop engaging lessons and interactive activities that educate and excite the next generation of Science, Technology, Engineering, and Math (STEM) professionals. The target audience for this project is middle school students in grades 6-8. The various fields of STEM will be demonstrated through three activities that focus on the human heart. The subtopics include how the heart pumps and circulates blood, methods for clearing blocked blood vessels, and blood types and genetics. The visual representations in each of the three activities will allow the students to comprehend the complex functions of the human heart in a simplified manner. The desired outcome of these activities is to encourage independent learning, allowing students to formulate their own conclusions based on the activities and worksheets provided. In addition, these activities will encourage teamwork and problem solving as students overcome challenges in a collaborative environment. The goal of introducing these activities to middle schoolers is to make STEM exciting so that they are interested in learning more and potentially joining the field in the future.

NJ DMAVA Ground Source Heat Pumps

TEAM MEMBERS
Walter Foard, Allison Garfield, Braden Garth, Moira Smith, Colton Thomas, Andrew Wilson, Mahdiyeh Zaferanchi (graduate)

PROJECT MANAGERS
Dr. Jess Everett, Dr. Mac Haas, Dr. William Riddell

SPONSORS
NJ DMAVA



NJ DMAVA will eventually completely electrify their facilities throughout the state, which means eliminating the use of natural gas and oil for heating. Heat pumps are the only viable means for heating with electricity efficiently. Traditional heat pump systems transfer heat to and from a building to the outdoor air. A ground source heat pump (GSHP) system uses a system of underground pipes to transfer heat to and from the ground. The relatively constant and mild temperature of the ground means that GSHP can be significantly more efficient than air source heat pumps. However, this comes at a considerable initial cost to install the in-ground system of pipes. Therefore, it is essential to evaluate all NJ DMAVA for suitability of GSHP. This project is developing models to identify the key factors of buildings for suitability, with the ultimate goal of helping NJ DMAVA prioritize the implementation of GSHP throughout the state.

NJ DMAVA Building Information Modeling

TEAM MEMBERS
Adetomiwa Awogbamila, Steven Castlegrant, Kieran Breen, Abbie Coen, Youssef Gerges, Peter Demirjian

PROJECT MANAGERS
Dr.Jess Everett, Prof. William Riddell, Jason Muermann, Cedric Jankowski

SPONSORS
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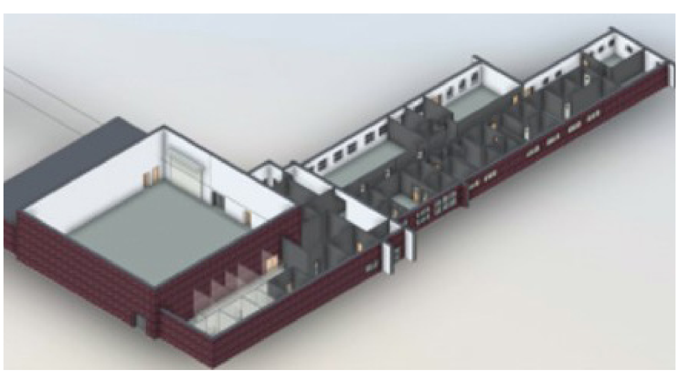


Building Information Modeling (BIM) is a collaborative process that architects, engineers, and contractors use to create, manage, and share comprehensive digital models of a building's physical and functional characteristics. BIM promotes a seamless transition through the entire lifecycle of both new and existing buildings. BIM models of existing structures at New Department of Veterans Affairs' (NJDMAVA) sites require three-dimensional (3D) scans that are merged to create a point cloud. This point cloud guides the creation of a 3D model in Autodesk Revit, which is also used to generate a two-dimensional (2D) floor plan. This level of visualization and conceptualization of buildings allow NJDMAVA to increase sustainability by integrating facilities management, as well as implementing sustainability principles into the design, construction, and operation of buildings.

NJ DMAVA Energy and Water Use Audits

TEAM MEMBERS

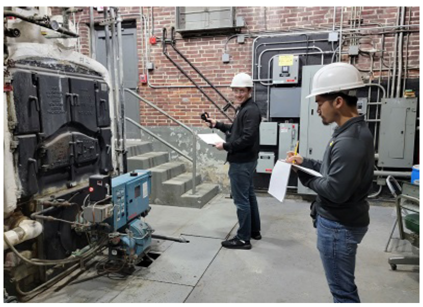
Ryan Baily, Daniel Bindas, Michael Brown, Nicholas Burn, Daniel Corrigan, George Cullis, Stephanie DeMatteis, Jose Duran, Trinity Good, Kaitlyn Hewitt, Steven Lange, James Ngyen, Tyler Ortzman, Seth Steward, Thomas Torney, Bryson Townsend, Mason Posner, Ethan Cantor (graduate)

PROJECT MANAGERS

Dr. Jess Everett, Dr. Mac Haas, Dr. Jie Li, William Riddell, Adriana Trias

SPONSORS

NJ DMAVA



Student teams have performed site visits to six different NJ DMAVA buildings throughout the state. At these visits, students measured indoor air temperature, air quality, and lighting levels, took thermal images of the building envelope, identified devices that use electricity and water, and studied the HVAC system. In addition to the site visit, the teams studied building plans and utility bills. These observations allowed the students to create building simulations to analyze and model both energy and water use. Based on familiarity with the building, candidate measures to reduce energy and water use, as well as opportunities to generate clean energy on site through solar power were identified. The models for energy and water use were then used to evaluate each candidate measure for potential savings, C02 emission reduction, and return on investment. These recommendations help NJ DMAVA to operate their facilities in an efficient manner.

NJ DMAVA Sustainable Facilities Management

TEAM MEMBERS

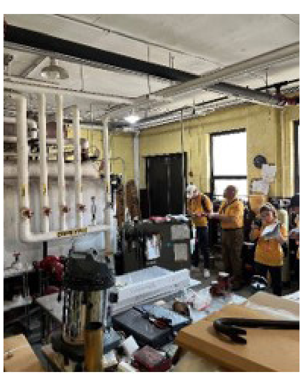
Ryan Bailey, Dan Corrigan, Tyler Hubbs, John Malaszeck, Richard Rivera, John Pineda, Teresa

PROJECT MANAGERS

Dr. Jess Everett, Dr. William Riddell, William Johnson, Kathy Mullins

SPONSOR

NJ DMAVA



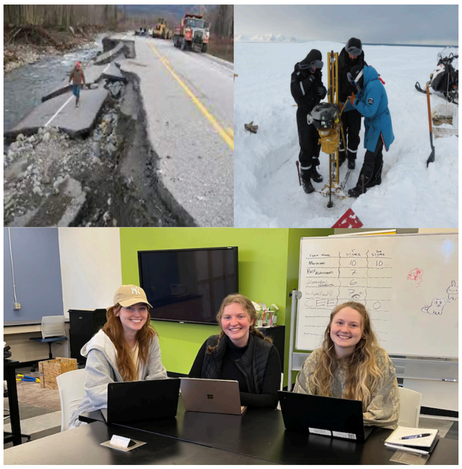
Students help the New Jersey Department of Military and Veterans Affairs (NJDMAVA) and New Jersey Army National Guard (NJARNG) manage ~ 250 buildings on 1,200 acres. They use FacilityDude CMMS and USACE's BUILDER SMS software to optimize maintenance and repair. They apply their education and experience to help NJARNG and NJDMAVA maintain mission readiness by creating level II planned maintenance reports for building systems and equipment that can extend the service life of NJDMAVA assets and assist with repair vs. replacement decisions. Planned maintenance recommendations involve building structural, HVAC, plumbing, fire protection, and/or electrical systems as well as various building equipment.

Permafrost Resiliency in Arctic Region

TEAM MEMBERS
Bridget McDevitt, Alison McHugh, Kyla Rollo

PROJECT MANAGERS
Dr. Jagadish Torlapati

SPONSORS
Department of Education

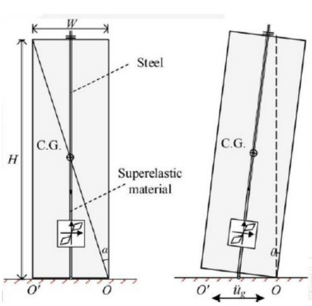


The cryosphere, encompassing all things frozen, is an integral part of sustaining life functions on planet Earth. The cryosphere has many critical responsibilities, such as regulating global temperatures. One of the critical components of the cryosphere is the permafrost, which is the frozen ground existing in the high northern and southern latitudes. As anthropogenic factors cause global temperatures to rise, permafrost has been thawing at an alarming rate. In this clinic, we completed a thorough literature review to understand some of the consequences of thawing permafrost in the Arctic region. Some of the impacts of permafrost melt include damage to infrastructure, coastal erosion, and microbial changes. Although these direct impacts of permafrost melt are widely documented and studied, literature regarding the impact of carbon dioxide and methane emissions resulting from permafrost melt is limited. Estimates of the overall percentage of carbon trapped inside permafrost have been calculated, but a holistic view of the impacts of increased carbon concentrations as temperatures continue to rise. The primary goal of this study is to evaluate the potential pathways for the bioremediation of carbon present in the permafrost to preserve the resiliency of the ecosystems present in the Arctic region.

Seismic Protective Systems

TEAM MEMBERS
Nasir Brown, Joshua Mauchly, Paul Riter, William Truex, Joshua Wright

PROJECT MANAGERS
Dr. Islam Mantawy, Hamdy Farhoud

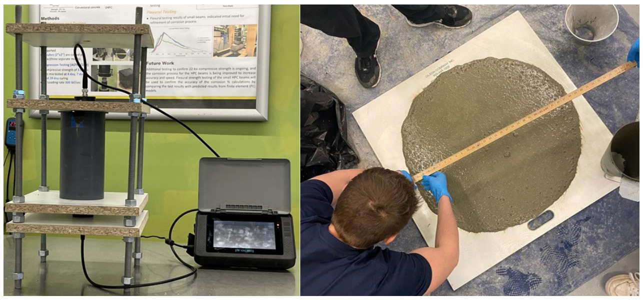


Earthquakes have been a formidable natural disaster throughout human history, with these seismic events being responsible for the destruction of countless structures and the loss of countless lives. As highlighted in Turkey and Syria, even today's modern structures may still be at risk of significant damage or failure if a seismic event occurs. Due to this, in areas with frequent seismic activity, it becomes necessary to incorporate seismic protective systems into the structural components of the building in order to mitigate the damage caused by earthquakes and prevent structural failure. As such, the objective of this project is to get students acquainted with the principles of seismic structural design by performing research on the various types of seismic protective systems. In order to achieve this goal, a literature review was performed and experimental data relevant to the different systems was collected and analyzed. Likewise, a research paper outlining the different seismic protective systems was developed as well. Near the conclusion of the semester, models of each system were developed and tested using a shake table apparatus.

Self-Consolidating Concrete

TEAM MEMBERS
Austin Schuhrer, Kevin Colligan, Ronan Swanson, Anthony Altomonte, Tyler Abate, Dalton Corte

PROJECT MANAGERS
Dr. Gilson Lomboy



Self-consolidating concrete (SCC) refers to concrete that has no resistance to flow and can be placed and compacted under its own weight. SCC must have low yield and high viscosity values. To balance deformability and stability, the amount of fine materials is typically high. In some cases, a viscosity-modifying admixture is used to stabilize the concrete mixture. Polycarboxylate-based high-range water reducers are typically used to plasticize the mixture and lower the yield value. This project aims to develop an SCC and measure the setting times using ultrasonic pulse velocity (UPV). Setting time measurements requires six to eight hours of observation using a standard penetrometer. Using the UPV makes data collection continuous and unmanned. The SCCs are tested for flowability properties, temperature, air content, strength, elastic modulus, and electrical resistivity. The setting times are measured with the UPV and the penetrometer. Measurements will be at 10, 20, and 30 °C.

The Scholar Bridge - Practicum

TEAM MEMBERS
Kaitlin Flanegan, William Bright, Lauren Mulvihill, Aaron Nunn, Stephen Ciarletta, William Karaces, Justin Dworacek

PROJECT MANAGERS
Dr. Adriana Trias-Blanco

The objective of this clinic project is to analyze the influence of the moment of inertia of structural elements on their performance in constructed systems. For this, three teams will build physical models of bridges and vertical structures to satisfy the following objectives: (1) evaluate the influence of column orientation on the performance of a three-story building subjected to variations in mass concentration and lateral excitation; (2) perform bridge member optimization through the analysis of load capacity vs. deflection while modifying the number of structural elements present in the bridge; (3) quantify the influence of girder orientation and local damage on the responses of a truss bridge through the evaluation of deflection. Data will be collected via remote sensing in the form of imaging (video, photos) for postprocessing analysis. The results gathered from this clinic project also have the intention of presenting hands-on learning activities for civil engineering undergraduate courses, as are: (a) Structural Analysis, (b) Steel Design, and (c) Structural Dynamics.

Topology Optimization Based Additive Construction

TEAM MEMBERS

Michael Dustal, Joseph Kayal, David Lopez, Anthony Mackin, Jenna Migliorino, Connor Trautweiler, Austin Werner, Tia Donovan, Alyssa Sunga

PROJECT MANAGERS

Dr. Islam Mantawy

The development of additive manufacturing has been increasing over the past decades by the results of more efficient processes and abilities to design complex parts. In similar procedures of additively manufacturing plastics or metals, the ability to extrude cementitious materials into a formable shape has also been in research over the past years. The primary objective of Topology Optimization is to use structural analysis and finite element analysis to optimize a structure's shape and dimensions while maintaining the strength properties. The strut and tie method is mainly used for determining dimensions of a truss which will be able to maximize its load capacities. The method used for creating these structures in practice is by additively manufacturing different objects through the 3D printing of a mortar cement mix. The practice of 3D printing mortar can first be mastered by printing smaller scaled products. Then, once this is accomplished, bigger structures such as houses and beams can be printed on a larger scale. The applicability of additively manufacture of structures is that it enhances the ability to create complex shapes that normally would take longer to make.

