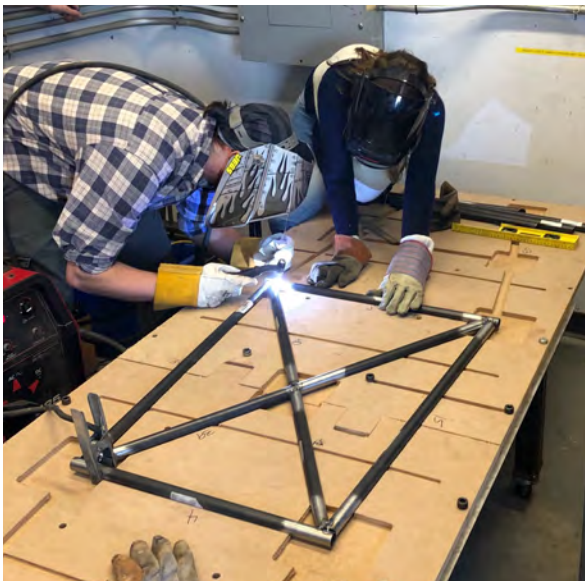
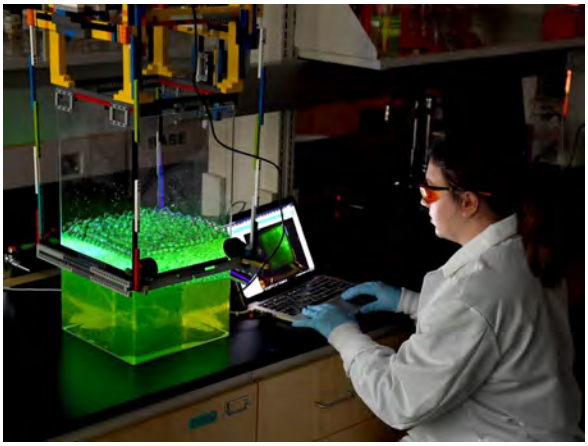
Rowan University

HENRY M. ROWAN COLLEGE OF ENGINEERING





PREFACE

A hallmark of the Henry M. Rowan College of Engineering is the Engineering Clinic Program. Engineering clinics are an eight-semester sequence that thread through every students' course of study, emphasizing a "hands-on, minds-on" approach, empowering students with an entrepreneurial spirit toward developing engineering solutions.

The freshman and sophomore clinic experience emphasizes the art and science of design through an interdisciplinary approach, highlighting the integration of the fundamentals of engineering into problem solving, along with the evaluation and presentation of results.

In the junior and senior clinic experience, students work in small teams, under the guidance of faculty and external sponsors to integrate lessons learned from their coursework into solutions for open-ended engineering problems. Each team works on a unique project, targeted toward the National Academy of Engineering's "Grand Challenges of the 21st Century" to improve quality of life and advance society.

This publication features the work of 140 clinic projects, involving over 600 students. While these results represent this year's specific clinic projects, when viewed more broadly, they represent the accomplishments of our students, faculty, mentors, and partners. The work is a reflection of the high-quality of our engineering education program, and the high-quality of graduates who leave us, prepared to be leaders in our profession.

We hope you enjoy learning about our students and their projects as much as we enjoy sharing them with you.

For more information, or to become a part of the clinic program, please reach out to Associate Dean for External Affairs, Sean Fischer, fischers@rowan.edu or 856-256-5354

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Sincerely,

Anthony M. Lowman, Ph.D.

Dean, Henry M. Rowan College of Engineering

CELEBRATING DIVERSITY OF IDEAS

Junior and senior engineering clinics serve our students with real-world engineering challenges under the supervision of expert faculty. Student teams work on open-ended and often difficult engineering problems. These teams bring together students with diverse experiences and skillsets to address the challenges at hand. Over half of our teams are multidisciplinary and are often composed of both juniors and seniors. Students need not work with faculty from their own discipline. At Rowan Engineering, we encourage a free exchange of ideas and a multi-pronged approach to solving problems. As highlighted in this booklet the projects address a wide-range of topics that students can pick from. As a result, Rowan graduates have the opportunity to come away from these experiences with both the breadth and depth within engineering.

The autonomy in selecting the Junior and Senior Engineering Clinics is central to this model. It allows students to pursue their interests and design their career path. We do our best to present them with choices. There are students who graduate after working on four different clinic projects; and there are those who prefer to focus their attention on one or two projects. Clinic projects not only reinforce engineering fundamentals, they ignite life-long passion for research and design. Beyond technical exposure, students practice their professional skills of leadership, time management, teamwork, and communication. Working closely with faculty, their teams, and sometimes sponsors, they build professional relationships that are pivotal in our highly connected society.

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 at our annual Engineering Clinic Showcase. Join us as we celebrate this diversity of ideas.

Sincerely,

Smitesh Bakrania, Ph.D.

Junior and Senior Engineering Clinic Coordinator

Fall 2018 Clinic Summary

Popular Projects

Formula Electric Clinic
Design Build and Fly
Design, Build, Test of Baja SAE Vehicle
Student Steel Bridge Competition
Polymer Composite for Navy
Nitrous!
Weeding Robot for Organic Algriculture
Bioinspired Mechanical Small robot
Brewery Power Quality
WiFi Solar Monitor

Top Profs.

Brewer
Muhlbaier
Iranmanesh
Schmalzel
Osta/Kadlowec
Zhang/Kadlowec
Lecakes
Merrill
Bauer
Cleary

Popular Departments

1 ME 2 CEE 3 ECE 4 ChE 5 BME 6 EXE

Proposed Projects

ME	30
CEE	39
ECE	44
ChE	27
BME	19
EXE	4
Total	163

Student Sign-ups

ME	185
CEE	153
ECE	108
ChE	96
BME	64
EXE	5
Total	611

Spring 2019 Clinic Summary

Popular Projects

Design, Build, Fly
Brewery Power Quality
Polymer Composite for Navy Apps
Formula Electric SAE Car
Engineers on Wheels
Design, Build, Test of Baja SAE Vehicle
Engineers Without Borders
Project Engineering & Development
Cold Weather Reinforced Concrete
Microcombustion Power Device

Top Profs.

Muhlbaier
Rasool/Bouaynaya
Amadoro
Mandayam
Schmalzel
Kadlowec/Zhang
Schmalzel, Krchnavek
Bauer
Jahan
Lomboy

Popular Departments

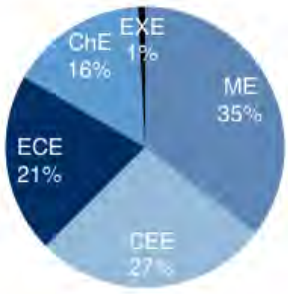
1 CEE 2 ME 3 ECE 4 ChE 5 EXE

Proposed Projects

ME	37
CEE	44
ECE	46
ChE	26
EXE	6
Total	159

Student Sign-ups

ME	178
CEE	137
ECE	104
ChE	80
EXE	4
Total	503



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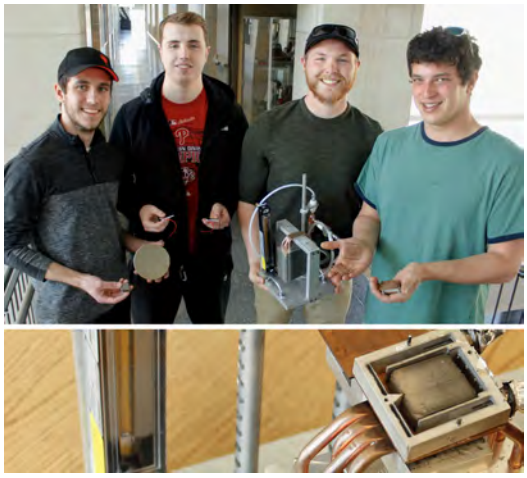
Catalytic Microcombustion for a Portable Power Source

TEAM MEMBERS

Benjamin Taylor, Matthew Shulman, Alexander Tenerelli, Zach Wagner

PROJECT MANAGER

Dr. Smitesh Bakrania



Catalytic combustion-powered thermoelectric generators can be viable alternatives to batteries in portable electronic devices. Such devices take advantage of energy-dense hydrocarbon liquid fuels, are robust without any moving parts, and have low operating temperatures preventing degradation of the thermoelectric modules. Existing micro-reactor designs have shown high efficiencies, but have yet to demonstrate truly portable and functional for power production. Our previous work has demonstrated self-ignition of methanol-air mixtures using platinum nanoparticles deposited on rectangular cordierite substrates. The heat generated by the reactor is converted to electrical power using two thermoelectric modules. The recent work focusses on managing the temperature distribution within the substrate and across the device for improved device performance. Several avenues were explored. An exhaust module was designed to capture the energy from combustion products. The new configuration resulted in a greater temperature gradient across the TEG modules. An alternate preheating configuration was implemented to enhance heat recapture from the reactor. A novel tailored catalyst material distribution approach resulted in more uniform heat release across the substrate width. The combined efforts have yielded marked improvements in device performance that will be guide future efforts.

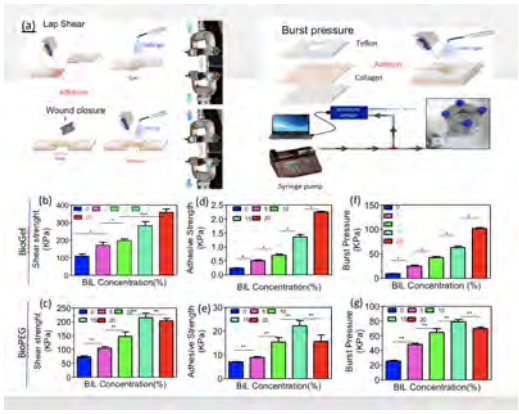
Bio-Ionic Liquid Polymer Composite as Electrolyte for Energy Storage Device

TEAM MEMBERS

Alexander Hesketh, William Gray

PROJECT MANAGER

Dr. Iman Noshadi, Vaishali Krishnadoss



Polymers when combined with appropriate salts in a liquid state (ionic liquid) have an increase in ionic conductivity and provide advantages over the conventional electrolytes. In this study, the increase in conductivity is utilized for the use of polymers as electrolytes in a 3D printed capacitor. The biocompatible ionic liquid electrolyte is prepared by conjugating the biopolymer Gelatin Methacrylol (GelMA) and ionic liquid (IL). The biopolymer-ionic liquid electrolyte and graphene as an electrode in a three-electrode system exhibits a specific capacitance of 200 F/g and were 3D printed to create an electrochemical capacitor that showed a specific capacitance of 16.33 μF/g at a current density of 1 A/g. The volumetric capacitance of the 3D printed energy storage device was found to be 44.07 μF/cm3. Multiple geometries were studied to find the optimal conductance. Low cost and easily manufactured implantable power sources built with biocompatible and biodegradable materials are of growing interest for future implantable medical devices in the healthcare industry. The biocompatibility of the energy storage device was also tested by implanting the device in rats. The electrolyte exhibits good electrochemical stability and biodegradability. The integration of an eco-friendly, biocompatible ionic liquid electrolyte provides a new perspective on energy storage.