Using numerical models to investigate the impacts of floods on water quality

TEAM MEMBERS

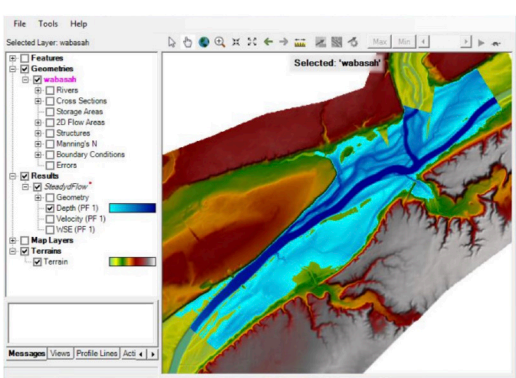
Ethan Busa, Kathleen Stone-Jordan, William Jones, Nicholas DeJesus

PROJECT MANAGERS

Dr. Jeong Eun Ahn

SPONSORS

NJDEP



Flood Inundation Mapping

The Chestnut Branch of Mantua Creek is a stream that traverses a combination of developed agricultural and suburban land in the Glassboro area in New Jersey and its surrounding communities. It flows by the Lipari landfill, into Alcyon Lake, converges with Mantua Creek, and eventually flows into the Delaware River. Due to recent development in the area, an increase in runoff from impervious surfaces has led to moderate to high levels of water quality impairment and erosion to the bank. Such conditions have resulted in the hindrance of plant growth, the death of aquatic life in the stream, and the general degradation of the stream's water quality. This team has been working on HEC-HMS and HEC-RAS models developed by the United States Army Corps of Engineers to better understand the water flow and quality. This team conducted an extensive literature review and learned how to set up and run these models by following tutorials. This team also compared various water quality model systems and determined one water quality model that better works for this study. With this knowledge and learning, this team has been moving forward to create a 1D stream model for the Chestnut Branch of Mantua Creek.

Watershed Protection and Green Infrastructure Education

TEAM MEMBERS
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PROJECT MANAGERS
Dr. Kauser Jahan and Dr. Jeong Eun Ahn

SPONSORS
NJDEP

This project involves Rowan Civil Engineering and Glassboro High School students to use a detention basin as a demonstration project for watershed protection and Green Infrastructure Design. Glassboro high school already has a conveniently located stormwater basin across from our Henry M. Rowan Engineering Building. Students are involved in collecting and analyzing water quality samples weekly for nitrogen, phosphorus and E Coli. They will also identify the best management practice to convert the existing system to a green retention basin. Naturalized plantings can enhance the effectiveness of the stormwater facility to treat water quality as well as water quantity. Students will investigate plantings for effective pollution prevention with help from the high school students and teachers.

WaterWorks: Innovative Exposure to Careers in Water/ Wastewater Utilities

TEAM MEMBERS
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Ziesse

PROJECT MANAGERS
Dr. Kauser Jahan

SPONSORS
US Environmental Protection Agency (USEPA)

A USEPA funded project titled WaterWorks aimed at exposing careers in water and wastewater utilities to K-12 educators and students is currently in progress. WaterWorks, consists of four contemporary core K-12 educational modules titled WaterMobile, WaterTalk, WaterPal and WaterCave to excite the next generation to join our nations water/wastewater workforce. All four components are designed to excite the next generation to pursue careers related to the needs of the water/wastewater industry. There is a dire need for a new diverse workforce as the current workforce is reaching the retirement age. We are partnering with area schools, water and wastewater utilities and non-profit organizations to expose careers via hands on activities, videos, and presentations. Activities are also mapped in sync with the New Jersey Science Standards to assist educators also.

WaterWorks: Structural/ Geotechnical Engineering

TEAM MEMBERS

Daniel Ceravolo, Corrine Parisi, Marlana Centeno, Sean Denny

PROJECT MANAGERS

Dr. Adriana Trias-Blanco, Dr. Cheng Zhu

SPONSORS

US Environmental Protection Agency (USEPA)

Liquefaction simulation of the potential behavior of buildings during an earthquake.

Concrete tank in water treatment plant / Water storage concrete tank.

The overall objective of WaterWorks is to provide capacity to students to explore various career opportunities within the water workforce. Particularly, the Structural/Geotechnical Engineering project focuses on the development of hands-on activities for high-school students to learn how geotechnical and structural engineering play an important role in water infrastructure. The activities developed during this clinic project will be part of the WaterMOBILE section of WaterWorks, which will be implemented in the City of Camden, New Jersey. The activities, concerning geotechnical engineering, developed on this clinic provide knowledge for understanding liquefaction under different scenarios and soil conditions. While the activities that involve structural engineering, are oriented towards understanding the importance of the structural behavior of concrete water tanks and different aspects that affect their structural integrity.

Chemical Engineering

Advanced Composite 3D Printing

TEAM MEMBERS
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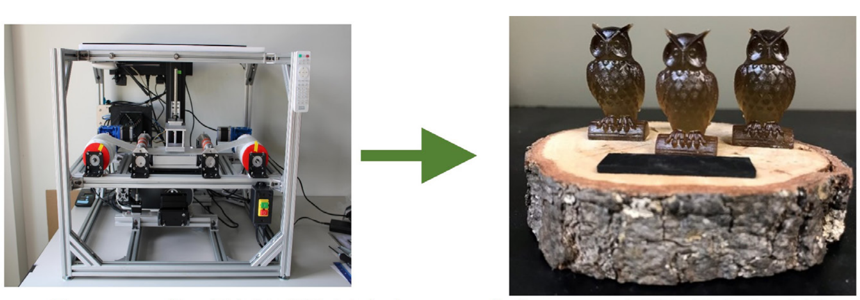
PROJECT MANAGERS
Dr. Joe Stanzione, Karl Dyer, Amit Dhundi

SPONSORS
U.S. Army Research Laboratory

This Clinic project pushed the envelope of advanced composite additive manufacturing for high performance and military applications. Students were asked to tap into their creative engineering, innovation, and teamwork skills to ideate, design, machine, code, and ultimately manufacture custom digital light projection (DLP) 3D printers capable of fabricating fiber reinforced polymers of both simple and complex geometries. Systems engineering and convergent and disruptive manufacturing were central to this project. Students worked closely with folks in the Sustainable Materials Research Lab (SMRL) in the Chemical Engineering Department at Rowan University as well as with Rowan University's Advanced Materials and Manufacturing Institute (AMMI).



Custom Composite DLP 3D Printer   Advanced 3D Printed Parts

Antisolvent Crystallization of Saline Systems

TEAM MEMBERS
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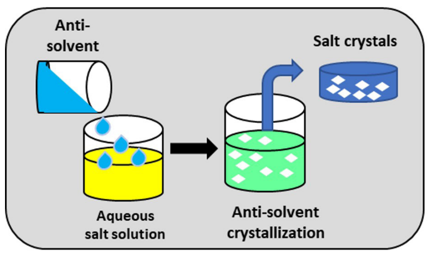
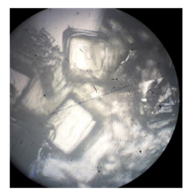
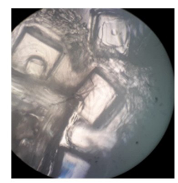
PROJECT MANAGERS
Dr. Gerard Capellades, Dr. Kirti Yenkie, Dr. Parul Sahu

Current methods for the recovery of inorganic salts from seawater and industrial brines, as well as for wastewater processing, are energy-intensive and often lead to the generation of highly concentrated waste streams that are difficult to process and have a negative environmental impact.

In this clinic, we worked together with scientists at the Central Salt and Marine Chemicals Research Institute (CSMCRI) in India, to develop novel methods for the crystallization of inorganic salts from aqueous solutions, using green organic solvents. We used a combination of thermodynamic and kinetic models to optimize the recovery process, allowing for a selective, timed recovery of value-added products from brines.







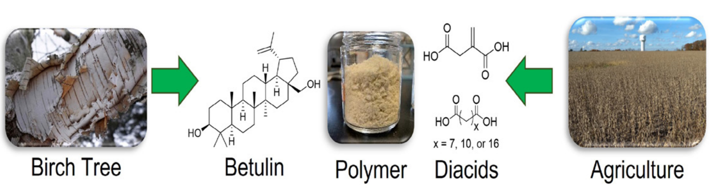
Awesome Stuff from Betulin

TEAM MEMBERS
Casey Cox, Colby Higgins

PROJECT MANAGERS
Dr. Emre Kinaci, Dr. James Newell, Dr. Joe Stanzione, John Chea, Alexandra Lehman-Chong

SPONSOR
National Science Foundation

The potential harmful health and environmental effects of monomers used during a polymer's manufacturing stage are important yet often disregarded considerations when evaluating sustainability of synthetic materials. Betulin is an inherently nontoxic chemical that can be extracted from birck bark. Itaconic acid (IA) is a nontoxic chemical commercially produced from agricultural waste. Here, betulin was used to synthesize fully biosourced polyesters with tailored amounts of unsaturation. The melt flow behavior of thermoplastics without IA was analyzed at multiple temperatures to identify ideal conditions for filament extrusion. Tensile testing was used to determine the mechanical properties of these thermoplastics. Polyester thermoplastics both with and without IA were incorporated in polyester-methacrylate (PM) resins. The unsaturated thermoplastics were able to participate in photopolymerization, transforming them into thermosets. Cured PM resins with unsaturated polyester content exhibited crosslinking behavior, resulting in polymers with better chemical resistance and thermal stability. Overall, the saturated betulin-based polyester thermoplastics have potential applications as filament for 3D printing, and the PM resins have potential UV-curable applications. This Project demonstrated that bioderived, benign chemicals can be used to synthesize polymers for safer manufacturing processes.



Awesome Stuff from Birch Bark

TEAM MEMBERS
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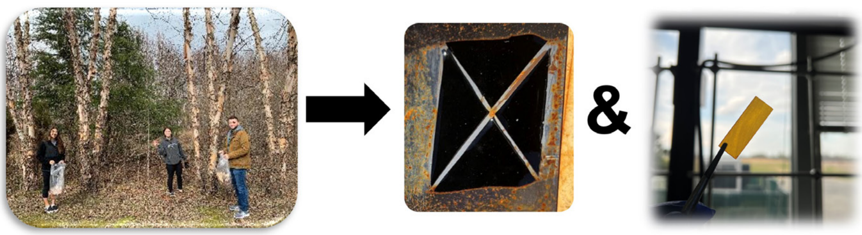
PROJECT MANAGERS
Dr. Emre Kinaci, Dr. James Newell, Dr. Joe Stanzione, John Chea, Alexandra Lehman-Chong

SPONSORS
National Science Foundation

This Project examined the production of thermoset polymers from material extracted from birch trees growing on campus. The students collected the bark, extracted both ethanol and chloroform soluble fractions using a Soxhlet extraction technique, and were able to develop polymeric materials, including coatings, from the product of these extractions. The polymers were characterized in terms of both their thermal, mechnical, rheological properties. Ultimately, the goal of the project was to develop polymers from completely renewable materials that possess physical and rheological properties that would enable them to replace petroleum-based polymers in commercial applications.



Fossil Park Birch Trees Promising Coating Promising Polymer

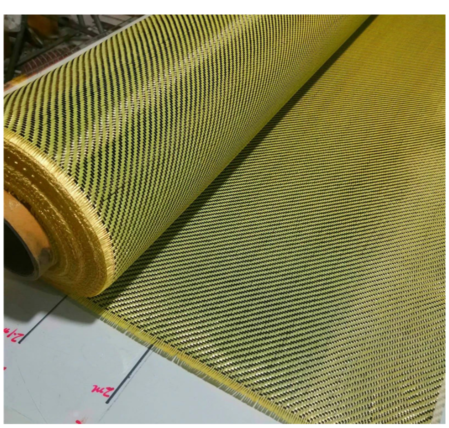
Cool Polymers

TEAM MEMBERS
William Beck, Christopher Altamuro, Vic Collinsworth

PROJECT MANAGERS
Dr. James Newell, Dr. Joseph Stanzione, Michael Chauby, Matthew Schwenger

SPONSORS
US Department of Defense

This project examined the conversion of high-performance polymer fibers to form carbon-carbon composites for aerospace and military applications. The team compared the raw polymer to its carbonized form in terms of mechanical properties through tensile testing, microstructures through scanning electron microscopy and X-ray diffraction, and thermal behavior via thermogravimetric analysis. The result proved that these polymers may offer unique properties that may aid in the next generation of advanced composites.



Elemeat

TEAM MEMBERS

Skye Chang, Alexa Gassler, Danielle Green, Shreya Kelshikar, Jillian Williams, Nicholas Zanon

PROJECT MANAGERS

Dr. Gary Thompson

SPONSORS

VentureWell

The Elemeat Clinic applies multidisciplinary collaboration, practical innovation, and the entrepreneurial spirit to the precision fermentation sector of biotechnology. After raising $10k of non-dilutive funding in 2021/2022, Elemeat designed and constructed a prototype for a low-cost, user-friendly 3-L benchtop bioreactor. To develop a better understanding of biomanufacturing and how this bioreactor fits into a large-scale operation, a process was developed to produce the Hepatitis B Surface Antigen (HBsAg) using genetically modified P. Pastoris yeast.

Machine Learning for Sustainable Chemicals and Processes

TEAM MEMBERS

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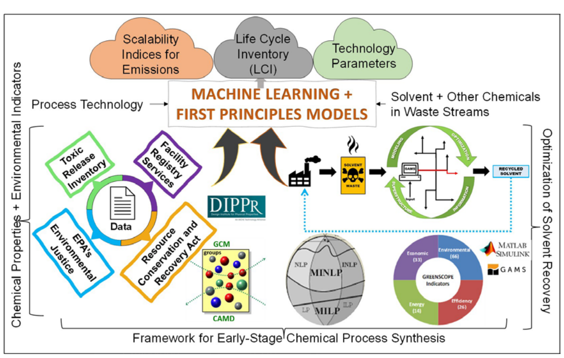
PROJECT MANAGERS

Dr. Kirti Yenkie, Dr. Robert Hesketh, Dr. Stewart Slater, Emmanuel Aboagye, Austin Lehr

SPONSORS

AstraZeneca and US Environmental Protection Agency



This project intends to advance the state of knowledge in sustainable chemical design through the development of novel Machine Learning techniques applied to process modeling and simulation. Currently, access to physical and chemical properties, separation mechanisms, environmental impacts, sustainability metrics, and life cycle of novel chemicals, such as bio-based solvents, alternative chemicals, and APIs, can be very difficult since there is very little to no information available in the literature. However, these chemical properties as well as the environmental sustainability metrics are required to accurately determine if the novel alternative chemicals can provide an eco-friendly and safer substitute for more commonly used chemicals. To this end, this project integrates machine learning approaches with traditional process synthesis and modeling methods so we can easily find the missing information such as chemical properties, structure, and composition as well as predict the common environmental and sustainability metrics.

PowerGum

TEAM MEMBERS

Kyle Verbitski, Claire Schleper, Zachary Lloyd, Stephen Goffredo, Nathan Garrison, Jack Bell

PROJECT MANAGERS

Dr. Gary Thompson

PowerGum is a student-lead project that focuses on developing the most revolutionary pre-workout supplement on the fitness supplement market. Generally, preworkout is sold in the form of powder mixed with water or is pre-bottled. However, this is not the most convenient delivery method for all consumers. PowerGum's product features a fully-dosed preworkout supplement in the form of gummy candy! The main efforts of the PowerGum team throughout semesters in engineering clinics have revolved around formulation, testing of ingredient properties, solving crystallization problems for the borderline insoluble creatine, and flavoring/ texture. The next steps for the PowerGum team are to transition from just being a lab experiment to a real food product that takes over the fitness scene.

Processing of Carbon-Carbon Composites Via Induction Heating

TEAM MEMBERS

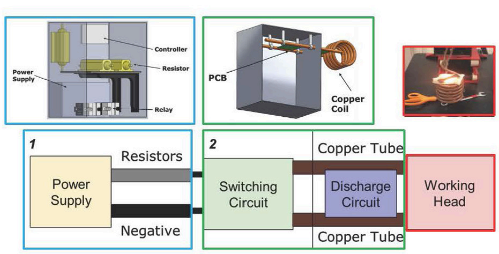
Jack Campanella, Aysha Sohail, Samuel Sotelo-Flores

PROJECT MANAGERS

Dr. Giuseppe Palmese, Amy Honnig, Michael Chauby

SPONSORS

Army Research Lab (ARL)



Carbon/carbon (C/C)-composites are lightweight and can maintain high tensile strength at extreme temperatures. These properties have given C/C-composites application in the automotive , civil infrastructure, aerospace and other industries. The fabrication of C/C-composites has been marginally improved over the past several decades, and this has not been sufficient to enhance the commercial viability of these materials. This clinic focused on the design and implementation of an induction heater to fabricate C/C-composites. In induction heating, high frequency electric currents are used to generate magnetic fields. Coupling of a conductive sample to the electromagnetic inductor field generates heat within the sample capable of carbonization in a few seconds in contrast to hours needed when heat is applied in a tube furnace. The shortened carbonization time could provide significant cost savings in C/C-composite fabrication, but there are numerous scientific and engineering questions that need to be addressed before this technique can be implemented commercially. In this project, a high frequency induction system was designed and constructed with the aim of optimizing the inductive coupling to low conductivity carbon materials that would result in higher heating rates. Further work is being carried out to establish maximum heating temperatures as a function of position around the coil, power, and carbon type.

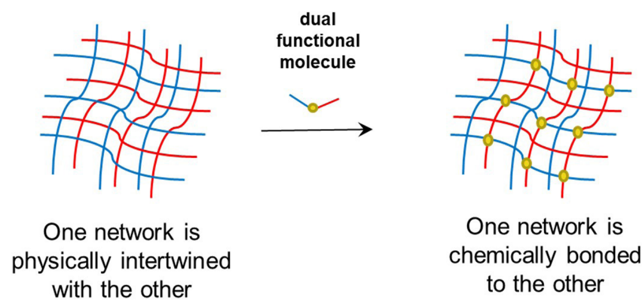
Pure Epoxy-Methacrylate Resin

TEAM MEMBERS
Emily Rooney, Vance Moran

PROJECT MANAGERS
Dr. Jianwei Tu, Dr. Joe Stanzione

SPONSORS
U.S. Army Research Lab (ARL)

A dual functional epoxy-methacrylate resin can be used in 3D printing for linking two polymer networks to yield stronger products. Current synthetic methods results in resin mixtures of epoxy and methacrylate molecules. The separation and purification of the resins to yield a true dual-functional molecule is both of fundamental and practical interest. Students were involved in the separation, purification, characterization of the product obtained, and were exposed to common chemical laboratory techniques including thin layer chromatography, column chromatography, rotary evaporator, rheometry, and titration.



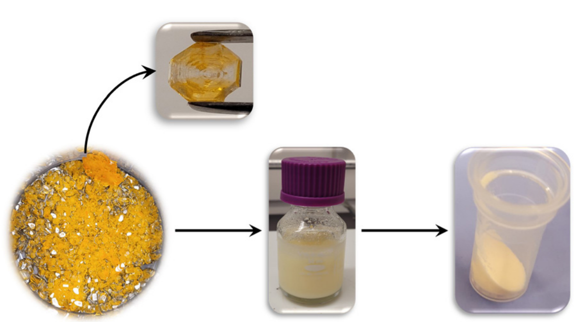
Purification of Pharmaceuticals by Crystallization

TEAM MEMBERS
Alejandra Santos, James Nicholson, Isabella Fasciani, Joseph Kratz, Preston McNamara, Michael Toresco, Anthony Garavento

PROJECT MANAGERS
Dr. Gerard Capellades, Mitchell Paolello

SPONSORS
Boehringer-Ingelheim

Crystallization as a purification process is widely used in the bulk chemical, pharmaceutical, and fine chemical industries. However, the mechanisms for how process impurities are retained in pharmaceutical products are poorly understood and hard to quantify. This has led to multiple FDA recalls in recent years and is a matter of public health. In this clinic, we worked in collaboration with crystallization groups at Boehringer-Ingelheim and Merck, to investigate the main factors affecting the retention of process impurities in pharmaceutical crystals. We used colored impurities as model systems to visualize their location in the powder, and developed diagnostics to drive the design of novel purification strategies.



Resilience of Wastewater Treatment Networks

TEAM MEMBERS
Anne-Marie C.A. Zamor, Tyler Heritage, Christopher Cavalieri

PROJECT MANAGERS
Dr. Kirti M. Yenkie, Emmanuel Aboagye

SPONSORS
Atlantic County Utilities Authority

Wastewater treatment (WWT) for reuse and safe disposal has become crucial for sustainable existence. WWT methods must vary based on the properties of the inlet waste stream, such as the number of contaminants, their amounts, toxicity, shape, size, etc. To this end, we will develop a methodology to generate a maximal structure comprising of all possible treatment methods and flow patterns using a systems approach, followed by the elimination of inapplicable methods based on certain constraints, that will make the designing of WWT networks more efficient. In addition to this, WWT utilities, equipment, and assets such as pipelines, manholes, etc., will be analyzed for risks and failure probability.

The holistic approach will enable cost-effective, energy-efficient, and sustainable WWT as well as facility management to build resilience. This project is in collaboration with Széchenyi István University, the University of Miskolc, Hungary, and is supported by the Atlantic County Utilities Authority (ACUA), NJ.

Roadmap for Efficient Processes in Petroleum Pipelines

TEAM MEMBERS
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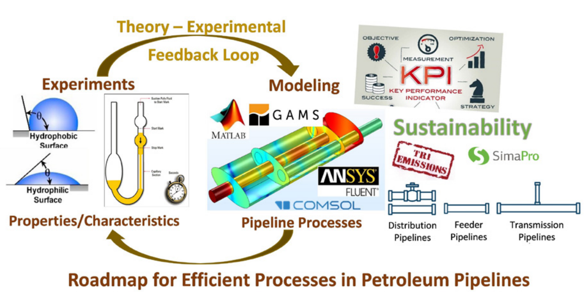
PROJECT MANAGERS
Dr. Kirti Yenkie, Dr. Robert Hesketh, Dr. Stewart Slater, Dr. Mariano Savelski, Swapana Jerpoth, Barnabas Gao

SPONSORS
ExxonMobil-NJ and US Environmental Protection Agency



ExxonMobil Lubricants Oil Blending Plant (LOBP) in Paulsboro NJ is Company's 2nd largest facility in the world performing oil blending and filling operations at multiple scales. Because of the growing number of unique blend compositions/ formulations and properties, the plant uses an existing manifold system to perform multiple blending and filling operations. Since products are greater than connections, lines must be reused for multiple formulations. This requires certain lines to purge leftover products from previous operations before next task. This is cost-intensive and utilizes significant amount of pure product to perform purging operations. Thus, goal of this project is to reduce the amount of flush oil produced during the flushing of blending and filling lines. This will be accomplished by understanding issues in line flushing at Paulsboro LOBP, and identifying alternatives through the integration of chemistry, process design, and optimization.

Solvent Effects on Pharmaceutical Crystallization Kinetics

TEAM MEMBERS
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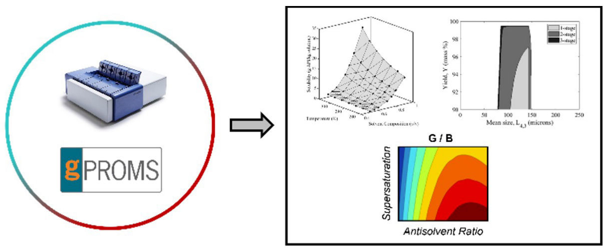
PROJECT MANAGERS
Dr. Gerard Capellades, Ibrahim Joel

SPONSORS
Pfizer



Solubility & Kinetic Screening   Design Space Predictors

Solution crystallization processes are a key step in the purification of pharmaceuticals and for the isolation of powders with the right medical function. Crystallization development follows a lengthy process that often becomes a bottleneck in the design of reliable processes for new pharmaceuticals. Part of the complexity stems from a poor understanding on how solvents affect kinetics, which leads to sub-optimal designs and issues with process robustness and environmental impact.

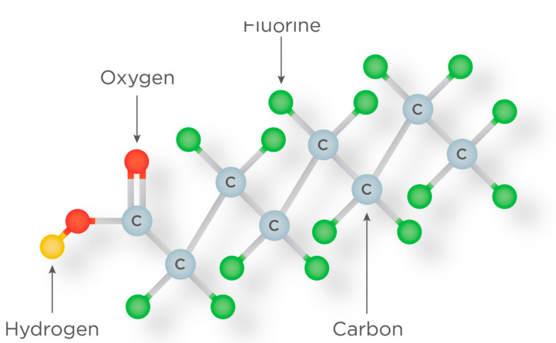
In this clinic, we collaborated with crystallization groups at Pfizer to develop tools for the rapid screening of solvent-dependent crystallization kinetics. These tools can be used to find design space predictors early in process development, aiding in the optimal selection of solvents for the final process.

Sustainable Fluoropolymers

TEAM MEMBERS
Casey Barrett, Juli Klingler, Dylan Snyder

PROJECT MANAGERS
Dr. James Newell, Dr. Joseph Stanzione, James Downing

SPONSORS
US Department of Defense



Because of their exceptional bonding, fluoropolymers make exceptional non-stick coatings on cookware, anti-friction coatings on leading edges of aerospace and military items, and stain-resistant coating on fabrics and furniture. Unfortunately, unwanted and potentially toxic byproducts (known as PFAS) are created during the production of fluoropolymers. PFAS persists in the environment for very long times, accumulate in the body, and may cause health issues. This team compared the properties of traditional flurorpolymers with those exposed to a new, patented process designed to eliminate the undesirable PFAs. Their rheology, thermal, X-ray, and infrared spectroscopy studies showed that the enhanced materials showed far less PFAS than the original forms.

Upcycling of Distilling Byproducts

TEAM MEMBERS
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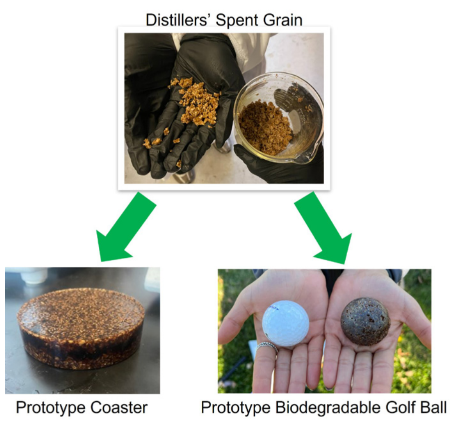
PROJECT MANAGERS
Dr. Emre Kinaci, Dr. James Newell, Dr. Joe Stanzione

SPONSORS
Independent Spirits Distillery



Craft distilling and brewing have exploded in the US over the past couple of decades and southern New Jersey is no small player in this industry; e.g., Bonesaw, Heritage Winery, and Independent Spirits Distillery (ISD), to name a few. The Advanced Materials & Manufacturing Institute (AMMI) at Rowan and ISD have recently established a collaboration to work together on improving the overall sustainability of local, craft spirits. ISD is grain-to-glass craft distillery located in Woolwich Township, NJ – a stone's throw away from Rowan. This Clinic was driven by shear curiosity! Students were asked to tap into their creativity and chemical engineering design skills to develop novel and practical solutions to add value to distilling byproducts (e.g., spent grains and leftover liquids). Yes, time was spent at the distillery as well as in the AMMI labs. Products were synthesized and characterized with knowledge gained about their processing-structure-property relationships.

USDA Food Decontamination

TEAM MEMBERS
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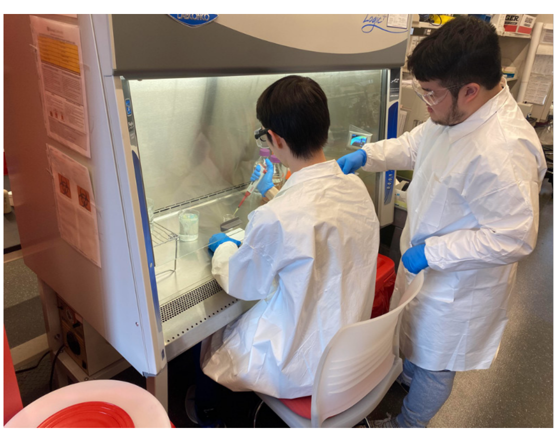
PROJECT MANAGERS
Dr. Gary Thompson, Zachary Rosenzweig

SPONSORS
USDA National Institute of Food & Agriculture



Due to ongoing microbial contamination, particularly with E. coli, the food industry needs ways to keep leafy greens safe, emphasizing the importance of pasteurization methods. The purpose of this clinic is to investigate the threshold of electroporation using intermittent pulsed electric field (PEF) exposures on spinach leaves with E. coli, to determine its viability for potential leaf decontamination. PEF exposures create small pores in the cell membranes, allowing for increased permeation and eventual cell rupture. Various combinations of pulsing parameters are applied to the spinach and E. coli samples, via electroporation. These parameters consist of pulse duration, number of pulses, pulse field strength, and pulse frequency. Assays are performed on the samples to analyze the effect of the PEF exposures. These assays include color, dry weight, impedance spectroscopy, live/dead, and colony formation units. The results of this clinic confirm the viability of using pulse electric field exposures in the food decontamination industry.