Engineers on Wheels: A Mobile Program for K-12 Outreach

TEAM MEMBERS

Amanda Basantis, Joseph Egan, Kyle Hauske, Nicholas DePersia, Eduardo Garcia, Alyssa Grassie

PROJECT MANAGER

Dr. Kauser Jahan

SPONSORS

Martinson Foundation

Engineers on Wheels (EOW) is a mobile engineering outreach program sponsored by Rowan University. Each semester, a group of 4-6 interdisciplinary engineering students teach lessons that cover science, technology, engineering, and mathematics (STEM) to various elementary and middle schools in the surrounding area, focusing on students in grades 5-8. Over approximately six weeks, visits are made to the various schools to promote continuous learning and to provide a more detailed look at the various disciplines in engineering. The repeated visits also allow the EOW team members to develop a rapport with the students that they are working with, which enables them to provide guidance by advising the students towards a path to a successful career not only in engineering but also in other STEM fields. Each engineering discipline is highlighted through a traditional classroom lesson, which is then paired with creative hands-on activities and experiments. The activities are intended to kindle students' interest in STEM as well as facilitate a deeper understanding of the impact that engineers have on our daily lives. Founded in 2010 under the direction of Dr. Kauser Jahan, this outreach initiative has been successful in garnering students' interest in STEM disciplines. The program begins and ends with an anonymous survey to allow the EOW team to quantify the changes in general knowledge and interest in pursuing engineering careers among the students. Over the past nine years, results have consistently been extremely positive.

Algae Grows the Future

TEAM MEMBERS

Erin Pepe, Jeffrey Dobkowski, Adam Caravallo, Samantha Price, Ashley Ferrante, Zachery Miller

PROJECT MANAGER

Dr. Kauser Jahan

SPONSORS

National Science Foundation

Algae Grows the Future is an NSF funded project that focuses on algae-based experiments for engineering students and K-12 educators/ students for promoting engineering careers. The algae used for this project is Chlorella vulgaris , a photosynthetic freshwater organism that is relatively easy to grow in large quantities. Educational experiments are conducted with K-12 students as well as First Year Engineering Clinic students here at Rowan University to introduce students to engineering and inspire them to pursue engineering careers. Experiments conducted using the algae include growth rate experiments under various experimental variables [light and nutrients], and applications of algae in engineered products. These experiments are cost-effective, hands-on, and visual in nature. Students are given surveys to determine how the algae experiments affects their learning and views on engineering. It has been found that the use of algae for experiments in K-12 and Freshman Engineering Clinic classrooms has helped students learn about the processes followed for engineering experiments, as well as inspired students to pursue a career in engineering.

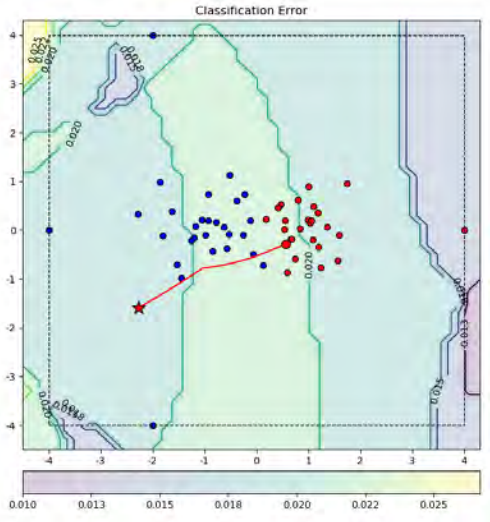
Adversarial Machine Learning

TEAM MEMBERS

Glenn Dawson, Matthew Delengowski, Sean McGuire

PROJECT MANAGER

Dr. Robi Polikar



As the prevalence and everyday use of machine learning algorithms, along with our reliance on these algorithms grow dramatically, so do the efforts to attack and undermine these algorithms with malicious intent, resulting in a growing interest in adversarial machine learning. A number of approaches have been developed that can render a machine learning algorithm ineffective through poisoning or other types of attacks. Machine learning algorithms are now routinely used to detect and guard us against cyber attacks, but what is guarding the machine learning algorithms themselves from such attacks? To protect these algorithms, it is important to evaluate what kind of attacks are possible and which ones can be easily detected. While the impact of malicious poisoning attacks on some popular algorithms, such as deep neural networks, has been well researched, the vulnerability of other approaches has not yet been properly established. In this effort, we explore the vulnerability of a variety of different machine learning algorithms, including those used for domain adaptation and learning in nonstationary or streaming data environments. We show that the algorithms used in these type of environments are particularly vulnerable to poisoning attacks. If machine learning algorithms are to be more secure, they need to have smart detection mechanisms against an increasingly sophisticated attack mechanisms.

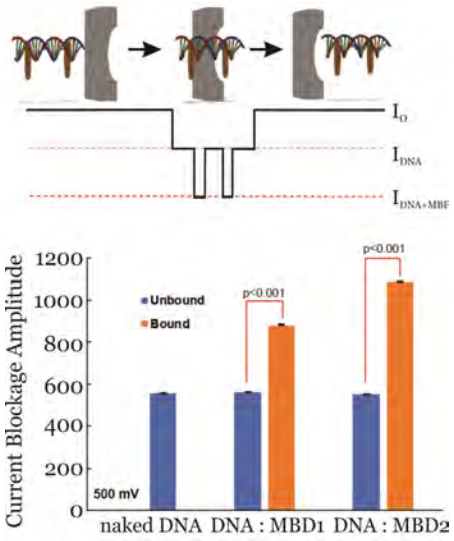
Detecting Methylation using Nanopores and Methyl-Binding Proteins

TEAM MEMBERS

Julian Bello, Olivia Sergent, Christopher Moran, Joanna Soyring, Nicholas Troise

PROJECT MANAGER

Dr. Jiwook (Stephen) Shim



DNA methylation is a naturally-occurring epigenetic modification, which adds methyl groups to DNA. While normal DNA methylation is important because it regulates cell growth and proliferation, aberrant methylation, which can manifest itself as the overall loss of 5-methyl-cytosine (global hypomethylation), or gene promoter-associated (CpG island-specific) hypermethylation, is highly associated with cancer-specific diseases. These mechanisms, which activate local oncogenes and inactivate tumor suppressor genes respectively, are promising biomarkers for early cancer detection at the molecular level. Solid-state nanopores have shown viability in detecting single-molecule analyte with principles of ionic current spectroscopy. By labeling with certain methyl-binding proteins (MBPs), which bind to methylation sites on dsDNA, solid-state nanopores can be used to detect changes in the observed signal relative to an unmethylated control. In this study, 100 bp-long dsDNA with 2 methylated regions were complexed with two types of MBPs, methyl-binding domain 1 (MBD1) and methyl-binding domain 2 (MBD2) and investigated with solid-state nanopores. The percentage of protein bound events versus naked DNA events was about 10 times greater with MBD2 complexes than MBD1 complexes. Similarly, complexes with MBD2 were significantly to have both methylated regions of DNA bound when compared to MBD1, suggesting that MBD2 demonstrates a greater affinity for DNA.

Building Engineering Ethics Activities for First-Year Engineering Students

TEAM MEMBERS

Navroop Kaur, Jason Stefanski

PROJECT MANAGER

Dr. Cheryl Bodnar, Dr. Richard Cimino, Dr. Scott Streiner

Teaching ethics to engineering students is very important as they will most likely face situations that have ethical ramifications in professional practice. Ethics instruction aids with identifying ethical situations and observing one's own approach to ethical situations. Furthermore, engineers need to develop a mindset to deal with ethical dilemmas. For this, they have to be able to supplement their ethical judgement with appropriate resources. The focus of this study was to modify the existing ethics activities within the Freshman Engineering Clinic II gamified online homework platform "Rezzly". Activities created for the platform were designed according to Bloom's taxonomy and ABET student outcomes #3 (communication), and #4 (ethical responsibility). Moreover, all quests were peer reviewed as part of the development process for strong instructional design strategies. Two pathways were designed for the activities, one focusing on developing arguments and applying them to ethical dilemmas and the second pathway to teach students how to apply three perspectives of ethics - personal, normative, and situational - to engineering topics. Data collected from students who complete assignments in Rezzly will investigate whether students a) are able to see a situation from a different perspective by formulating counterarguments and b) can identify their ethical perspective and provide appropriate justification for it.

Sustainable Data Consulting

TEAM MEMBERS

Zachary Weintraut

PROJECT MANAGER

Dr. C. Stewart Slater

Over 200,000 different data sets are publicly available on governmental databases, but only a handful of options exist for visualizing the environmental data. Consequently, one's ability to draw valuable insights from the data is limited by the interface with which the data is accessed. Current tools for visualizing governmental data were identified and customer discovery interviews were conducted to determine existing issues that industry professionals face when trying to find needed data. An online, interactive visual interface was then developed via an ArcGIS platform to reinvent how consumers access public data. The following work is an evaluation of what data is currently available in the public data sets and how it could be better used for highlighting areas of environmental concern.

Engineering Assessment Redesign for Diversity

TEAM MEMBERS
Scott Brody
PROJECT MANAGER
Dr. Tiago Forin
SPONSORS
NSF

In line with university goals and a National Science Foundation grant, several student led teams have been working to enhance Rowan's engineering curriculum to better suit underrepresented groups. In this clinic, the focus was on creating assignments and assessments. Content was redesigned to be more global in nature. Hopefully, by showcasing engineering examples from around the world, students will develop appreciation for other places and cultures besides one's own. Assignments were also made to be more conducive to students of alternative learning styles. As these curricular content was being developed, there are issues that were discovered that impact the application of these assignments. The students also began to map out the ways to properly assess these assignments drawing inspiration from design education practices and ensuring that faculty can capture the impact these assignments have on student development and attitudes.

NJDMAVA Building Audits: Fort Dix JFHQ & Woodbridge Readiness Center

TEAM MEMBERS
Ryan Federline, John Foster, Brandon Salamone, Jason Muermann, Anthony Brooks, Bernard Bogus
PROJECT MANAGER
Dr. Bob Krchnavek, Nick Nocco, Dr. Jess W. Everett
SPONSORS
NJ Department of Military and Veteran Affairs

The Rowan University Energy Audit Team conducted an energy audit for the Fort Dix Joint Force Headquarters per the request of the New Jersey Department of Military and Veteran Affairs to meet federal energy mandates. The objectives of the energy audit were to find significant sources of energy consumption and offer suggestions to reduce the total energy consumption through economically viable measures. A Light and Plug Load model of the entire facility was completed by identifying all energy consuming items, and an eQUEST model was created to simulate the facility's electric and fuel consumption. At the Fort Dix Joint Force Headquarters, the total average annual energy consumption was broken down between 12% for electricity and 88% for natural gas. Possible measures identified by the audit include the replacement of fluorescent T8 light bulbs with LEDs, the installation of occupancy motion sensors, and updating solar panels. Following the energy audit, an informative report will be written by the team detailing their findings and recommendations and sent back to the client.

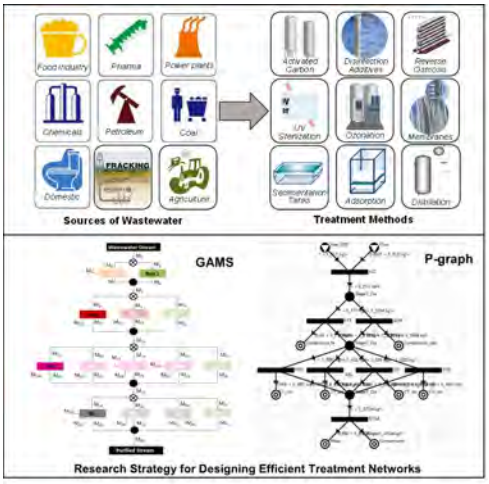
Design of Efficient Wastewater Treatment Networks

TEAM MEMBERS

Sean Burnham, Rohan Zia

PROJECT MANAGER

Dr. Kirti Yenkie



Water is the most necessary commodity for survival for all forms of life around the world. Unfortunately, it is often undervalued and wasted, as those who readily have access to clean, safe water do not understand the magnitude of its importance. The wastewater stream from different sources is often filled with contaminants that will prove detrimental to life forms waiting downstream from this wastewater. Treating wastewater depends on the contaminant concentration, which determine the appropriate treatment technology and removal efficiency in each stage. Certain factors like toxicity, size, chemical structure, and physical amounts all play a role in how the problem is approached. Therefore, the development of a superstructure, consisting of all possible treatment methods and then reducing to the desired technologies to best select the route that can most effectively process the wastewater is essential. We use representative case studies for municipal and pharmaceutical wastewater treatment and model them as optimization problems in GAMS programming language. In the next step, we use the P-graph approach for solving the same problem as this tool can provide insights into non-intuitive solutions, which guarantee global optimality.

Recognition of Digits using Deep Convolutional Neural Networks

TEAM MEMBERS

Marc Giordano, Ryan Drexel

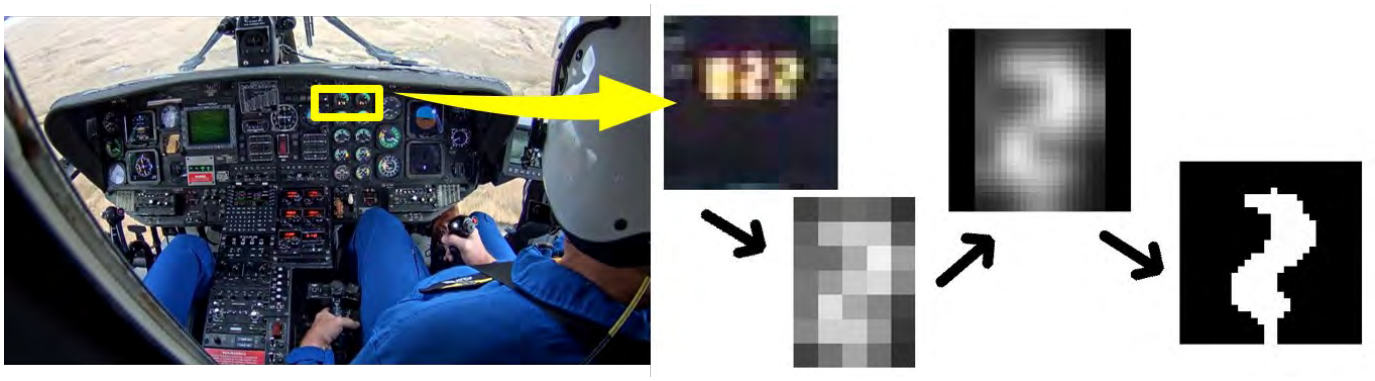
PROJECT MANAGER

Dr. Ghulam Rasool

SPONSORS

Federal Aviation Administration

Recognizing different objects, especially digits can be an easy task for humans; however, very challenging for computers. In this project, we aimed to recognize numbers in a video stream using convolutional neural networks (CNNs). Using a CNN model trained on the MNIST (Modified National Institute of Standards and Technology) handwritten dataset, the images from helicopter cockpit video were first scaled up and then processed. The MNIST model was trained on 28x28 pixel grayscale images; however, our images were 5x7 pixels in size and simple transfer learning may not work. In our case, images were saved as grayscale and scaled up to 20x28, and a 4-pixel black border was added on each side to make the size 28x28. We are running experiments to train CNNs for the classification of these digits now.



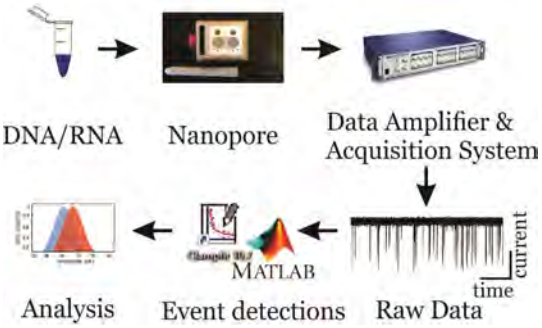
Biological nanopore sensor for molecular cancer biomarker detection

TEAM MEMBERS

Joanna Soyring, Christopher Moran, Melissa D'Alia, Trang Vu

PROJECT MANAGER

Dr. Jiwook (Stephen) Shim



Cancer is the second leading cause of death in the US, estimating over 1660 deaths a day in 2019, but the cancer mortality rates can be reduced if detected at early stage. Nanopore technology offers a wide range of applications in single-molecule assay and analysis with high throughput and high sensitivity. Using a biological nanopore, we develop a nanoscale biosensing tool to investigate aberrant DNA methylation pattern, which is a prominent biomarker for cancer screening at early stage, risk assessment, and personalized medicine. The biological nanopore-based sensor can work with small sample volume, allowing the extracted gene promoter methylations to be directly detected without amplification and accurately detected without labeling. In this project, a biological nanopore is utilized to distinguish between unmethylated- and methylated-double-stranded DNA. An 85% current blockage is characterized as a "level 4 blockage," and signifies the unzipped dsDNA region translocating through the pore. Through nanopore ionic current signatures, significant differences were observed between the methylated and the unmethylated DNA. This is the evidence in support of the ability of biological nanopores to detect differences in the characteristics of the DNA.

Framework for Solvent Recovery, Reuse, and Recycling in Industries

TEAM MEMBERS

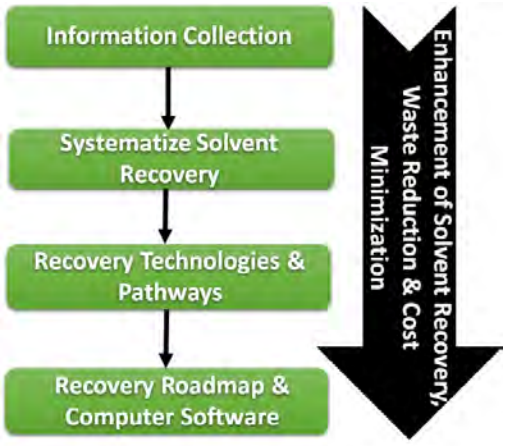
Amanda L. Christon, Vanessa A. Pierce Maxim P. Russ, Jake Stengel

PROJECT MANAGER

Dr. Stewart C. Slater, Dr. Mariano J. Savelski, Dr. Kirti M. Yenkie

SPONSORS

US EPA



Solvents are commonly used in both the fine chemicals and pharmaceutical industries in liquid reactions to aid reaction and purification steps to maintain the quality of the product. Solvents can account for as much as 90% of the process by mass, but are often disposed of after single use. Incineration is the most widely used process for solvent disposal, though it is not necessarily a "green" method. Because of potential detrimental effects to the environment, recovery methods are being considered to improve the "greenness" and sustainability of processes in the pharmaceutical and fine chemical industries. Potential solvent recovery technologies have been researched for the purpose of developing mathematical models using General Algebraic Modeling System (GAMS). Some of these technologies include distillation, ultrafiltration, and extraction. The models consist of material and energy balances as well as utility requirements, equipment design, and costing to assist in determining the most feasible method for solvent recovery. This work is a part of a US EPA funded project. The ultimate goal is to consult with industries on a case-by-case basis to develop a roadmap for solvent recovery that reduces cost, minimizes environmental impacts, limits waste produced, while also maintaining safe operation.

Creating Inclusive Curriculum in Engineering and STEM

TEAM MEMBERS

Luke Venskus, Abbie Hughes

PROJECT MANAGER

Dr. Tiago Forin

SPONSORS

NSF

This study presents the ongoing development of more inclusive classrooms within the Civil and Environmental Engineering Department at Rowan University. Inclusivity in a classroom is based on practices of liberative pedagogy. The key sources of the work such as Pedagogies of Liberation in an Engineering Thermodynamics Classroom by Donna Riley will serve as a template for our work informing our ideas for assignments and changes in classroom settings as developed. Particular aspects of the inclusive classroom became a central focus including acknowledging different learning styles, assessing the growth of the students, and developing the teacher student relationship. It was discovered fairly quickly that the development of new curriculum for engineering classes was doable but would require time to develop further. Once each assignment was developed a rubric particular to that class, work, and what aspects were to be grown in the students had to be made in order to gauge the students development, and in tern the development of the inclusive classroom. Presented are the highlights of certain assignments that were created and their impact.