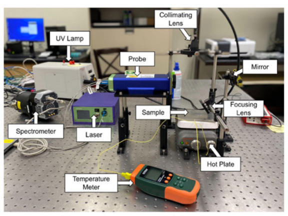
Using Raman Spectroscopy in 3D Printing

TEAM MEMBERS
Kayla Bensley, Adam Markashevsky, Alyssa Sepcic

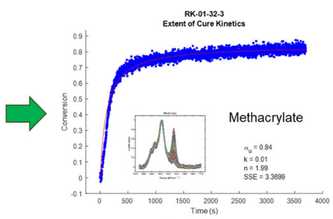
PROJECT MANAGERS
Dr. Robert Chimenti, Dr. Joe Stanzione

SPONSORS
U.S. Army Research Laboratory

Students learned how to use both traditional Raman spectroscopy in the “fingerprint region” (~500cm-1 to ~2000cm 1) and ultra-low frequency region (5cm-1 to 200cm-1) to measure in situ curing kinetics of 3D printing resins. Students learned how to use a direct write 3D printer, sectioned the printed sample, and used a confocal Raman microscope to map the layer-by-layer cure profile of both green and post-cured prints with various exposure times. Time permitting, students investigated how Raman spectroscopy can be used to measure a wide range of thermal-structural properties of polymers. This project not only gave students hands-on experience with direct write 3D printers and Raman spectrometers, but they gained hands on experience with many other characterization tools such as differential scanning calorimetry (DSC) and dynamic mechanical analysis (DMA). Finally, students learned how to analyze large multivariate data sets using custom MATLAB code.



In situ Curing Raman Spectroscopy



Liquid Resin Curing Kinetic Behavior

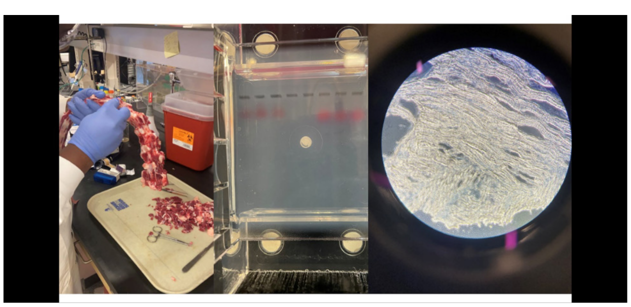
Xenograft Tissue Engineering

TEAM MEMBERS
Connor Mowen, Gianna Riviello

PROJECT MANAGERS
Dr. Gary Thompson

The use of decellularized tissue scaffolds is an emerging field due to its potential to regenerate damaged cartilage without a severe immune response and with use of the host’s own cells. Several different methods of decellularization are currently being explored, such as physical, chemical, and electrical treatments. These treatments aim to remove immunogenic cellular materials while preserving the extracellular matrix and its components. This preservation allows for the decellularized tissue to be injected into the host for cartilage replacement.

The clinic team is investigating using the physical and chemical methods that permeabilize cell membranes and destroy cells and their components. These methods are being compared with electroosmosis treatments, which allows charged materials in cells to move electrophoretically and uncharged materials to be removed via osmosis. The team is currently focusing on evaluating how effectively these treatments remove cellular materials while preserving the extracellular matrix components. This is done using various dye binding assays stains that both quantify DNA, GAG, collagen, and nuclear content and visibly display the scaffold’s microstructure.



Electrical & Computer Engineering

3D-Printed Mixed Reality Turret & Drone Development

TEAM MEMBERS
Matthew Bost, Thomas Brown, Jeffrey Chew, William Covert, Nicholas Curcio, Richard Kurczeski, Michael Mulvihill, Nevin Okonski, Brett Schweiger, William Sitarik, Nicholas Rochino

PROJECT MANAGERS
Dr. George Lecakes

SPONSORS
Department of Defense (DOD)

In collaboration with Picatinny Arsenal, students have created a full-scale, 3D-printed M2 turret for use in a VR simulation. The turret is equipped with sensors to simulate recoil, record ammo counts, and track its orientation in the digital world. Additionally, a custom physical drone will be created for live dataset collection. This project has the potential to revolutionize the way that we train for combat. The VR simulation will allow users to experience combat in a safe and controlled environment. It will also allow users to collect data on their performance, which can be used to improve their skills.

AI-Assisted Bidding Tool for Offshore Wind Farms

TEAM MEMBERS

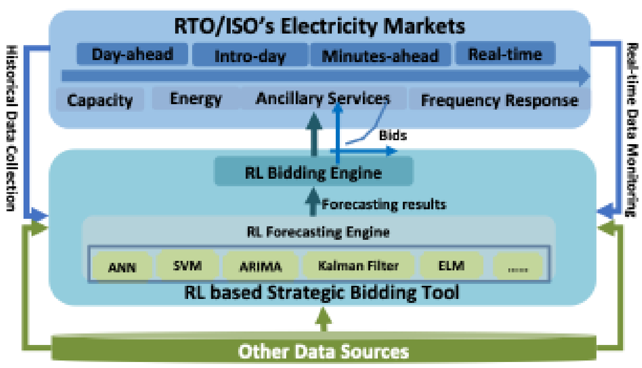
Jack Bonham, Reese Engelke, Louis Russo, Katlynn Hewitt, James Fera

PROJECT MANAGERS

Jie Li

SPONSORS

NJEDA



In order to assist the New Jersey Governor Murphy's goal of 7.5 GW offshore wind by 2035 and 100% clean energy by 2050, and strengthen the economical and reliable use of wind energy sources, this project explores the utility-scale wind farms' strategic

participation in the wholesale electricity market. First, the project will baseline the current practices of wind farms' participation behaviors and revenue generation models in different electricity markets. Then a highly autonomous, AI-assisted strategic bidding tool will be designed and developed for advising the wind farms' proactive decision making in exploring revenue generation opportunities while complying with the system integration requirements. This AI-assisted tool is built upon an advanced Reinforcement Learning engine and a set of Machine Learning (ML) forecasting models, which are used to predict wind power outputs and electricity market prices.

Augmented Reality Helicopter Head-Up Display for Federal Aviation Administration

TEAM MEMBERS

Troy Cognigni

PROJECT MANAGERS

Dr. George Lecakes, Amanda Almon

SPONSOR

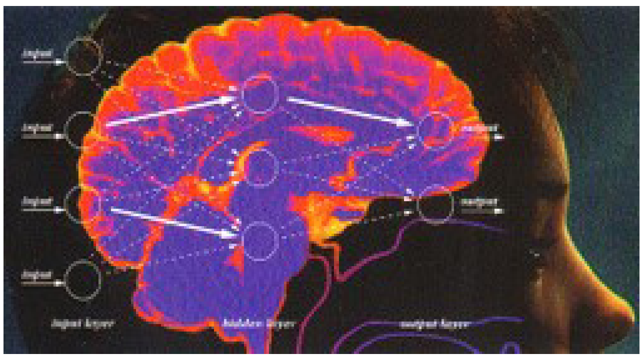
Federal Aviation Association (FAA)

This project is developing VR and AR simulations to assist helicopter pilots in their training and operations. The project is being conducted in collaboration with the Federal Aviation Administration (FAA) and uses the Varjo mixed reality headset. The goal of the project is to increase pilot safety, situational awareness, and efficiency. The VR simulations will provide pilots with a realistic and immersive training environment. They will be able to practice flying in a variety of conditions, with the AR simulations overlaying critical information, such as altitude and airspeed, onto the pilot's view of the real world. This will help pilots to stay aware of their surroundings and make better decisions in critical situations. The VR and AR simulations could help to reduce accidents and improve the efficiency of helicopter operations.

Differential Diagnosis of Alzheimer's Disease Using the Clock Drawing Test

TEAM MEMBERS
Matthew Owen, Vincent Del Tufo, Parker Hopkins, Zachary Bravo, Dr. David Libon

PROJECT MANAGERS
Dr. Robi Polikar



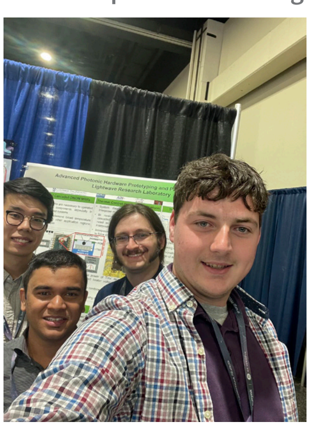
Several neurological disorders, such as Alzheimer's disease (AD) are common among the elderly, with no definitive mechanism for differential diagnosis and no cure. The most common approach for diagnosis uses a series of neuropsychological tests evaluated by neurologists. Misdiagnosis is not uncommon, and the decision is often subjective. Machine learning may help with an automated and objective diagnosis of various diseases. In this project, we analyze vast amounts of data collected through Framingham Heart Study - the longest running public health study - which now includes such neuropsychological tests. Of these, the unique clock-drawing test has been shown to generate relevant predictors of cognitive decline. This test alone generates hundreds of such features, however, and it is not clear which ones are most informative or relevant. Our primary goal is to determine features that are most relevant to diagnosis, and develop appropriate machine learning algorithms to obtain a diagnostic accuracy that is as good or better than current state of the art. This project is in collaboration with Rowan Univ. School of Osteopathic Medicine - New Jersey Institute for Successful Aging.

Entrepreneurship in Wireless Power Transfer

TEAM MEMBERS
Shahadat Talukder, Daniel Bindas

PROJECT MANAGERS
Hua Zhang

SPONSORS
NSF I-Corps Northeast Region



Wireless Power Transfer (WPT) involves creating and implementing innovative solutions to transmit electrical power wirelessly without any metal connection. This technology has the potential to revolutionize the way we use and charge electronic devices, as well as electric vehicles.

Entrepreneurship in WPT is important to have a strong understanding of the technology and its applications, as well as a solid business plan, funding, and a talented team to execute your vision, which is different from a research project. To better understanding the customer and market demand, we plan to have at least 15 interviews with relative companies. This project is funded by NSF I-Corps Northeast Region, we have been trained how to choose interviewers and practice the communication skills with them.

iFrost: A Portable Permafrost Detector

TEAM MEMBERS
Jim Kang, Jake Rahm, Ryan Johnson, Ferdinando Gismondi, Oscar Mahecha-Benitez, Jochy Perez

PROJECT MANAGERS
Dr. Schmalzel

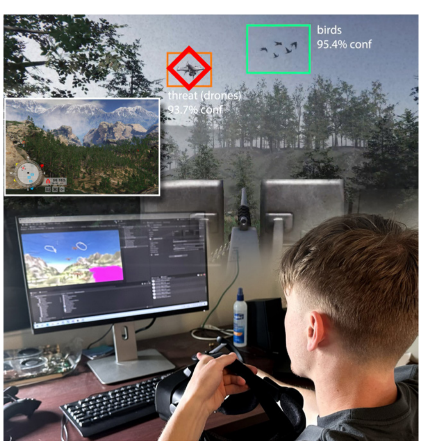
The U.S. Army Corps of Engineers Cold Research Regions and Engineering Laboratory (CRREL) has been developing iFrost: a portable device that uses electromagnetic induction to characterize permafrost layers beneath the soil. The iFrost project stems from various engineering challenges that must be resolved in order to construct, modify, and maintain infrastructure in cold regions. The goal of this project is to contribute an improved and approved predetermined element model to predict frost depth in soils and mechanical responses of soil and unbound pavement layers. The iFrost system consists of a transmitter and receiver coil to send and receive electromagnetic signals to and from the soil. When the transmitter sends a primary field to the soil, any conductive body within range of the primary field will generate eddy currents in response to the signal. This creates a secondary field that the receiver must read and filter out of the primary field. The measured secondary field directly corresponds to the conductivity of the object below the soil. The primary field steps through various frequencies, where the secondary field readings are stored and later plotted in an excel spreadsheet to compare to known conductivities.

Mixed-Reality Simulations of Future Battlefields

TEAM MEMBERS
Cheyenne Ajebe, Jeremy Beal, Jason Boucher

PROJECT MANAGERS
Dr. George Lecakes, Amanda Almon

SPONSOR
Department of Defense (DOD)



In collaboration with Picatinny Arsenal, students designed and implemented a system to assess situational awareness in mixed reality simulations using large-scale walk-in VR systems and head-mounted devices. This system will be used to support VR/AR/MR/XR modeling and simulation environment development activities, providing an opportunity for students to gain experience in working on cutting-edge technology and making a real impact on the future of warfare.