AIAA Design, Build, Fly

TEAM MEMBERS

Cory Adler, Brennan Appleman, Caio Arruda, Ian Day, Nolan Foy, John Fullerton, Caleb Jackson, Waqar Khaliq, Michael Marano, Eunice Nepomuceno, Rutesh Patel, Quinn Rinaman, Michael Shirley, Pietro Sparacio, Michael Sylvestro

PROJECT MANAGER

Dr. Jennifer Kadlowec, Dr. Hong Zhang, Jack Wynn

SPONSORS

Rowan AIAA Club

This year's AIAA's Design, Build, Fly objective is to construct a multi-purpose aircraft within the specific size requirements that can successfully perform multiple carrier operations during the flight missions. This clinic goes through multiple design stages, manufacturing processes, and test planning. Rowan University's 2018-19 DBF team consists of 16 Rowan Engineering students, each given specific roles and responsibilities in their respective subsystem. The team has also created a Gantt chart to stay on schedule and be ready for the competition in April. The flight objectives at this year's competition include flying 3 laps without any payload, deploying at least 4 rocket stores, and remotely rotating a radome while the aircraft is in flight. The missions also require the aircraft to have a stowed configuration, which involves designing a wing that has folding capabilities, which means it needs to fit inside a 3' by 2' box while still meeting the 4' minimum wingspan. All these functions must be demonstrated during the ground mission in under 5 minutes. Each function will be scored based on how well each is demonstrated which is crucial in order to place well in the competition.

STEM Demos for Engineering Outreach

TEAM MEMBERS

Bo Gilligan, Ben Golden, Brandi Kelly, Dan Mahncke, Jake Nugent, Kevin Purcell, Brian Thatcher, Brennan Thiemann

PROJECT MANAGER

Dr. Melanie Basantis

The 2018/2019 STEM Demos for Engineering Outreach Clinic team hosted and inspired over 1000 middle and high school students during the academic year. The goal of the STEM Demos for Outreach Clinic is to develop innovative, hands-on projects and demonstrations for K-12 students showcasing each of the engineering programs and present these projects in an informal, fun and engaging manner to regional middle and high school audiences. The welcoming and supportive environment created by the clinic team coupled with an applied approach to engineering education affords the opportunity for middle and high school students to discover Rowan engineering, think innovatively, and easily inquire about undergraduate engineering education and college life. Through the STEM Outreach clinic, Rowan Engineering Students have empowered and positively impacted over 1000 middle and high school students exploring engineering at the Henry M. Rowan College of Engineering. Students work in teams to tackle each project while also developing a better understanding of basic engineering principles. An engineering overview is provided along with a tour of the engineering buildings including stops at all of the engineering labs. Functional input on college life and preparing for the transition to collegiate engineering is provided by STEM Demo Clinic team. The STEM Clinic Team also supports on and off-campus STEM initiatives such as middle and high School Career and Science Fairs as well as supporting the Camden-based CHAMP program.

Process Safety Decision Making in a Digital Immersive Environment

TEAM MEMBERS

Matthew Knighton, Sarah Ramsey, Jeffrey Stransky, Kevin Wixted

PROJECT MANAGER

Dr. Cheryl Bodnar

SPONSORS

The work performed was supported by NSF Improving Undergraduate STEM Education [IUSE DUE#1711376, 1711644, 1711672, and, 1711866] for which the authors are very grateful.

In the chemical industry, process safety incidents occur that can have significant detrimental outcomes. Often times these incidents aren't the result of a single event but rather a series of decisions that lead to the final incident. For this reason, seniors pursuing a degree in chemical engineering need exposure to decisions that occur within process safety contexts. A digital immersive game, Contents Under Pressure, was developed to allow students to see the complexities of process safety decision making. The focus of this clinic project is on the analysis of students' approaches to moral and informal reasoning in the game based on data from 66 senior chemical engineering students. Moral reasoning was investigated through analysis of students ratings of reflection prompts representing Kohlberg's moral reasoning levels of pre -conventional, conventional, and post-conventional. Student's approaches to informal reasoning was investigated by examining the student's response time for decision prompts in the game to determine if any patterns existed between the type of prompt and the length of time it took for students to make their decision. Developing a better understanding for how students approach process safety decisions allows for modifications to be made to instruction to improve students' preparedness for the working environment.

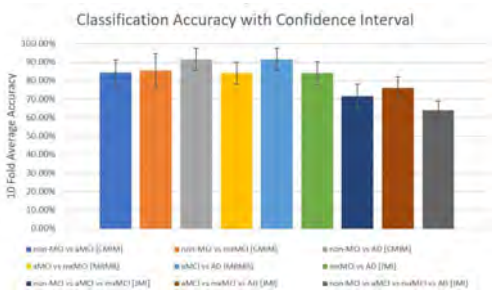
Analysis of Clock Drawing Test Features for Early Diagnosis of Alzheimer's

TEAM MEMBERS

Kyle Naddeo, Lonnie Sauder, Nicholas Klein, Thai Nghiem, Timothy Duong, Jacob Epifano

PROJECT MANAGER

Dr. Robi Polikar, Victor Wasserman, Dr. David Libon



Alzheimer's disease (AD) is the leading cause of death among elderly, with no definitive mechanism for diagnosis and no cure. The most common approach for diagnosis uses a series of memory tests evaluated by neurologists. Misdiagnosis is not uncommon, and the decision is often subjective. More recently, machine learning has emerged as a powerful mechanism to help with automated and objective diagnosis of neurological disorders in general, and AD in particular. In this project, we join forces with Rowan School of Medicine in analysis of vast amounts of data collected through one particularly promising test, the so-called clock drawing test. This deceptively simple test generates a treasure trove of data in hundreds of potential features. Our primary goal is to determine which of these features are in fact 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.

NJDMAVA Building Audits: Fort Dix Battle Lab & Westfield Readiness Center

TEAM MEMBERS

Jason Muermann, Michael Del Vecchio, Alexander Guzman, Piotr Lukaszek, Seamus Plunkett

PROJECT MANAGER

Nick Nocco, Dr. Francis (Mac) Haas, Dr. Jess W. Everett

SPONSORS

NJ Department of Military & Veterans Affairs

The Rowan University Energy Audit Team conducted an energy audit for the Fort Dix Battle Lab per the request of the New Jersey Department of Military and Veteran Affairs to meet federal energy mandates. The objectives of the energy audit were to find significant sources of energy consumption and offer suggestions to reduce the total energy consumption through economically viable measures. A Light and Plug Load model of the entire facility was completed by identifying all energy consuming items, and an eQUEST model was created to simulate the facility's electric and fuel consumption. At the Fort Dix Battle Lab, the total average annual energy consumption was broken down between 51.1% for electricity and 48.9% for natural gas. Possible energy-saving measures identified by the audit include the replacement of fluorescent T8 light bulbs with LEDs, the installation of occupancy motion sensors, and implementation of window blinds. Following the energy audit, an informative report detailing the team's findings and recommendations will be written and submitted to the client.

Dextrous Prosthetic Limb - Mechanical Design

TEAM MEMBERS

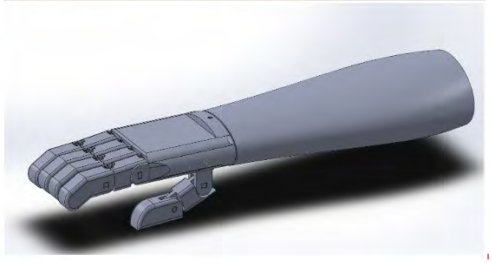
Christopher Devone, Alex Ventura, Robert Livingston, and Matthew Pincus

PROJECT MANAGER

Dr. Ghulam Rasool, Dr. Nidhal Bouaynaya

SPONSORS

NJ Health Foundation



Loss of functionality of a limb can have significant impacts on an individual's quality of life. Completing everyday tasks can be a constant struggle, which adds to the emotional, social, and mental distress caused by losing a limb. To aid those who have lost limbs, prosthetics help alleviate the complications and stress of performing physical tasks. Currently, however, the prosthetics available in the market have an exorbitant price tag and a solution must be found in order to make these products more accessible to those who need them. The mechanical team for the dextrous prosthetic hand has engineered physical solutions to this problem by utilizing a combination of 3D printed parts and variable motors. The designs created are functional, affordable, customizable, and easily replicated.

NJARNG Sustainable Facilities Management

TEAM MEMBERS

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PROJECT MANAGER

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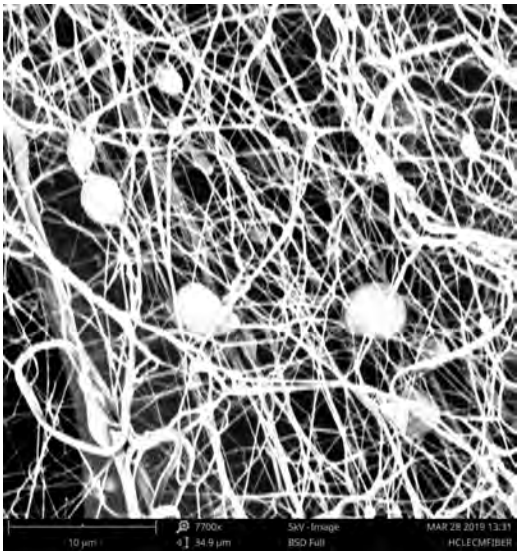
SPONSORS

NJARNG

The Sustainable Facilities Center at Rowan University is working with the New Jersey Army National Guard (NJARNG) to improve the cost-effectiveness, sustainability, and mission readiness of over 250 facilities. To achieve these goals, the Sustainable Facilities Center has begun the inventory and condition assessments of NJARNG facilities, developing life cycle cost analysis (LCCA) methodology, and establishing a decision making framework for repair or replacement of systems and components. Inventory and condition assessments are performed by Rowan University and entered into the BUILDER Sustainment Management System (SMS) for NJARNG facilities. Rowan University is training NJARNG armorers to implement a web-based work order system to facilitate maintenance and repair work. These tools will provide a snapshot of current condition and ongoing maintenance costs for facilities, as well as enabling predictions of future conditions. A LCCA is used to determine a cost-effective strategy regarding the installation, replacement, and maintenance of various building system components. Pilot LCCA models for HVAC components contained in the BUILDER SMS database are under development and will be expanded to include various other systems. Repair or replacement decision strategies are being identified for recommendation for use by NJARNG.

Tendon/Polymer Nanofiber Scaffolds for Regenerative Medicine

TEAM MEMBERS
Cameron J Burns
PROJECT MANAGER
Dr. Vince Beachley



The development of blended tendon extracellular matrix (ECM), and polycaprolactone (PCL) aligned nanofibers could greatly assist in the repair and regeneration of damaged tendons and ligament. ECM derived from a given base tissue contains a great number of signaling molecules and more than any other form of off the shelf collagen or gelatin. In this particular system, the ECM provides advantages in cell adhesion, differentiation, and growth, whilst the PCL provides a strong scaffold on which cells can grow and guides the alignment of the cells. More often than not, the process of blending two disparate materials for electrospinning requires a common solvent, yet ECM is not soluble in the organic solvents often used in the creation of PCL nanofibers. This was overcome by first digesting ECM with pepsin in aqueous hydrochloric acid. Following this, the samples were blended with PCL solutions dissolved with aqueous acetic acid. This process allows for a clean blend of the PCL and ECM rather than a suspension. The solutions were then spun using an electro-spinner and collected. Fibers were examined under a scanning electron microscope. Eventually, the fibers will be seeded with cells in order to examine the cell adhesion properties of the scaffold.

Optimizing Irritable Bowel Syndrome (IBS) Diagnosis and Treatment

TEAM MEMBERS
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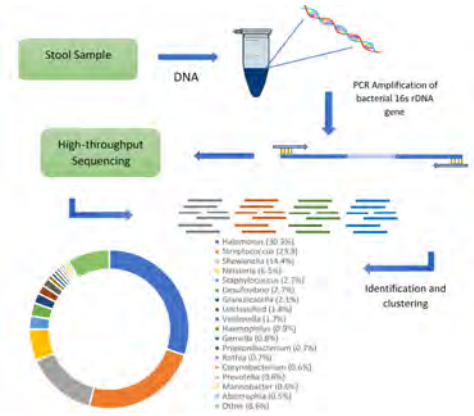
PROJECT MANAGER
Dr. Kirti M. Yenkie
SPONSORS
Inspira Healthcare



Irritable Bowel Syndrome (IBS) is a chronic gastrointestinal disorder that affects 10-15% of the worldwide population. Although IBS is rather common, a reliable diagnosis and treatment method has yet to be developed and implemented. Currently, no test exists to characterize the IBS subtypes in patients, leaving both patients and doctors with uncertainty in the diagnosis and potential management strategy. This work focuses on optimizing treatment and diagnosis of IBS using patient data and computational modeling software. The gut microbiota can be analyzed using 16S rDNA sequencing to determine bacterial compositions, and this data was gathered by the project collaborators at the Cooper Medical School at Rowan University and sent to the team. Trend analysis and diversity tests are performed using RStudio to determine how the gut microbiota varies between patients. Based upon preliminary research and data, IBS patients are expected to have distinguishable bacterial compositions in comparison to healthy controls. The existing literature shows that IBS patients' gut microbiota are far less diverse than healthy ones, with high populations of relatively few bacteria. The output bacterial levels can be used to determine efficient probiotics and diets to attain a healthy gut microbiota and diminish IBS symptoms on a patient-to-patient basis.

Effects of Genipin Crosslinking on Hydrogels Derived from Bovine Tendon

TEAM MEMBERS
Alicia Coombs
PROJECT MANAGER
Dr. Vincent Beachley

Extracellular matrix (ECM) hydrogels are a useful biomaterial in the tissue engineering field used for injectables in drug delivery systems, wound dressing, tissue regeneration and many other applications. One major limitation of ECM hydrogels is that they are structurally weak and have a much lower modulus when compared with human tissues. It was hypothesized mechanical properties of ECM hydrogels could be advanced via crosslinking. Genipin, a crosslinking agent was used to crosslink decellularized tendon ECM hydrogels. The gels polymerized with a 400 ul volume of pre-gel solution consisting of ECM, hydrochloric acid and pepsin, 1/10 the volume NaOH and 1/9 10x Phosphate Buffer Saline (PBS). Increased structural stability was observed with an increase in ECM concentration. Genipin was dissolved in dimethyl sulfoxide (DMSO) to form a 0.5% w/v solution. The gels were crosslinked using 50 uL/mL genipin. Crosslinked ECM hydrogels with ECM concentrations of 10%, 12%, 15%, 20% and 26% were mechanically tested. When genipin was added directly into the pre-gel solutions during neutralization, the resulting gels were much less compact and larger than gels crosslinked after polymerization. The addition of genipin to the ECM hydrogels increased the mechanical strength and modulus of the gels.

NJARNG Building Information Modeling

TEAM MEMBERS
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PROJECT MANAGER
Samantha Valentine, Dr. Jess W. Everett, Dr. William Riddell, Ryan Loeh
SPONSORS
NJ Army National Guard

Building information modeling (BIM) is the collection and compilation of data that can be used to design, construct and manage infrastructure. These tasks can require an immense amount of data which can be daunting to comprehend. This data includes location type and condition of building system components. The objective of this project is to provide 3D building information models of National Guard Readiness Centers to visualize and assess facilities. The original task provided for each center was to model the building envelope using commercial BIM software and point clouds captured by a terrestrial laser scanner. After completing the models for building envelopes, various systems such as electrical, plumbing, and HVAC were added. With the completion of these systems, the NJ Army National Guard will have comprehensive models of the Readiness Centers that they can use for future work in condition assessment, energy modeling, simulations, and planning.

Improving the Efficiency of Coffee Manufacture using Membrane Systems

TEAM MEMBERS

Steven Husar, Carly Jankowski, Michael Vincent Laurio, Adam Niznik, Sommer Vandergrift

PROJECT MANAGER

Dr. Stewart C. Slater, Dr. Mariano Savelski

SPONSORS

U.S. Environmental Protection Agency, Nestlé Beverage U.S.A.

A study, in partnership with Nestlé Beverage USA, U.S. Environmental Protection Agency, and Rowan University, has been conducted to improve the sustainability profile for the manufacture of instant (soluble) coffee products. The feasibility of membrane processes as alternative to energy-intensive separations such as evaporation, in pre-concentrating coffee extract prior to spray/freeze drying, was investigated. The advantages of a novel dynamic vibratory membrane process, such as shear-enhancement and flux improvement by reduction of gel formation and fouling, were also evaluated in comparison with traditional cross-flow configuration. Membrane screening studies showed that nanofiltration is the most effective in terms of permeate flux, and selectivity. Correlations for instantaneous and average permeate flux, characteristics, and rejections as functions of percent recovery were obtained from parametric studies involving aqueous coffee extract at different concentrations, operating pressure, and vibrational displacement. These were used to estimate design parameters at high overall recoveries (as is with a commercial unit). A greener scaled-up membrane operation was compared with a thermal process for concentrating a coffee stream and energy savings, operating and capital costs, and resulting life cycle emissions profiles were determined. Our research shows this is a promising area for further investigation to make other manufacturing operations more sustainable.

Vascularized scaffolds for spinal cord injury repair

TEAM MEMBERS

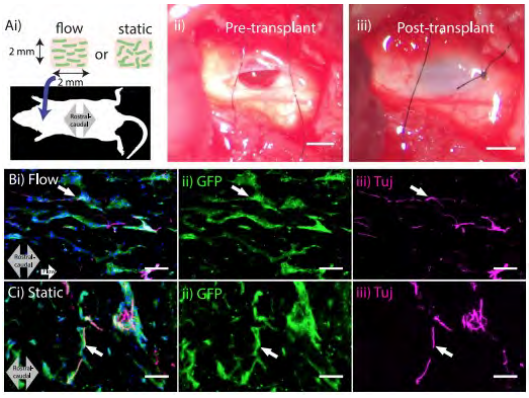
Angelica DaSilva, Jeremy Decker

PROJECT MANAGER

Dr. Peter Galie

SPONSORS

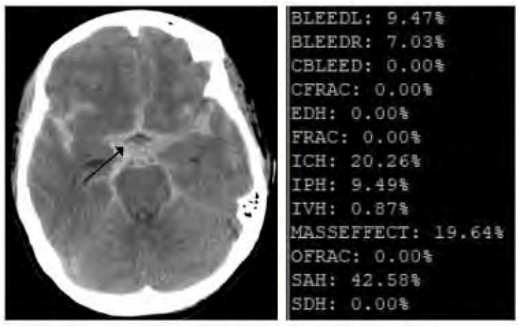
Neilsen Pilot Research Grant (Award 544652)



Our research group is investigating the efficacy of vascularized scaffolds to stimulate and guide the growth of axons following spinal cord injury. Our preliminary studies demonstrated that axons from the injured animal infiltrate the scaffold and grow along transplanted blood vessels. Currently, we are interrogating strategies to bring this approach closer to the clinic. In particular, we are developing a protocol to generate blood-brain barrier-forming endothelial cells from induced pluripotent stem cells (iPSC). Senior Angelica DaSilva and junior Jeremy Decker are leading this effort by characterizing the iPSC and analyzing their response to three-dimensional protein matrices. Their work has demonstrated that iPSC-derived endothelial cells form vascular structures within a transplantable hydrogel environment. Furthermore, experiments have been conducted to characterize the mechanobiology of the iPSC-derived cells through the use of atomic force microscopy and nanoindentation. Computational modeling of the cells using a Neo-Hookean constitutive equation has yielded insight into the mechanics of these cells and helped further characterize their response to environmental stimuli. Overall, this work informs future transplantation strategies that will rely solely on a patient's own cells for treatment.

Detection of Acute Stroke from CT Images

TEAM MEMBERS
Matt Mammarelli
PROJECT MANAGER
Dr. Ghulam Rasool
SPONSORS
NJ Health Foundation



The typical procedure for detecting if someone had a stroke is through visual inspection of CT images by a team of radiologists. This method has inherent human error and raises the question if this process could be performed with more accuracy and efficiency through the use of a trained deep learning model. A dataset composed of CT Plain DICOM images was created for around five hundred patients where there were recorded stroke labels by three radiologists for every patient. Label consensus was then defined as more than one radiologist agreeing that a certain label applied to a stroke patient. These patients were then divided based on the stroke label consensus of their CT Plain images and fed into a model. A convolutional neural network (CNN) model was created using the SmallerVGGNet architecture and trained using multi label classification. Two trains were performed, the first with 64 patients and the second with 329 patients. Both trains yielded results of around 90% for training and validation accuracies and 20% for training and validation losses. Both models were able to distinguish test CT Plain images into percentages of labels indicating variations of acute stroke.