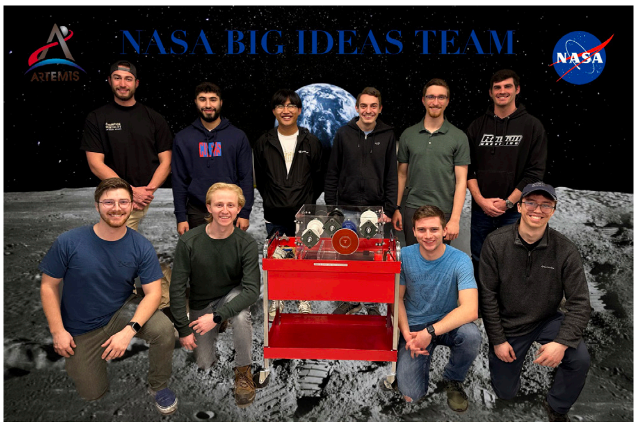
NASA BIG Idea Challenge

TEAM MEMBERS

Robert Weaver, Tyler Baer, Husain Ali, Rick Blair, Mason Buckalew, William Estlow, Doug Hartmann, Robert Kerwin, Khoa Tran, Vince Volpe

PROJECT MANAGERS

Dr. John Schmalzel



To support long-term habitation on the lunar surface, mankind needs to develop ways to extract and use readily available in-situ resources. NASA proposes utilizing these resources to create habitats, storage vessels, and other important support elements for permanent infrastructure. The Rowan Big Idea challenge team proposes The Magnetic Origination of Ore Nanoparticles (MOON) system which aims to extract the ferrous ore, ilmenite, from lunar regolith for use in the metal production pipeline. The MOON system utilizes conveyor belts and electromagnets to extract ilmenite using it's paramagnetic properties. The flexible and scalable design supports processing various volumes of lunar regolith to achieve production goals. The process involves a regolith intake which supplies the machine before magnetic and non-magnetic particles diverge in two paths. The end product will be ferrous materials requiring further processing. The MOON system is a compact magnetic separator designed to solve the problem of collecting ferrous ores with a simple, effective method. Its modular and robust design requires minimal maintenance and can run autonomously. The team designed and tested a small-scale prototype to verify proof of concept and guide future design iterations. The MOON system represents a critical step in developing self-sufficient lunar infrastructure to support long-term habitation.

NASA RASC-AL: Homesteading Mars

TEAM MEMBERS

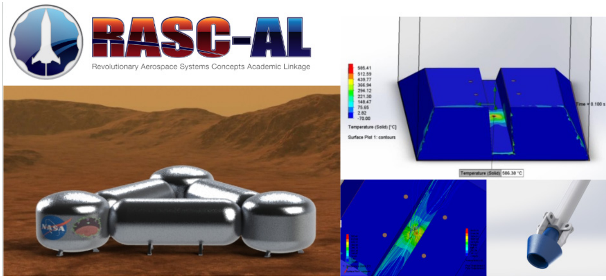
Luke Iles, Andrew Razze, Garrett Young, Anastasis Marasco, Brandon Tibbitt, Louis Russo

PROJECT MANAGERS

Dr. John Schmalzel

SPONSOR

NASA



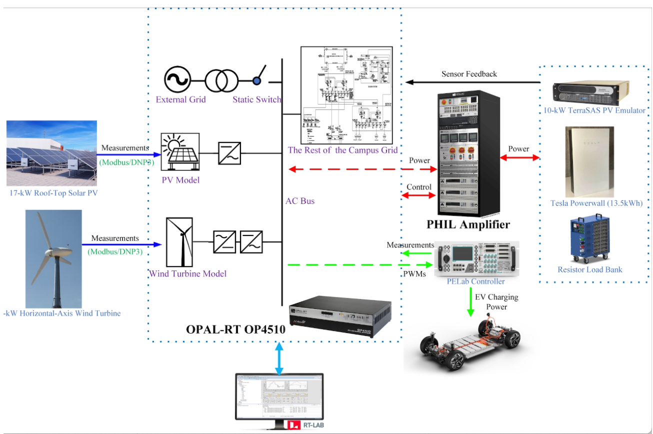
Every year NASA hosts the national RASC-AL competition, this year NASA gave four potential themes for groups to pick from. This year's clinic chose Homesteading Mars, where they developed a comprehensive plan to get four astronauts to mars, maintain them, and replace them after eight years with a new crew. Before a human crew is sent to Mars the materials necessary for survival and return will need to be already prepared. For this reason, preliminary launches including a methane fuel generator, surface nuclear fission reactor, and habitat modules will be sent to Arcadia Planitia two years prior to the crew's trip. Once on the Martian surface, the crew will be inhabiting a network of smaller connected habitat modules. While on Mars, the crew will need food, water and breathable air to survive. The food will be grown using a combination of aeroponics as well as aquaponics. To make a more secure source of water a hole will be drilled about one foot in diameter and water will be harvested from the ice glaciers below the surface, and oxygen will be generated using NASA's MOXIE system and the basic oxygen produced from the greenhouse plants.

Smart Building Nanogrid Planning

TEAM MEMBERS
Arber Llugani, Ryan Delozier, Nathaniel Racsok, Jimiao Zhang

PROJECT MANAGERS
Dr. Jie Li

SPONSORS
NSF



As important smart grid building blocks, optimal planning and operation of individual buildings' energy assets, including roof-top PV, energy storage, EV chargers, small wind, as well as building energy management, are key to realize the goal of campus-wide

decarbonization while improving its energy self-sufficiency and resiliency. This project will explore a PV-EV-Storage-Wind-Load nanogrid planning solution, using a professional grid planning software (HOMER Grid) to conduct techno-economic analysis. Rowan

Engineering Hall will be used as a testbed with its 17kW PV system, and a planned 5kW wind turbine, and a 13.5kWh power wall.

The Future of 3D Asset Creation: GANs

TEAM MEMBERS
Gryphon Arey, Reese Engelke

PROJECT MANAGERS
Dr. George Lecakes

SPONSORS
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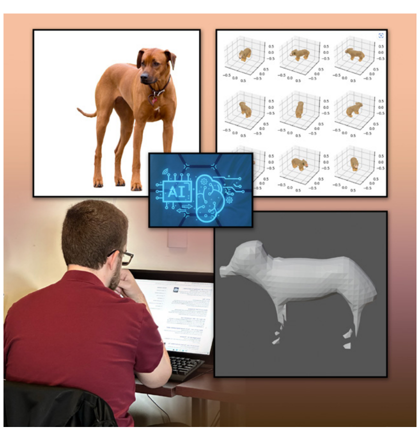
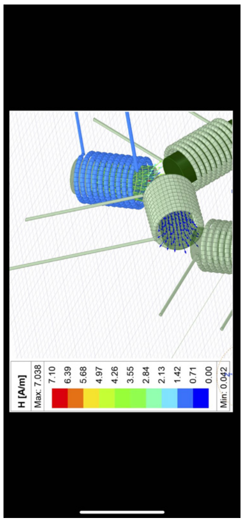


In collaboration with Picatinny Arsenal, we seek to use machine learning algorithms such as Generative Adversarial Networks to create 3D digital assets for use in virtual reality simulations of future battlefields. It has the potential to make a significant impact on the way that 3D digital assets are created. GANs could be used to create 3D assets more quickly and easily than traditional methods, saving time and money. The project is also being used to explore the potential of GANs for creating realistic and complex 3D environments. This could have applications in a variety of fields, such as virtual reality, augmented reality, and training simulations.

Underwater Wireless Power Transfer

TEAM MEMBERS
Matt Reed, Jacob King, Shahadat Talukder

PROJECT MANAGERS
Dr. Hua Zhang



Underwater wireless power transfer (UWPT) is an emerging technology that significantly impacts underwater applications. One of the most prominent applications of UWPT is charging autonomous underwater vehicles (AUVs) without using high voltage connectors. In traditional AUV charging systems, physical connectors were used, which were not only challenging to install in deep water but also posed potential safety risks. UWPT systems eliminate the need for physical connectors by using electromagnetic fields to transfer electrical power through the water to the AUVs. The transmitter generates an electromagnetic field that is picked up by the power receiver on the AUV. This technology allows for safe, efficient, and reliable charging of AUVs.

In this clinic project, we simulate an AUV charging design using Ansys Maxwell 3D design software. Our simulation utilizes a six coil receiver with a three coil transmitter charging scheme. The aim is to develop a more efficient charging system for underwater electric vehicles and devices.

Using Virtual Reality to Empower Parents of Autistic Children

TEAM MEMBERS
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PROJECT MANAGERS
Dr. George Lecakes, Amanda Almon

SPONSORS
New Jersey Health Foundation, Inc.

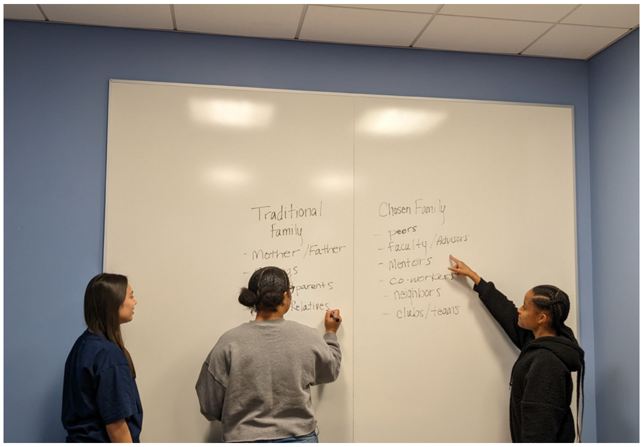
Parents of children with autism spectrum disorder (ASD) often find it challenging to understand and respond to their child’s behavior. A virtual reality (VR) simulated training program can help parents develop the skills and knowledge they need to provide compassionate and effective care for their child. This project uses the Meta Quest 2 to provide parents with a safe and realistic environment in which to practice new skills.Parents will be able to identify and understand their child’s behavior, use positive reinforcement to encourage desired behavior, respond to challenging behavior in a calm and effective way. This program is designed to be compassionate and supportive, empowering parents to provide the best possible care for their child.

Experiential Engineering Education

Chosen Family

TEAM MEMBERS
Isabel Rivera, Emmy Sagapolutele, Bria Terrell

PROJECT MANAGERS
Dr. Justin Major, Dr. Cheryl Bodnar, Ms. Cayla Ritz



Throughout our clinic project, we investigated "chosen family," a collective network of people outside of students' traditional families that can provide support through knowledge, resources, and guidance. In the engineering education environment, chosen family members consist of professors, mentors, peers, and coworkers, among others. As part of this project we researched chosen family and marginalized groups within the peer reviewed literature and developed an initial survey. The survey has now been administered within the College of Engineering to determine who engineering students perceive as part of their chosen families. Through the lens of diversity, equity, and inclusion, our goal was to understand minoritized students' plight in navigating engineering education. Ultimately, we hope to identify the relationship between success in engineering students and chosen family and share our results with the broader engineering education community.

Co-Curricular Activity Guide

TEAM MEMBERS
Jenny Hoang, Jared Markunas, Alexandria Ordoveza, Tyler Shorr, Gillian Volpe, and Hannah Corbin (Clinic Consultant)

PROJECT MANAGERS
Dr. Cassandra Jamison, Dr. Cheryl Bodnar, Mr. Jeffrey Stransky

Co-curricular participation has a significant role in students' development of professional skills. This study seeks to understand the relationship between co-curricular involvement and the development of these professional skills among engineering students; particularly commuter students, upperclassmen, and underclassmen. A survey was distributed amongst engineering students to collect data regarding their co-curricular involvement and how these activities have aided in their development as engineers. Data was analyzed to identify trends that could be useful in a co-curricular guide website. The overall goal of this guide is to provide students with a resource that educates them on the skills that employers are looking for the most and helps them to find co-curricular activities to help sharpen these skills. Stakeholder interviews were conducted to get feedback on the initial prototype of the co-curricular guide. Feedback on website features such as usability and functionality was collected, and the website was revised to be as user friendly as possible. The co-curricular guide will be used by future students to ensure accessibility to all co-curricular opportunities ahead of them.

Design Thinking Across Campus

TEAM MEMBERS
Aatish Gupta, Abby Hainsworth, Kenyon Burgess, Luke Hardin, Zach Steelman, Cory Tindall, Kyle Clark, Nick Patestos, Grace Culley

PROJECT MANAGERS
Dr. Michael Dominik

The Clinic investigated how Design Thinking methods might be incorporated into pedagogical practices at multiple Rowan University colleges. The purpose was to promote institutional adoption of design thinking methods as a means for creative problem solving. The rationale is that design thinking methods can be applied to multiple academic disciplines, and that Rowan University students can benefit from its teaching and practice.

Engineering Adjacent Activity Participation

TEAM MEMBERS

Jack Harstead, Nick Insinga, David Lentz, Dylan Letcher, AJ Marchev, Ryan Petzitillo, Sadia Rawsan

PROJECT MANAGERS

Dr. Cheryl Bodnar, Dr. Cassandra Jamison, Dr. Justin Major, Ms. Alexandra Jackson

Being actively involved in clubs, hobbies, and activities is crucial for an engineering student's development, allowing them to acquire knowledge and skills beyond the classroom. However, not everything that a student is involved in outside of class is engineering-specific, some is non-engineering or somewhere in between. This research study aims to identify why students participate in non-engineering related activities and identify motivations for participating in engineering-adjacent activities. Students participated in semi-structured interviews, which sought to identify students' goals, motivations, and major-specific and extracurricular activities that students selected for participation. Interviews were then reviewed to identify themes relevant to student motivation. Our work will help to answer questions about why engineering students choose to become involved with the activities they do and how those experiences influence their future pathways. Using these answers, we can help students to choose the activities that have been shown to be most beneficial for their chosen pathways as well as help them to form connections between their chosen activities and their goals.

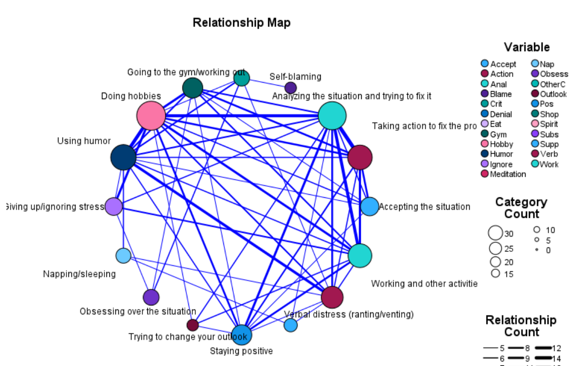
Stress and Coping Mechanisms of Undergraduate Engineers

TEAM MEMBERS

Nolan Pickett, Tyler Garrett, David Myers, Luke Stockl

PROJECT MANAGERS

Dr. Kaitlin Mallouk, Darby Riley



When first attending college, it is difficult to adjust to the increased pace and workload compared to other types of education and the difficulty increases as students progress through their desired degree path. The change in learning can be difficult to manage. Learning to manage the stress that comes along with higher education is essential for keeping on track to graduate. The goal of this study is to understand how students manage their stress and the causes of their stress. Specifically looking at undergraduate engineering students we want to answer the following research questions: (1) How stressed are engineering students, (2) is there a common cause of stress, if so what is it? and (3) How do engineering students manage their stress and which method(s) are most effective? Using a survey that asked Rowan engineering students to identify their top five sources of stress and top five coping mechanisms, we found that the most frequently cited stressors are mental health, grades, and work/life balance. Additionally, we were able to categorize student coping mechanisms as healthy or unhealthy and showed that students who reported less stress used more healthy coping mechanisms than students who reported higher levels of stress.

Sustainable Food Systems IOT

TEAM MEMBERS
Jason Blanda, Gianna Cava, Mason Posner, Abagael Riley, Mohammed Sahir, Jack Thorpe

PROJECT MANAGERS
Dr. Katie Barillas

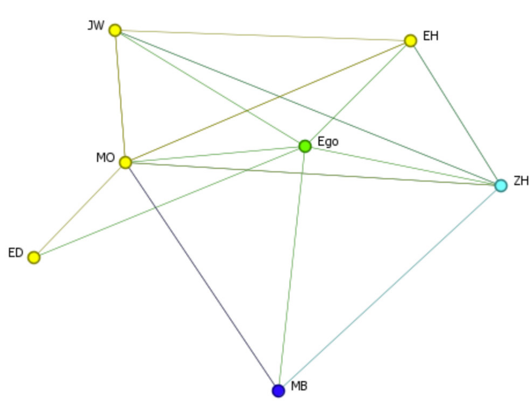
SPONSORS
IEEE Epics

A 2017 online survey of Rowan students illuminated a statistic about food insecurity on our campus. The Rowan Environmental Action League has a garden that produces food that is provided to any student who wants freshly grown produce and excess produced is given to the Rowan SHOP Food Pantry. In this clinic, students used precision agriculture, a field of study where sensors are used to improve yields and decrease resource management, to develop a prototype solution for the Rowan Environmental Action League to be implemented in their community garden. The prototype will manage a valuable resource, water, at the garden with a system of solar powered sensors and pumps. Students also developed outreach tools using LEGO® Education SPIKE™ Essential Set for the Bullock Garden that relate to sustainability and farming for elementary aged children.

The Effect of Collaborative Environment on Engineering Students' Social Networks

TEAM MEMBERS
Noor Aulakh, Hannah Corbin, Alexander Herrman, Shahir Mollah, Conor Peterson

PROJECT MANAGERS
Dr. Kaitlin Mallouk, Darby Riley



This project examines how collaborative learning impacts the social networks of engineering students. This is important because it will provide us with insight into how collaborative learning can affect feelings of social connectedness, which is known to impact students' academic success. More specifically, we address the following research question: How does collaborative learning impact the social networks of engineering students? A survey was designed and sent to senior undergraduate engineering students at Rowan University. The survey included demographic questions, questions about the student's perceptions of their social connectedness and their instructors tendency to promote collaborative learning, and a series of questions designed to elicit the student's social network. The results of this study indicate that, in instances where students perceived that their instructors implemented collaborative learning more often, a student's social network became more densely interconnected. Additionally, the number of friends a student chooses to work with is positively correlated to how often said student works or studies in a group setting. We also found a correlation between social connectedness within a department and the competitiveness of the department. These findings can be used to inform instructor's pedagogical approaches and provide additional support for the benefits of collaborative learning.

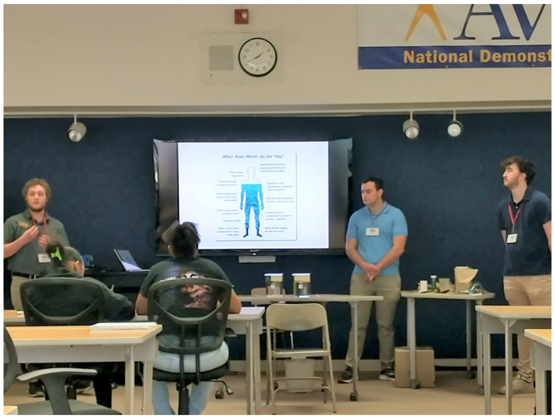
Water Environment MS Outreach

TEAM MEMBERS
Antonio DeAngelis, Stephen Kehoe, Charles Rudderow

PROJECT MANAGERS
Danielle Farrell

SPONSORS
New Jersey Water Environment Association

J/SEC students provide outreach by presenting to middle schoolers on water treatment and the environment. Knowledge may be reinforced through a site visit to treatment facilities near campus, and by an essay writing challenge. J/SEC students will review the MS essays and present findings in the poster category at the NJ Water Environment Association annual conference in Atlantic City.



Mechanical Engineering

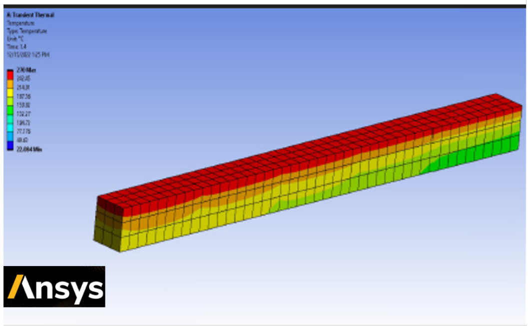
A Digital Twin for 3D Printing

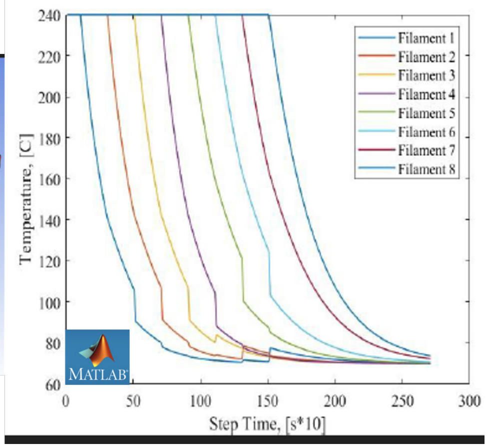
TEAM MEMBERS
Paul Maienza, Masum Patel, Milton Rivera, Tyler Shorr, Vincent Vernacchio

PROJECT MANAGERS
Dr. Paromita Nath

SPONSORS
Department of Defense (DOD)

Digital twin is a virtual representation of a physical system. Digital twin of a manufacturing process enables improvement in quality of the manufactured parts through process monitoring and decision-making in real time. This project focused on the computational modeling aspect of a digital twin. Heat transfer analysis is a major component of multi-physics simulation of additive manufacturing processes. For the fused filament deposition process, two heat transfer analysis-based models were developed: an analytical model using MATLAB and a finite element model using Ansys, to predict the bond quality between the filaments.





AIAA Design/Build/Fly

TEAM MEMBERS

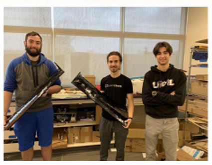
Ethan Steven Segal, Mikhlid Alzubi, Vincent Astarita, Jose Felipe Contes, Kien Ngoc Hoang, Sabastian A Quinn, Tomer Michael Ramati, Nicholas Rossi, Kevin M Thompson, Manas Gupta, Forrest McCarthney, Griffin Paul Pezzuti, Nicholas Mathew Saccomanno, Daniel W Wang.

PROJECT MANAGERS

Dr. Nand Kishore Singh and Dr. Ratan Jha








The objective of this project was to design, build, and fly an aircraft. The team had to design an aircraft to execute electronic warfare (EW) missions including staging of the aircraft, surveillance, and jamming. The aircraft was designed to carry electronics packages internally weighing equal to or greater than 30% of the gross weight of the craft. The second mission is to carry jamming antennas of varying lengths attachable to the tip of both wings. While designing, the team also fulfilled design limitations like a maximum dimension (length, width, and height) of 62 inches, a maximum weight of 50 pounds including the shipping box, and ease of assembly and disassembly. Throughout the semester the team designed and optimized the performance of aircraft based on the results of simulation and test flights. Finally, the team was able to successfully fly their aircraft performing all the missions. Rowan's 2022-2023 AIAA/DBF team consisted of 14 mechanical and electrical engineers divided into four teams: Fuselage, Wing, Empennage, and Propulsion. There were also special roles of team lead, overall project manager, material acquisition manager, and pilot. This project allowed the team to build a functioning aircraft in a team-based environment using the engineering knowledge.

ASME Student Design Competition

TEAM MEMBERS

Richard Brown, Mary Kunz, Connor Mahon, Nicholas Sirianni, Leif Svendsen, Matthew Weinstein, Steven Weinstein, Nicholas Zanowicz

PROJECT MANAGERS

Hong Zhang

Every year, American Society of Mechanical Engineering(ASME) hosts a student design competition, which draws teams of future engineers from all over the world. The goal of 2023 competition is to collect renewable solar and wind energy and to design and build a remotely controlled vehicle that can move weights around a game surface using limited energy, namely, charged and stored in a single AAA rechargeable battery. The vehicle, including its onboard controller, wireless communication, and charging unit, has to be light so it can save all the power to push a payload, which is simulated by steel balls, over a ramp. The team of Rowan students consists of ME and ECE majors. They worked together to develop a dual charging station using both wind and light, and step up the 1.2V battery power to drive the wheels propelling the vehicle and the servo steering it. A Bluetooth-based remote controller is also developed to wirelessly drive the vehicle from starting point and climb to the top of the ramp while pushing the payload with it.

BAJA SAE Junior Clinic

TEAM MEMBERS

Vincent Gallo, Ryan Connors, Anthony Kuczynski, Kaitlyn Hines, Jake Bobrowski, Brian Deady, Nicolas Fink, Christian Garabo, Matthew Hewitt, Noah Jager, Katherine Kaniewski, Joshua Lewbart, Maureen O'Brien, Evan Parker, Brenden Prefer

PROJECT MANAGERS

Anu Osta

The Society of Automotive Engineers (SAE) hosts yearly competitions in which a single-seat, all-terrain vehicle is designed by a team of students in compliance with the rules set forth by the SAE Baja Collegiate Design Series. The goal of participating in Baja SAE is to compete in various static and dynamic events, in which the design and assembly of the car is rigorously put to test.. Design of the Rowan Motorsports 2024 Baja Car began in the summer of 2022 with the goal of producing a lightweight car without sacrificing strength or reliability. The 2024 car will compete in the regional SAE Baja competitions in 2023 and 2024. They will test, identify design flaws and redesign the systems. The Baja team consists of the following sub-systems: frame, transmission, front suspension and steering, rear suspension, brakes and throttle, safety, and data acquisition. The primary design objective of the car is reliability while still maintaining weight savings. The weight reduction and overall design choices are tailored toward increasing long-term performance in the endurance challenge.

Building a Wind Turbine

TEAM MEMBERS

Jonathan Bell, Jake Breyer, Corey Churgin, Beth Kraus, Maxwell Rutka, Benjamin Ryan

PROJECT MANAGERS

Dr. Chen Shen, Dr. Nand Singh

SPONSORS

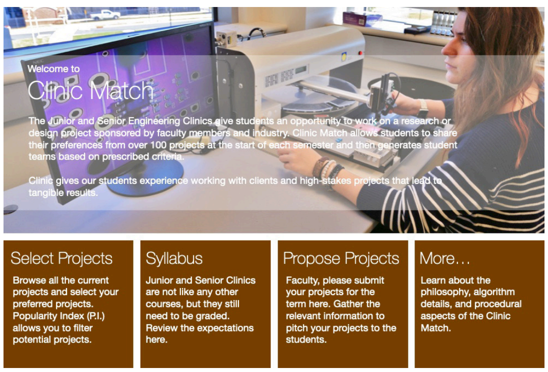
New Jersey Economic Development Authority

Wind energy is the No.1 leading renewable energy in the U.S., and an increasing number of wind turbines can be found at different places. In this project, our goal is to build a lab-scale functional wind turbine and develop strategies to improve its performance and to provide condition monitoring. In the first semester, the team builds up a meter-scale wind turbine which contain all major parts as a real one: the tower, nacelle, rotor, and blade. All the designs are first developed in SolidWorks and subsequently verified by calculations and simulations. Different parts are also purchased and assembled later to build the wind turbine, with a lot of hands-on activities involved. The performance and working conditions of the wind turbine we built are also validated by monitoring the electrical energy that is generated. In the second semester, the team continues to optimize the structures as well as to test its performance such as improving the blade shapes and materials. Strategies are also developed to perform condition monitoring tasks, including both mechanical and electrical parts.

Clinic Match Update

TEAM MEMBERS
William Estlow

PROJECT MANAGERS
Dr. Smitesh Bakrania

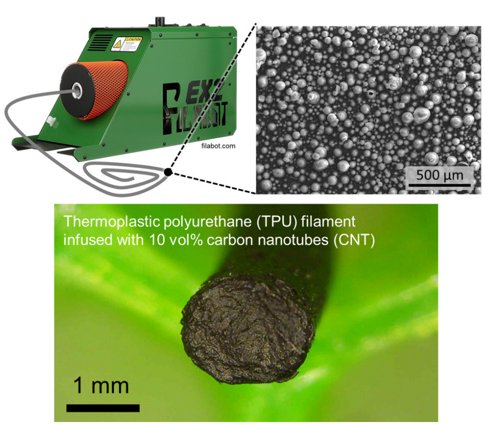


Clinic Match is how we manage to assign over 500 students to 140 different projects every term. Clinic Match allows students to shop for projects and select their top eight choices to join for each term of their junior and senior years. Under the hood it is a major undertaking with an algorithm that assigns students to project based on a set criteria. The front facing platform allows students and faculty to interact with the information and submit their preferences. Beyond the automated assignment, designated discipline managers make final adjustments for students who did not get their preferred choices or failed to submit in a timely-fashion. This term a new student in-charge was involved with making improvements that provide a better experience for all the stake-holders. A new Clinic Match portal was developed to optimize election and user traffic. Features that allowed easier manual assignments were added. These efforts have produced a platform that is highly dependable and scalable for the future growth of the program. Clinic Match is in its 10th year of service and continues to provide opportunities to students across the college.