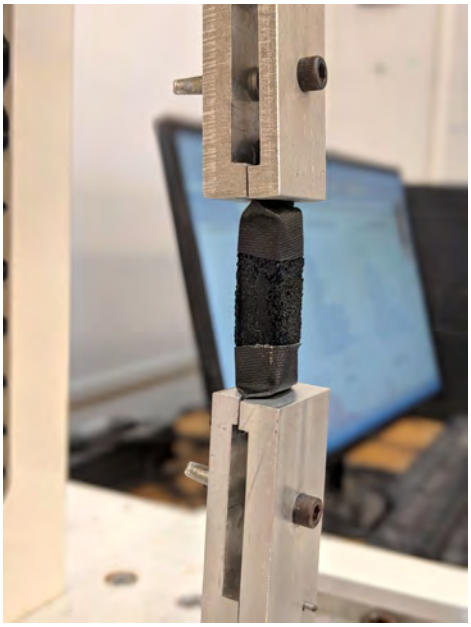
RED Introduction to Infrastructure

TEAM MEMBERS
Tony Carlino, Will Sjaastad, Charlie Sceia, Carlos Perdomo
PROJECT MANAGER
Dr. Ralph Dusseau, Dr. Jagadish Torlapati
SPONSORS
National Science Foundation

Revolutionizing engineering diversity (RED) has teamed up with Rowan University to support the Department of Civil and Environmental Engineering in creating significant sustainable changes necessary to overcome long standing issues. This is done by educating the undergraduates in order to prepare them to solve 21st century challenges. These hurricanes include Maria, Florence, and Michael. The students are challenged by brainstorming ideas on how to prevent extreme flooding in our nation's cities and towns. They also address the question “how can we construct our infrastructure moving forward with sustainability to withstand a 100-year hurricane?” Students are also educated on bridge failures that have occurred within the last couple of years such as: The I-85 Bridge Collapse in Atlanta Georgia, The Pedestrian Bridge Collapse in Miami Florida, and The Italian Bridge Collapse in Genoa, Italy. These engineering failures have been researched in detail to prepare the structural classes for the challenges they will be face with structural design. Data has also been collected with pre- and post-surveys for each class to ensure the lectures and activities are having a positive effect the students’ ability to understand engineering principles and the severity of our nation's infrastructure.

Tactile Sensors Using Porous Materials

TEAM MEMBERS
Michael Capasso, Rhandy Paladines
PROJECT MANAGER
Dr. Wei Xue



Our piezoresistive tactile sensors utilize the deformative properties of a polymer with pores to create a material that changes its electrical resistivity as it is deformed. Our specific sensors are made using polydimethylsiloxane (PDMS), which is a polymer, then suspending carbon nanotubes throughout to make it conductive. Finally, it is made porous to allow its conductivity to be altered as it is deformed. This is an ongoing project; the goal of which is to determine the physical and electrical properties of these types of tactile sensors in both static and dynamic environments, as well as determine where they would be useful in improving the everyday lives of people around the world.

Lung Cancer Detection using Deep Learning

TEAM MEMBERS
Brendan Nugent, Nicolas Setaro
PROJECT MANAGER
Dr. Ghulam Rasool
SPONSORS
NJ Health Foundation

Lung cancer treatment statistics indicate that early diagnosis drastically increases the chances of a patient's successful treatment. Commonly, radiologists observe hundreds of images which construct a vast number of patients' CT scans, searching for nodules to make a diagnosis. With the advent of deep learning due to the increase in data availability and computation power, image recognition and analysis have provided solutions to complex problems. In radiology, models have achieved greater than doctor-level success in detecting pneumonia. Similarly, it is proposed that lung cancer can be detected in CT scans using deep learning. A model is being developed and will be trained and tested using the National Lung Screening Trial (NLST) dataset. The dataset is composed of over 75,000 CT scans and data regarding the number of images in each scan, the patient demographics, and lung cancer diagnosis. The CT scans serve as the features for the neural network and the diagnoses provide labels for training the model. Finally, the model should output whether the CT scan represents a malignant nodule or a benign nodule, '1' or '0', respectively.

Characterization of Piezoelectric Cantilever Beams for Energy Harvesting

TEAM MEMBERS

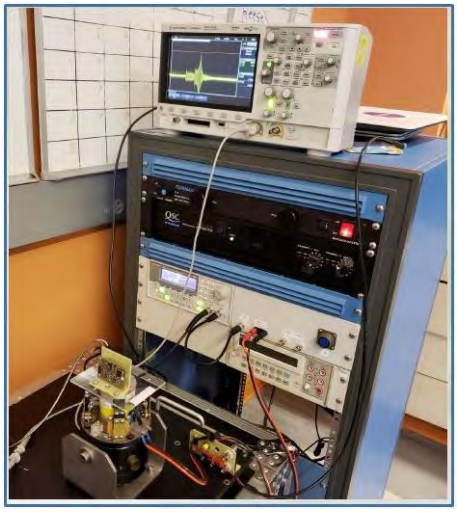
David Russo, Colby Clark, Sean Johnson, Dylan Dancel

PROJECT MANAGER

Dr. Sagnho Shin, Dr. John Schmalzel, Russel Trafford

SPONSORS

TBT Group



This project investigates a method of characterizing Piezoelectric cantilever beams for applications in roadside energy harvesting. Research to date studies piezoelectric harvesting units embedded in pavement, which has a host of logistical issues. Other previous implementations have focused on adhering piezoelectric elements to a substrate which acts as the beam. This project focuses on an implementation using only the piezoelectric as the cantilever beam and an initial investigation into the feasibility of harvesting electricity from a cantilever beam system on the roadside. A Piezoelectric element was tested by clamping it to the vibration table and observing the open-circuit voltage over a frequency range of 1 - 200 Hz at approximately 1 G. The test samples had a prominent but narrow-banded resonance at between 20 - 200 Hz, outputting roughly 2.45 - 6.22Vrms, resulting in between 63.6-289W. These preliminary results show there is a high probability that a piezoelectric roadside harvesting device is feasible.

Modeling of Cerebral Aneurysm Formation

TEAM MEMBERS

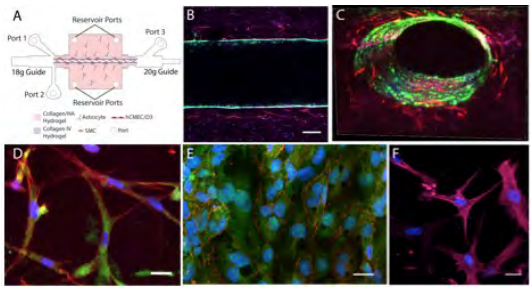
Brandon DeOre, Janki Khadela

PROJECT MANAGER

Dr. Peter Galie

SPONSORS

NSF Award ID 1728239



Disturbed blood flow disrupts the shear stress profile exerted on the endothelium, but the effect of altered shear stress on the integrity of the blood-brain barrier (BBB) is not fully understood. The complexity of factors within the in vivo brain prevents interrogation of the effect of altered shear stress on the BBB in animal models. Using a three-dimensional in vitro model of a cerebral bifurcation consisting of a co-culture of endothelial cells, smooth muscle cells and astrocytes, we have investigated the effect of disturbed blood flow on the integrity of the BBB. Combining microparticle image velocimetry with computational fluid dynamics provides the ability to apply distinct regions of altered shear stress to an endothelial lumen and interrogate its effects on BBB integrity using immunocytochemistry and permeability testing. This year, seniors Brandon DeOre and Janki Khadela have interrogated means of isolating mRNA from this system to study the effect of disturbed flows on gene expression of endothelial cells. The goal of this work is to better understand the response of the cells to this type of environment, in order to determine whether aneurysm development is associated with altered blood flow. Specifying the molecular mechanism underlying the cell response can potentially lead to new therapeutic targets to attenuate aneurysm formation.

Polymer Composite for Navy Applications – Design

TEAM MEMBERS

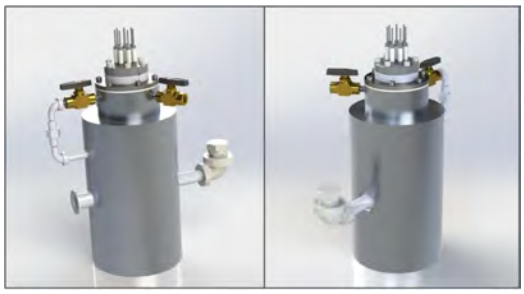
Ryan Buck, Robert Phillips, Erik Zapfe, Kyle Schultz, Ed Hicks, Brad Smith, Mark Hausman, Matthew Chin

PROJECT MANAGER

Dr. Wei Xue, Dr. Robert Krchnavek

SPONSORS

Naval Surface Warfare Center (NSWC), Naval Engineering Education Consortium (NEEC)



The primary objective of this clinic is to study the possible use of nanocomposite materials as dielectrics in high temperature superconducting (HTS) cables for the United States Navy. To do so we must design a system to test the synthesized polymer nanocomposite samples at cryogenic temperatures. The properties of these samples that are of most concern are dielectric breakdown strength, coefficient of thermal expansion, and mechanical strength. For conducting these tests we will be utilizing two separate testing systems. The first system, which is designed and currently being fabricated, will utilize liquid nitrogen to reach temperatures of approximately 80 Kelvin. This liquid nitrogen system will speed up our sample testing process while also allowing us to test at temperatures close to operating values. The second system is currently in the design stage and will utilize gaseous helium to produce a testing environment of about 40 Kelvin. With the ability to test for dielectric breakdown strength, coefficient of thermal expansion, and mechanical strength at various temperatures our team hopes to create a new HTS cable dielectric that will outperform previous dielectrics in all categories.

Concrete Finish Issues with Galvanized Rebar

TEAM MEMBERS

William F. Rohe Jr., Nicholas DiFranceisco, Aiden Rogers, Thomas Weideli

PROJECT MANAGER

Dr. Douglas Cleary

SPONSORS

Northeast PreCast LLC.

This clinic involved a problem relating to civil engineering. It focused on the investigation of precast concrete surface finish issues caused by chemical reactions with embedded galvanized rebar. Northeast Precast, a local precasting company, requested the clinic team to investigate this problem since some of their Mechanically Stabilized Earth (MSE) panels were experiencing the finish issues. Control tests were conducted at their plant, and electrochemical current reaction tests were conducted at Rowan's Civil Engineering labs. A total of 9 tests were done at the Northeast Precast plant, varying parameters such as form oil, admixture, form type, etc. The tests at Rowan used the concrete mix design from Northeast Precast, and only varied the anti-corrosion admixture for each test. This allowed the team to pinpoint which admixture was most effective based on the electro-chemical readings.

Biohybrid Drug Delivery Platform with Controlled Release and Targeting

TEAM MEMBERS

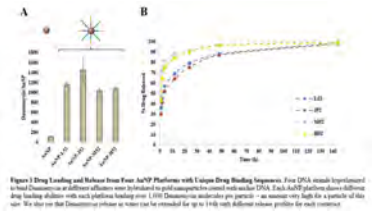
Matthew Grisley, Robert J. Mosley, Ricky J. Whitener, Matthew V. Talarico, Jacek Wower

PROJECT MANAGER

Dr. Mark E. Byrne

SPONSORS

This research was funded by the AURIC Seed Grant and the US Department of Education GAANN Graduate Fellowship Program in Biological & Pharmaceutical Engineering Award No. P200A120244. 1. Biomimetic & Biohybrid Materials, Drug Delivery Laboratories, Department of Biomedical Engineering, Rowan University 2. RNA Biochemistry Laboratories, Department of Animal and Dairy Sciences, College of Agriculture, Auburn University



We developed a novel biohybrid platform with potential for selective drug delivery to tumor cells. We utilize a gold nanoparticle (AuNP) as a core with controlled loading of a DNA monolayer on its surface. Aptamers can be conjugated to the nanoparticle - with little to no modification - through complementary base-pairing. Base-paired regions can be exploited to load therapeutics such as Daunomycin. Nanoparticle size is analyzed using dynamic light scattering and DNA loading is studied using a quartz crystal microbalance – a tool for highly sensitive, real-time observation of surface interactions in liquid media. We can load >1,000 Daunomycin molecules per AuNP with extended release. Additionally, we can modulate drug loading and release profiles through aptamer engineering by selectively choosing the nucleic acid sequence of the drug binding region. An endocytosis assay is performed using known endocytotic inhibitors to observe internalization of AuNP platforms; drug loaded AuNPs are also observed to kill cancer cells at a greater rate than free Daunomycin. This platform is innovative in its use of molecular biology to enhance drug delivery, and its multifunctionality allows for multi-target delivery of a variety of drugs on a single nanoparticle for personalized cancer therapies.