Custom Filaments for 3D Printing

TEAM MEMBERS
Katelyn Desmier, Joseph Kenney, Daniel Nerbetski, Bradley Steiger, Dana Yarem

PROJECT MANAGERS
Dr. Behrad Koohbor, Dr. Wei Xue



The fundamental idea of this project is to develop functionalized 3D printing filaments by re-extruding commercially available PLA and TPU (thermoplastic polyurethane) filaments. To this end, the project started by setting up a commercial filament extruder. Neat PLA and TPU spools were acquired, chopped into smaller pieces, and then fed into the extruder along with the desired additive. The list of additives included copper, iron, brass powder, and carbon nanotubes (CNT). The re-extruded custom filaments were used in FDM 3D printers to fabricate lightweight composite structures with additional functionalities, including but not limited to heat and electrical conductivity. The mechanical and electrical characteristics of the 3D-printed objects were measured. In particular, the evolution of electrical conductivity of CNT-infused TPU structures as a function of mechanical strain was characterized. Results obtained in this project reveal an approach for the practical and efficient fabrication of multifunctional filament feedstock for additive manufacturing of novel structures.

Develop a BioCool Solid State Personal Cooling Device

TEAM MEMBERS

Stephen Hulsen, Caylei Hoffman, Johnathan Todd, Quint Kearns, Alan Kwok, Sujay Patel

PROJECT MANAGERS

Dr. Hong Zhang

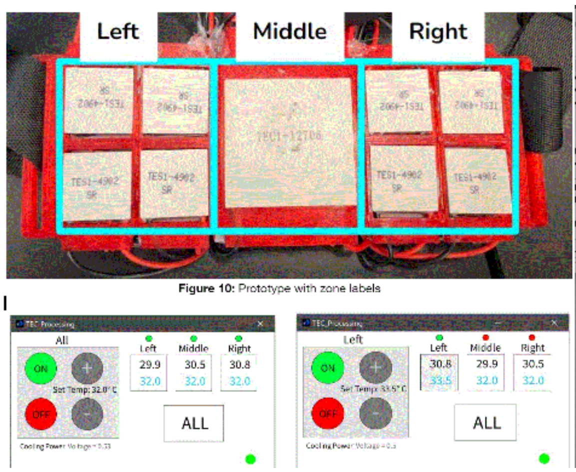


Figure 10: Prototype with zone labels

The project BioCool is a way to use Thermoelectric Coolers, or TECs, to cool down different body parts, specifically the knee and the forehead. The overarching goal of this project is to essentially create an electric ice pack that will monitor and regulate the skin temperature using the thermoelectric effect. It will directly transfer heat from the hot side to the cool side of the solid-state components, without using any moving components seen in traditional cooling systems. It will be much quieter and safer to be used as a personal medical or recreational device. The main goal of the semester was to create a base to hold the TECs. A graphical user interface, or GUI, was also created so that the users can read their temperatures on their phones. Another main goal of the semester was to create a gel pack so that wearing the device was more comfortable for the user. Tests were also conducted to test the effectiveness and efficiencies of the device on hands and foreheads.

Develop a Farming Robot

TEAM MEMBERS

Andrew Heyer, Michael Krouse, Patrick O'Rourke, Tyler Paupst, Igor Shanava, Evan Tucher, Brian Berry, MasumKumar Patel

PROJECT MANAGERS

Dr. Hong Zhang

Precision Agriculture (PA) increases farm productivity, reduces pollution, and minimizes input costs. However, the wide adoption of existing PA technologies for complex field operations is slow due to high system complexity and acquisition costs, low adaptability, and slow operating speed. The project of Farming Robot is to design, build, optimize, and test a modular agrochemical precision sprayer (MAPS), a robotic sprayer with an intelligent machine vision system (MVS). In the past two years, a push style MAPS was built with PVC pipes as a proof-of-concept prototype. In this academic year, the goal is to build a second generation aluminum-framed and self-propelled prototype that can carry more load and last longer in a more challenging field test. Currently, each of the four wheels of MAPS II is individually powered by a brushless DC motor and can be controlled via a touch screen or a remote controller. It can also be integrated to the autonomous mobile control in the future. The frame of the MAPS can be expanded to accommodate the various width of the hills in the field. A mechanical steering mechanism can also be used to supplement the steering in a muddy field.

Educational Hardware Modules

TEAM MEMBERS
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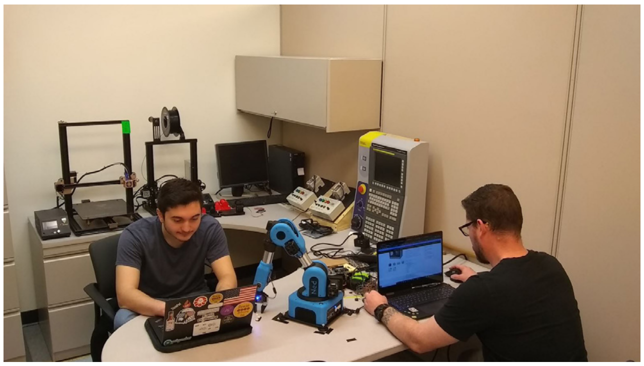
PROJECT MANAGERS
Dr. Anu Osta

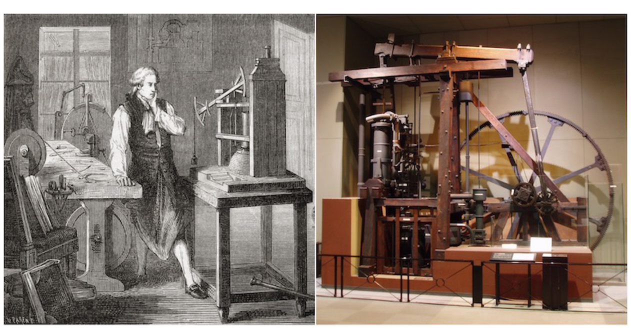


Students in this clinic developed in-class demonstration and laboratory modules. The modules were based on 3D printing, CNC, PLC controllers and Robotic equipment. They employed a combination of manufacturing processes for making the kit components, integrating them with off-the shelf electronics, along with using programming languages and computer CAD modelling. The lab modules served specifically the Advanced Manufacturing course. The objective was to enable the students taking the course to acquire hands-on skills in operating CNC machines, robotic manipulators, programming logic controllers, additive manufacturing equipment like SLA and FDM 3D printers.

Engineering History Course Development

TEAM MEMBERS
Kylie Taylor, Ryan Leeds, Joseph Midiri, George Cullis

PROJECT MANAGERS
Dr. Smitesh Bakrania



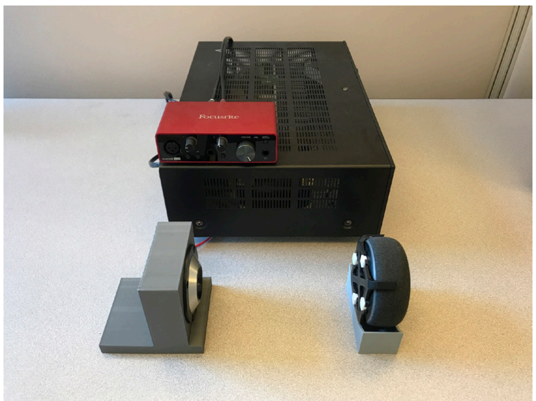
A new course was envisioned to provide a broader perspective on the engineering profession. This course would discuss the impact of engineering on civilization and provide a unifying discussion on how engineering evolved to address various human challenges. The goal for this project was to develop content for such a course with technical depth. The students were tasked with identifying and categorizing relevant topics and resources, developing a syllabus and schedule for a course proposal, generating detailed assignments and projects, and finally producing KEEN cards for dissemination. The team successfully completed the course development exercise. The team identified thirteen major engineering topics and sourced historical content related to them. These included Energy, Motion, Flight, Space, Materials, Manufacturing, Computation, Disasters, Ancient Wonders, War, Communication, Tools and Instruments. The course, titled "How it Worked," was successfully proposed and will be offered to engineering students as a technical elective in the future.

Exploiting Smart Speakers

TEAM MEMBERS
Malik Cyrus, Joshua Lloyd, Cole Ludwikowski, Derek Phansalkar

PROJECT MANAGERS
Dr. Chen Shen

SPONSOR
National Science Foundation



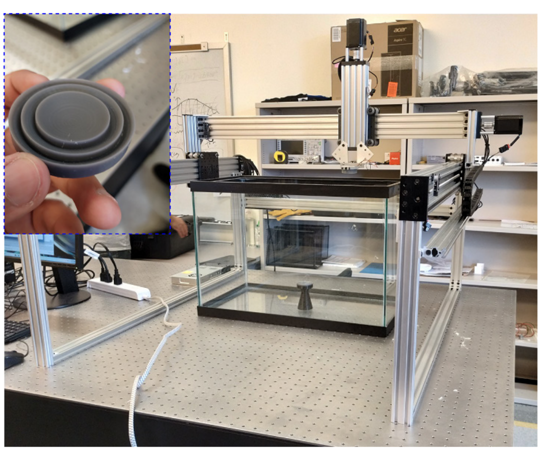
Smart speakers (Amazon Echo, Google Home, etc.) have become important in the contemporary society. In this project, students will develop strategies to hack an Amazon Echo using inaudible signals and come up with means to protect smart speakers from such attacks. Over the course of the project, we successfully demonstrated "hacking" of an Amazon echo with modulated inaudible signals and developed 3D printed filters that are installed in the speakers to mitigate this kind of attacks. The results and measurements show that our designed filters can effectively modulate the incoming sound signals and protect the smart speakers from receiving ultrasound components that may contain malicious information.
The team has summarized the results and are seeking to publish the results we obtain in a conference or a journal article. Currently, the conference abstract submitted to the 184th Meeting of the Acoustical Society of America has been accepted for oral presentation in May in Chicago; a journal paper is under review at this time.

Focused Ultrasound Device

TEAM MEMBERS
Alexandria Bazikos, Gianna Cava, Thorpe Jack, Aiden Kayes, Andrew Michaud, Milton Rivera, Johnathan Todd

PROJECT MANAGERS
Dr. Chen Shen

SPONSORS
New Jersey Health Foundation



The goal of this project is to design and develop a low-cost focused ultrasound device. Focused ultrasound has become a valuable tool in biomedicine with applications in diagnostics and treatment. The device we develop contains ultrasound transducers, 3D printed adapters, and driving systems that can guide ultrasound waves to different locations in a precise manner. The clinic started with designing customized 3D printed lenses that can focus ultrasound energy at a certain distance when coupled with a flat transducer. This dramatically reduce the cost as commercial focused ultrasound transducers are quite expensive. The performance of the focusing lens is verified both numerically and experimentally.
In the second semester, the team continues to develop supporting systems including a 3-axis move stage and the data acquisition and control systems. These systems will enable more versatility by freely directing the focal point to desired locations in a container to facilitate future studies. The ultimate goal is to have a low-cost functional device with customized user interface and functionalities to deliver pre-clinical applications.

Hip Exoskeleton for Slip-and-Fall Prevention

TEAM MEMBERS
Alexandria N. Bazikos, Evan Selzer, James F. Burns, Dani Marincas, Sujay N. Patel, Kevin Bockius, Damien Filoramo, Madison Plone, Nicholas Rochino, Thomas Saverino, Leif Svendsen, Nicholas Wilson

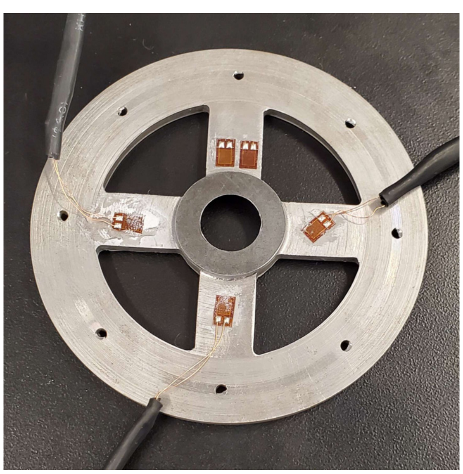
PROJECT MANAGERS
Dr. Mitja Trkov

Existing exoskeleton devices are often specifically designed to aid with a targeted task, such as level-surface walking or stair climbing. The ability of an exoskeleton device to assist during walking with gait perturbations still presents a challenge. The goal of this project was to design a hip exoskeleton device to assist with medio-lateral foot placement that can augment human bipedal gait capabilities and enhances safety during gait perturbations. In addition, the project included the design of the gait perturbation device to trigger trips during walking. Both prototypes were developed and preliminary bench tests were performed.

Instrumented Climbing Holds

TEAM MEMBERS
Stephanie DeMattheis, Gavin Ritter, Luke Solem, Miles Alimario, Anthony Tarchichi, Matthew Ciocco

PROJECT MANAGERS
Dr. Mitja Trkov



The goal of this project is to design a low-cost instrumented climbing system to monitor progress of climbers on a set route on an indoor climbing wall. There is a need for a reliable, low-cost system that could monitor progress of climbers on a set route on a wall and allow 'virtual' execution of competitions. The requirement for the system is to easily attach to the existing climbing infrastructure in climbing gyms to allow widespread adoption and use. In addition, the system should be integrated with monitoring system that can communicate the information about the applied forces, sequence of holds, and associated time stamps, as to monitor the progress of a climber.

Microplastics Removal

TEAM MEMBERS

Kylie Taylor, Quint Kearns, Dylan Hanni

PROJECT MANAGERS

Dr. Wei Xue, Dr. Smitesh Bakrania

Microplastics have become a world-wide problem with damaging effects on environments, aquatic animals, humans, and the entire ecosystem. This project is aimed to explore innovative methods to remove microplastics from water sources. The team was particularly interested in exploring the feasibility of using oil-based micro-cleaners to remove microplastics from water. The team identified 3 oils and 6 common plastics to study. The team prepared microplastic samples and tested them with oil for removal effectiveness. The removal involved both separation, following by extraction from water. The oils were used for separation while the team studied a polymer based extraction method. An optimal combination of separation and extraction is needed to effectively address the microplastic pollution problem. A study of oil-water-plastic interface was also conducted to better understand the results and design systems that are optimized for effective removal. This is an on-going project with the potential to make tangible impact on this environment challenge.