Bio-Cemented Clayey soil Through Microbial Induced Calcite Precipitation

TEAM MEMBERS

Mark Vail, Luke Anderson, Michael Moroski

PROJECT MANAGER

Dr. Melissa Lomboy, Dr. Cheng Zhu

Desiccation cracking in clayey soils due to moisture loss over time weakens the bearing capacity and lowers the stability of the soil, which may lead to catastrophic geotechnical failures. Microbial Induced Calcite Precipitation (MICP) is used as an environmentally friendly soil stabilization technique, and is known to increase bonding strength between particles to remediate desiccation cracking. The reaction requires a mixture of bacteria, calcium chloride and urea solutions. Urea acts as a food source to the bacterial strand and is a catalyst to the reaction between the bacteria and calcium chloride to create a calcium carbonate precipitation. Four clayey soil samples were prepared by mixing bentonite and sand with 100% moisture content of deionized water, MICP solution, bacteria solution, and pure cementation solution, respectively. The cracking process was observed under a high-resolution camera and underwent image processing to analyze the area, length, and width of each crack segment, and the total crack area percentage for each sample. Test results showed that soil treated with MICP resulted in less desiccation cracking and higher bonding strength than untreated soil. This study provides a new possible approach for desiccation cracking remediation.

NJDMAVA Building Audits: Fort Dix JT2DC & Lakehurst AASF

TEAM MEMBERS

Alexander Guzman, Nicholas Pagliocca, Chris Amling, Michael Del Vecchio, Timothy Campbell

PROJECT MANAGER

Dr. William T.Riddell, Dr. Nick Nocco, Dr. Jess W. Everett

SPONSORS

NJDMAVA

The Rowan University Energy Audit Team conducted an energy audit for the Joint Training and Training Development Center (JT2DC) per the request of the New Jersey Department of Military and Veteran Affairs to meet federal energy mandates. The objectives of the energy audit were to find significant sources of energy consumption and offer suggestions to reduce the total energy consumption through economically viable measures. A Light and Plug Load model of the facility was completed by identifying all energy consuming items, and an eQUEST model was created to simulate the facility's electric and fuel consumption. At JT2DC, the total average annual energy consumption was broken down between 51.1% for electricity and 48.9% for natural gas. Possible conservation measures identified by the audit include the replacement of fluorescent T8 light bulbs with LEDs, the installation of occupancy motion sensors, and increased insulation around exterior exits and garage doors. Following the energy audit, a report detailing findings and recommendations will be sent to the client.

Thermosensitive Hydrogels for Extended Release Therapeutics

TEAM MEMBERS

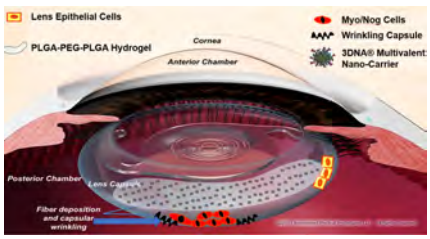
Daniel Maldonado1, Alex Yiantsos1, Nicole Rosselli1, Laura L. Osorno1, Robert Getts2, Mindy George-Weinstein3

PROJECT MANAGER

Dr. Mark E. Byrne 1

SPONSORS

Cooper Foundation, Genisphere, LLC., OcuMedic, Inc., and the Philadelphia College of Osteopathic Medicine. 1 Biomimetic & Biohybrid Materials, Biomedical Devices, and Drug Delivery Laboratories, Dept. of Biomedical Engineering, Rowan University, Glassboro, NJ, USA 2 Genisphere, LLC. 3 Philadelphia College of Osteopathic Medicine, Philadelphia, PA.



Posterior capsule opacification (PCO) a vision impairing disease that arises in approximately 20% of adults and nearly all children within three years following primary cataract surgery. Currently, Nd:YAG laser therapy is used to treat PCO; however, treatment is expensive and various complications arise. Our work focuses on the development of novel, biodegradable, in-situ forming hydrogels modified with poly(L-lysine) (PLL) for the controlled and extended release of DNA nanospheres that directly target the cells responsible for PCO. We have engineered in-situ gelling hydrogels (US Patent 62/479,719, pending) consisting of poly(lactic-co-glycolic acid)-b-poly (ethylene glycol) triblock copolymer (PLGA-PEG-PLGA) and PLL of varying MW that self-assemble via reverse thermal gelation to form a tunable 3D nanonetwork at physiological temperatures. Hydrogels with a LA/GA ratio of 15/1, PLL concentrations between 1-80 (w/v)%, and a polymer solution concentrations between 10-20 (w/v)%, allow for the formation of an optically clear hydrogel at 35°C able to control and extend the release of DNA nanospheres over four weeks. To study the drug release kinetics, controlled by the presence of the polycation in the formulation and degradation of the gel, we developed microfluidic devices that replicate the lens capsule's physiological and anatomical environment (i.e. size, temperature, pH, and flowrate).

S.H.A.K.E.R. Shield

TEAM MEMBERS

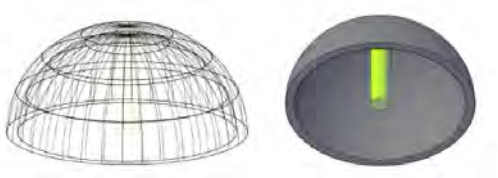
Taylor Groves, John Laranjeria, Christian Naugle

PROJECT MANAGER

Dr. Cheng Zhu, Dr. Charles McGlynn, Dr. Hong Zhang

SPONSORS

NSF I-Corps



Earthquakes are destructive and unpredictable disasters, causing untold amounts of damage and taking countless lives. The S.H.A.K.E.R. Shield, Seismic Hazard and Kinetic Energy Risk Reduction, is the first technology of its kind which is designed primarily to protect the inhabitants of a structure rather than the structure itself. The shield is to be composed of polyurethane and inflated using a combination of a canister containing carbon dioxide and nitrogen detonating and a series of aspirators which take advantage of the pressure differential to help the frame inflate in roughly less than 30 seconds. The purpose of this engineering team is to ultimately find the best geometry, material, and inflation mechanism using their engineering knowledge/skills, research, and equipment, and to achieve an economical first prototype of the structure. Currently, 3D geometries are being created using design softwares and are being placed into ABAQUS to compare stress concentrations to optimize the geometry. While this process is being completed, customer interviews and discovery processes are being performed to assess the feasibility of manufacturing the shield and possible methods of distribution to the customer. Lastly, tensile tests of samples of potential production materials are also being conducted to evaluate different material options.

Novel Examples for Geotechnical Engineering Education

TEAM MEMBERS

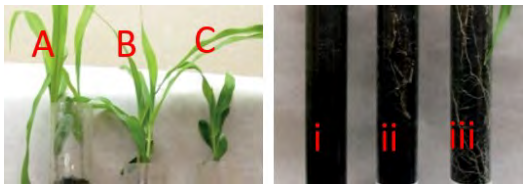
Elana Amir, Abigail Goger, Gabrielle Howell

PROJECT MANAGER

Dr. Cheng Zhu

SPONSORS

United States Universities Council on Geotechnical Education and Research



This project aims to develop examples and in-class activities that convey geotechnical engineering concepts to students in a way that is unique to traditional teaching methods. Currently, the project is developing materials in eleven most common areas of geotechnical engineering including soil origin, weight-volume relationships, soil structure and plasticity, soil classification, compaction, seepage, stresses, consolidation, shear strength, lateral earth pressure, and bearing capacity. Each example was developed to fit into one of five categories, including engineering, science, history, global issues, and art. The examples for each area were then compiled in the powerpoint presentation format for ease of use. In addition, an in-class activity that relates to the examples will accompany each presentation. The in-class activities are designed to have students further digest the information and gain a stronger understanding of the concepts. During this clinic project, we have developed 157 examples and 11 sample problems or in-class activities. Class surveys will be conducted to evaluate the effectiveness of the examples. We expect that, by connecting the concepts to disciplines that do not seem overtly related to geotechnical engineering, the library of novel examples will promote critical thinking and lead to greater retention of the information by the students.

Analysis of Ethical Reasoning among First Year Engineers

TEAM MEMBERS

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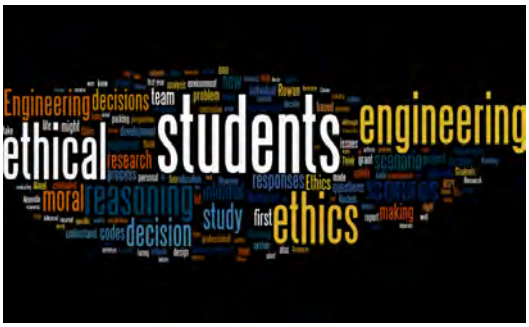
PROJECT MANAGER

Dr. Richard T. Cimino, Dr. Scott Streiner



The goal of this Junior and Senior Clinic was to study the ethical reasoning of first-year engineering students by analyzing student responses to a "Think-Aloud" activity. In this activity, students were faced with several ethical scenarios pertaining to both engineering and general life situations spanning the topics of public health and safety. The students' responses were transcribed and qualitatively analyzed through hierarchical holistic coding and a code book was then generated to reflect emergent themes in the reasoning that students exhibited. This Think-Aloud study was performed in tandem with a quantitative study of ethical reasoning in Freshman Engineering Clinic II during the Spring of 2019.

Structural Analysis of the Betsy Ross Bridge

TEAM MEMBERS

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PROJECT MANAGER

Dr. Ralph Dusseau

Accurate modelling systems can greatly reduce the difficulty of analyzing existing structures, or even assessing future structures. In order to create an accurate modelling system, it is crucial to ensure accuracy by comparing the results of the model against the known conditions of a real life example. The real life example observed for this project is the Betsy Ross Bridge. The bridge is being modelled in RISA 3D. Three spans of the bridge are being modelled, two on the east side of the span and one on the west side. Each span is made of steel I-beams and box beams. Currently, only two dimensional segments of the bridge are being modelled under gravity load and estimated deck loading, but in the future it is planned that the bridge will be modelled in 3D, and take all loads into account. Once RISA 3D is correctly calibrated to model the bridge, frequency analysis can be performed on the Betsy Ross Bridge as well as other bridges.