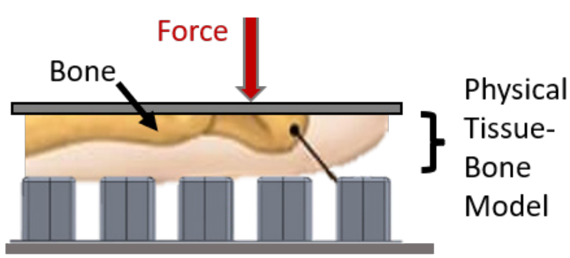
Physical Tissue & Bone Model

TEAM MEMBERS

Nicholas P. Wilson, Anthony R. Tarchichi, James G. P. Nguyen, Madison P. Plone

PROJECT MANAGERS

Dr. Mitja Trkov



Pressure injuries are a severe problem for the bed-bound patients and wheelchair users. Existing specialized hospital beds and mattresses only partially offset pressure ulcer formation of bed-bound patients. Soft robotic devices with integrated sensing and actuation capabilities offer promise to autonomously control and relieve high pressure points between the tissue and bed. To better understand the tissue-surface interactions and blood flow in tissue under load, the goal of this project is to create a prototype that mimics human tissue and bone. A vascular system was planned to be integrated into the prototype to monitor the blood flow under various loading conditions.

Polymer Composites for Navy Applications

TEAM MEMBERS
Nicholas Mahon, Max Coraggio, John Terifay, Paul Maienza, Jared Ericksen, Sean Lawton, Diana Martinez, Michael Smith

PROJECT MANAGERS
Dr. Wei Xue

SPONSORS
Naval Surface Warfare Center Philadelphia Division (NSWCPD), Naval Engineering Education Consortium (NEEC)

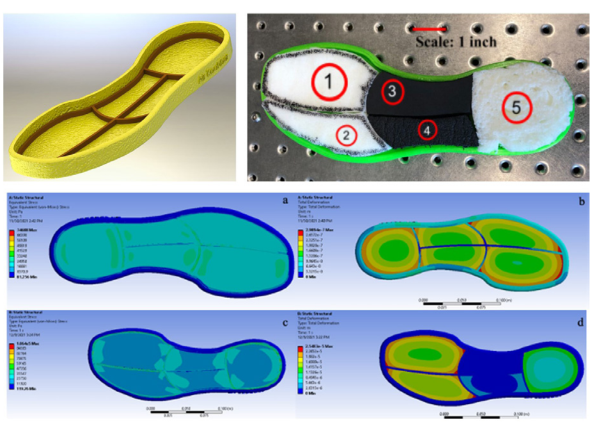
The primary objective of this clinic is to study the potential of polymer-based nanocomposite materials as dielectrics in high-temperature superconducting (HTS) cables for the United States Navy. The compact, lightweight, and efficient power transmission characteristics offered by HTS technologies have demonstrated a much higher power-to-volume capacity, which is more than 200 times of those from standard copper (Cu) conductor systems. The team aims to investigate various nanocomposites, including polymer-silica nanoparticle and polymer-POSS composites, as cryogenic dielectrics. The main technical tasks include (1) design and preparation novel nanocomposites, (2) obtain the sample properties (dielectric, mechanical, and structural) through material characterization, (3) design and fabricate necessary testing fixtures, and (4) analyze experimental data. Using dielectric polymers (polyamide or polyimide) as the host material, the behaviors of these nanocomposites have been explored. The dielectric performance of the composites measured at room and cryogenic temperatures shows that the new materials are promising candidates for future cryogenic applications.

Property Adjusted Shoe Soles

TEAM MEMBERS
Jacqueline Johnson, Carl Pantano, Andrew Solarski

PROJECT MANAGERS
Dr. Behrad Koohbor

SPONSOR
New Jersey Health Foundation



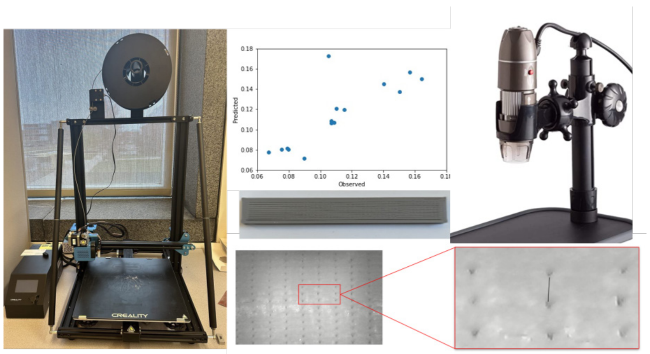
The goal of this 2-year clinic project has been to create shoe midsoles with tunable mechanical properties. A shoe outsole and its corresponding model were designed using data collected from a foot pressure map and then 3D printed from thermoplastic polyurethane. The clinic team designed and created several sections to house materials inside the outsole, separated by a thin non-intrusive frame. Foams were considered in this work. The placement of different foam sections was determined based on their mechanical properties which were characterized in quasi-static compression. The last step in the design of the so-called property-adjusted shoe soles was the embedment of force sensors that help measure the local plantar pressure at different locations of the foot. The midsoles designed and developed in this work aid people with foot pain with better cushioning or support in certain areas. In addition, the design proposed and implemented in this clinic can be an alternative to expensive custom orthotics for athletes.

Quality Assessment of 3D Printed Parts

TEAM MEMBERS
Chris Burger, Matt DelRosso, Anthony Madonna, Andrew Nguyen, Joseph Ruiz

PROJECT MANAGERS
Dr. Paromita Nath

Trial-and-error approach of optimization of manufacturing processes wastes material and energy. The goal of this project was to use machine learning models to determine the optimal printing parameters that maximize the quality of a 3D printed part. Specifically, the objective was to minimize error in part geometry and maximize the bonding between the filaments by optimizing print temperature, print speed, and layer height in a fused filament fabrication process. Parts were 3D printed at different print settings determined using design of experiments, and the quality characteristics were measured. This data was then used to train machine learning models. The model with lower prediction error was used for optimization.



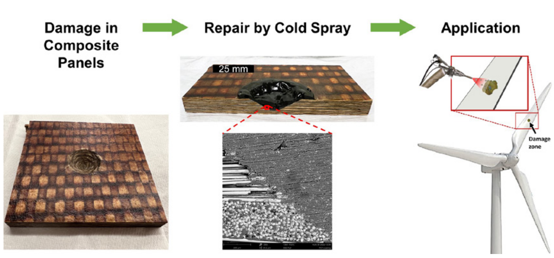
Repair of Composites by Cold Spray

TEAM MEMBERS
Margaret Barrasso, Kevin Madden, Zachary Primiani

PROJECT MANAGERS
Dr. Behrad Koohbor, Ibnaj Anamika Anni

SPONSORS

Army Research Lab



A significant challenge in the application of composite materials is the maintenance and repair of a damaged composite. This project aims to investigate the application of polymer cold spray technology as an innovative and effective alternative for repairing damaged composite panels. The project involves the intentional and controlled imposition of impact-induced damage to fiber-reinforced polymer composites to replicate the service damage (e.g., due to debris or projectile impact), followed by a repair protocol that is based on the cold spraying of thermoplastic polymeric powders. The impact-induced damage is generated using a custom-designed gas gun with the capability to shoot a wide range of projectiles at velocities as high as 15 m/s. The recovery of the lost structural properties (due to damage) is evaluated experimentally using three-point bending tests. The results indicate that the polymer cold spray can substantially recover the mechanical properties of the repaired product at a significantly reduced time, cost, and energy compared with traditional repair methods. Furthermore, the investigated "repair by cold spray" process can be used for on-site damage repair, leading to the development of high adhesion strengths and stiff coatings, while requiring minimal surface preparation.

SAMPE Bridge Contest

TEAM MEMBERS

Caylei Hoffman, Alan Kwok, Ryan Leeds, Ron Torculas

PROJECT MANAGERS

Dr. Behrad Koohbor, Dr. Nand Singh, Dr. Giuseppe Palmese

The Bridge Contest is an annual international competition at the SAMPE conference. SAMPE has hosted this competition for student members to design, analyze, build, and test a miniature structural bridge using various composite materials in accordance with a set of well-defined rules. The main objective is to design and build a composite bridge using an assortment of pultrusions, cores, fabrics, and other materials, such that the strength-to-weight ratio of the fabricated bridge is maximized. Following the successful establishment of the SAMPE student chapter at Rowan in 2022, the Bridge Contest Clinic was initiated with the idea to form teams of students who compete internally, and upon selection, would represent Rowan University at the annual SAMPE meeting.

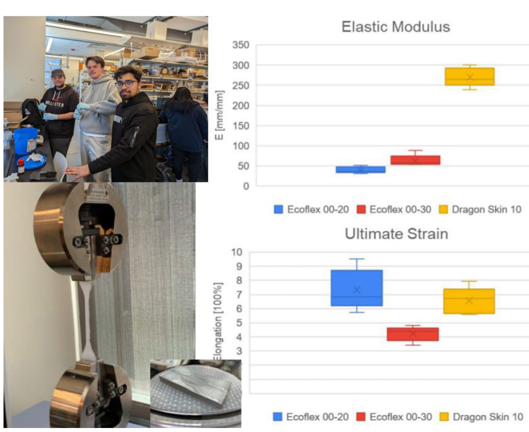
Shape Adaptive Robot Grippers

TEAM MEMBERS

Zachary Thistle, Aaron Raio, Joshua Schofield, Dominic Kresge

PROJECT MANAGERS

Dr. Wei Xue, Dr. Mitja Trkov



Soft robotics, made of inherently soft materials and empowered with intelligent control logic, will be crucial in future engineering applications. Inspired by biological systems in nature, especially animals such as fish or worms, soft robots have highly flexible and deformable bodies. With actuators similar to human muscles, these robots can quickly adapt to the surrounding environment, change their shapes, apply compliant motions, and manipulate complex objects. In this project, the clinic team has investigated a new group of materials, magnetorheological elastomer (MRE), for soft robotic applications. The MRE can change its mechanical properties (stiffness, shape, etc.) under an applied magnetic field. The objectives for this project include: (1) Literature review of MRE materials, soft actuators, and shape adaptative designs. (2) Design, fabricate, and test MRE-based samples. (3) Obtain mechanical and magnetic properties of the samples, especially the stiffness variability under magnetic control. (4) Design robot grippers to handle objects with various shapes. (5) Apply magnetic control so the grippers can handle objects with various weights.

Smart Health Monitoring System

TEAM MEMBERS
Angelo Coiro, Joseph DiCamillo, Gabrielle Fiore, Valerie Molinari, Argenis Rodriguez

PROJECT MANAGERS
Dr. Paromita Nath

This project aims to develop a health monitoring system using data from smartphones and smartwatches. After conducting an extensive literature review, two smartwatches were selected for use and the important variables for monitoring health were identified. The data collected from the smartwatches will be used for performing exploratory data analysis, correlation analysis, and constructing machine learning-based models.

Soft Robot for In-pipe Navigation

TEAM MEMBERS
Jessica Rodgers, Zachary Lis, Yashdeep Singh, Noah Giordano, Michael Brlan

PROJECT MANAGERS
Dr. Mitja Trkov

Robotic solutions have become commonplace in almost all aspects of life, from the automated vacuums in homes, to the highly developed systems supporting surgeons in complex and precise procedures. Robotic systems can now be designed with more adaptable and flexible components compared to traditional rigid assemblies, and have the potential to be used in a wide range of applications, where the exact environment and tasks may not be known, such as climbing, navigating, and grasping objects. The purpose of this project was to design and develop a soft robot for the locomotion competition at the 2023 IEEE International Conference on Soft Robotics (RoboSoft). This year's challenge was in pipe locomotion. Therefore, the specific tasks of this project were to design a soft robot that could autonomously navigate its way through an enclosed pipe, while demonstrate its flexibility and adaptation to changes in pipe diameters, curvatures, and surface conditions.

Stirling Engine Design Project

TEAM MEMBERS
Emma Redmond, Erin Harker, Kody Deuter, Nicholas Pilla, Troy Ejdys, Karly Amandeo, Stephen Hulsen, Andrew Michaud

PROJECT MANAGERS
Dr. Smitesh Bakrania

Hands-on project allow students to engage with the concepts taught in courses in a tangible and a meaningful way. Thus a new project that applied thermodynamic concepts was to be developed for the Introduction to Thermal-Fluid Sciences (iTFS) course. A Stirling Engine made using soda cans are challenging to build successfully. This project investigated effective methods for repeatably producing a soda can Stirling Engine. Alternative designs were also explored for implantation into the course. The team iterated on numerous design paths and conducted rudimentary analysis on the performance. Eventually a composite design was pursued with 3D-printed components for consistency. A specification sheet and an assignment document was produced to enable incorporation of the design into a course project. Students will eventually develop performance metrics and attempt to improve engine efficiency using thermodynamic concepts taught in the course.

Testing and Tuning of SAE Baja Vehicle

TEAM MEMBERS
Samantha Midili, Thomas Hickey, Charles Ernst, Maxwell Itzchaky, Bianca Jeremiah, Jacob King, Anakin Leatherwood, Michael Sainato, Christopher Burton, Colin Brown, Matthew McBride, Emmet Sedar, Shandor Szanati

PROJECT MANAGERS
Dr. Anu Osta

The Society of Automotive Engineers holds an international Baja competition every year where student teams are tasked with building and testing a single seat, all-terrain vehicle. As part of the Rowan University clinic experience, an off-roading vehicle ‘Daisy’ was designed and manufactured in compliance with the rules set out by the Society of Automotive Engineers as per the SAE BAJA collegiate design series. The Fall semester of 2022 was focused on the completing manufacturing and assembly of Rowan’s second 4WD SAE BAJA vehicle, as per new requirements. A vehicle was successfully designed with an ideal top speed of approx. 38 mph, torque of 350 lb-ft, weighing approx 520 lbs. and featuring components with validated strength and ergonomics. The Spring semester exclusively focused on manufacturing and assembly. This team participated in Épreuve du Nord 2023 in Canada. They will be participating in Baja SAE competition at Oshkosh, WI in Summer 2023.

Transfer learning in Additive Manufacturing

TEAM MEMBERS
Chris Burger, Matt DelRosso, Anthony Madonna, Andrew Nguyen, Joseph Ruiz

PROJECT MANAGERS
Dr. Paromita Nath

In additive manufacturing, the use of machine learning (ML)-based predictive models is becoming increasingly common. The aim of this project is to utilize transfer learning approaches to construct ML models using data collected from data-rich (cheaper to print parts) source environment and data-limited (more expensive to print parts) target environment to predict the quality of 3D parts in the target environment. The specific goals of this project are: (a) print parts using different materials and/or printers, (b) conduct mechanical testing on the parts, (c) implement transfer learning methods to build predictive models, and (d) select a model for process optimization based on model performance.

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