Developmental Delays and Toxicological Effects of Bisphenol A on Planaria

TEAM MEMBERS

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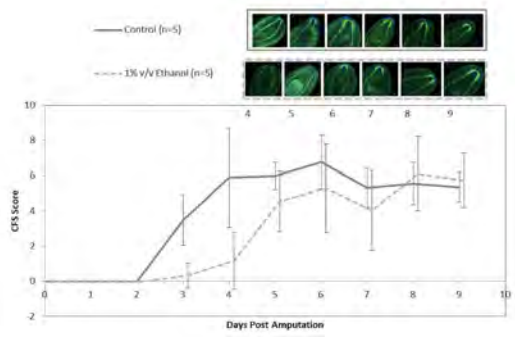
PROJECT MANAGER

Dr. Mary Staehle

SPONSORS

National Institutes of Health Grant R21ES026812; National Science Foundation Grant 1757815



The vast majority of chemicals used in the United States have not been systematically evaluated for risk to human health, and there is an increasing trend in birth defects that could stem from developmental toxicity from chemical exposure. Thus, there is a crucial need to assess toxicity on fetal neurodevelopment, which requires an alternative in vivo model. Schmidtea mediterranea (Smed) planaria flatworms have previously revealed exposure-induced behavioral effects in neuroregeneration and were thus chosen to showcase anatomical, molecular, and cellular differences following exposure to ethanol, bisphenol A (BPA), and BPA analogs (e.g. BPF and BG). We conducted an immunostaining study of Smed head regeneration that validated behavioral data among head regenerating. The anatomical data shows a dramatic delay in head reacquisition for worms exposed to BPA when compared to naïve and all other exposed worms. BPA exposed worms showed fewer and delayed neural connections. Novel chemicals such as BG show correct brain (cephalic ganglia) morphology, but low behavioral scores. Our current studies include investigations of the cellular mechanisms affected by these compounds at a molecular level. Through these multiscale studies in Smed, we are beginning to evaluate chemicals for their neurodevelopmental toxicity in order to ultimately optimize chemical design.

Shear Behavior of Granular Geomaterials

TEAM MEMBERS

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PROJECT MANAGER

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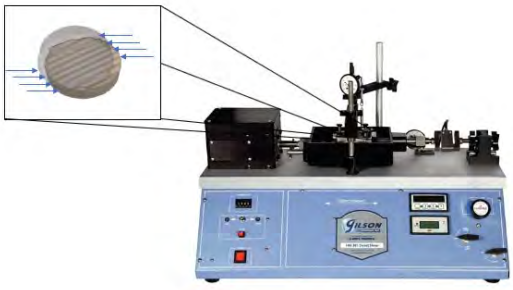

In Fall 2018, this clinic project focused on investigating the relationship between moisture content and the shear strength of bentonite samples against precast cement surfaces, which is applicable to the joint configurations of nuclear waste vessels. This was done by first determining the relationship between the moisture content of the clay to its dry density. Next, cement with a sinusoidal surface was created for the bentonite to shear against. After the optimum moisture content was found, a series of cylindrical clay specimen were subjected to direct shear testing. In Spring 2019, this clinic project focused on investigating the thermal and shear properties of different mixtures of bottom ash, pulverized rubber, and water, which is applicable to thermal insulation of subgrades in cold regions. Thaw weakening and frost heave in subgrades are the main causes to the surface pavement distresses. Direct shear tests were performed on specimen of varied proportions to compare strength responses.

Liquid-Propellant Rocket Engine

TEAM MEMBERS

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PROJECT MANAGER

Dr. Nourouddin Sharifi

SPONSORS

Venture Fund

The lack of liquid-propellant rocketry at a collegiate level is inhibiting progress in the field of rocketry as a whole, predominantly through the lack of knowledgeable college graduates entering the workforce. This research aims to develop archetypal design methods for collegiate/amateur liquid-propellant rocketry. The backbone of those design methods is a series of MATLAB scripts that automatically optimize the design parameters of the engine based on its design requirements. Students will be able to use the documents produced by this research to design their own engines. The design methods herein have been validated through comparisons to existing data from NASA's Chemical Equilibrium with Applications (CEA) software, the geometries and performance of an existing engine, and simulations using COMSOL. All 3 methods of validation suggest that the MATLAB scripts are a viable and scalable method of designing liquid-propellant rocket engines at a collegiate level. Following theoretical verification, the clinic built a test engine. The pressure-fed, 40 pound-force engine is powered by nitrous oxide and ethanol and is heat sink cooled. The engine was designed with the intent of being simple, scalable, and reproducible. Recommended future work includes manufacturing a higher thrust engine using regenerative cooling.

Catalysis on a Chip

TEAM MEMBERS

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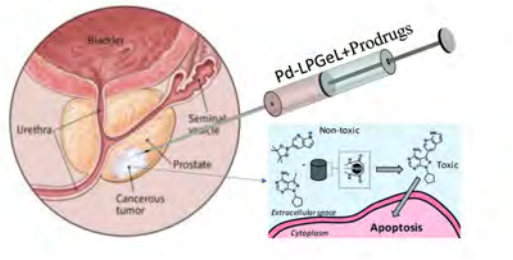
PROJECT MANAGER

Dr. Iman Noshadi



This project aims to create a novel injectable nanoreactor hydrogel to catalyze the in situ conversion of prodrug to the anticancer agent and mitigate side effects and other limitations of chemotherapy arising from poor bioavailability and tumor-therapeutic specificity. The design includes delivering anti-cancer prodrugs in shear thinning porcine gelatin hydrogel carrier, mixed with Palladium-Laponite (Pd-LP) combined with water forming strong hydrogen bonded links.

Impact Assessment of Extreme Storm Events on Coastal Communities

TEAM MEMBERS

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PROJECT MANAGER

Dr. Rouzbeh Nazari

SPONSORS

NJDCA, Armand, NJDEP

When news of an approaching hurricane or extreme weather event reaches the general population, chaos ensues. There are currently no means by which the average citizen scientist can perform his/her own analysis to determine how at-risk their life, home, or property is. Additionally, when considering a location to purchase/build a home or business, there is no comprehensive model that allows the everyday user to assess the area's vulnerability. To effectively prepare for extreme weather, and minimize the devastating effects on life and property, users need to know flooding predictions, likely roadway closures, affected hospitals and EMS, etc., all specific to their exact location. By using hydrodynamic modeling to predict the effects that hurricanes and extreme storms will have on the infrastructure of New Jersey, the team is creating an interactive map that will be open and accessible online to users anywhere. Using the map, citizens who are not familiar with the complex process of hurricane modeling and simulation will have the ability to assess the vulnerability and resilience of any New Jersey area.

Bluetooth Automotive Relay

TEAM MEMBERS

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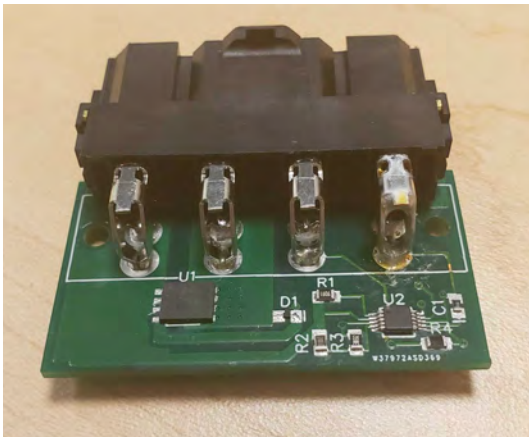
PROJECT MANAGER

Michael Muhlbaier



The Bluetooth Automotive Relay (BAR) is a solid-state, wirelessly controlled relay to be used for automotive purposes. This relay was designed to be able to control a load in a vehicle from a phone or other wireless device. Upon receiving a Bluetooth signal the device will allow the battery voltage to be passed to the connected load. Due to the voltages present in the relay, it has been design to withstand high currents and operate at low power. The first prototype is designed to power a 12V 30A inductive load, and uses a high side NMOS with a low On mode resistance to lower self-heating. To use the NMOS as a high side switch, there is an NMOS driver chip to allow the gate voltage to go above the source voltage. Currently, a test board is being manufactured with power resistors to run lower current tests; this is done so that the relay can be monitored as the current is stepped up. In the future, a two-MOSFET implementation will be used to block current from passing through the NMOS's body diode should the current ever attempt to flow in the opposite direction.

Evaluating the Feasibility of Converting Brewery Waste into Biofuel

TEAM MEMBERS

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PROJECT MANAGER

Dr. Sarah Bauer

Increasing demand for clean water and energy is amongst the largest problems facing society today, a concept known as the Water-Energy Nexus. Research into balancing the creation and consumption of both clean water and energy is expanding. The U.S. produces high quantities of waste in the form of biomass which is often seen as an environmental and economic liability. However, research shows increased potential into the reuse of waste biomass as a variety of usable products. The beer production industry creates substantial quantities of waste in the form of spent grains, spent hops and yeast. The objective of this research is to create usable products from this waste. This research hypothesizes that brewery waste holds potential for the production of energy. Hydrothermal liquefaction (HTL) conversion, a means of converting wet, organic biomass into liquid biocrude, was determined to be suitable for brewery waste due to the high organic composition of the waste feedstocks. Preliminary characterization of the raw brewery waste suggests that high carbon and water contents make the biomass suitable for biocrude production. This research will provide insight into the feasibility and sustainability of waste-to-energy systems utilizing waste generated from the beer production industry.

Polymer Composite for Navy Applications – Materials

TEAM MEMBERS

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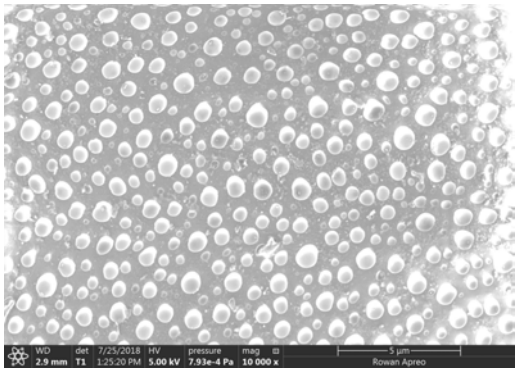
PROJECT MANAGER

Dr. Wei Xue, Dr. Robert Krchnavek

SPONSORS

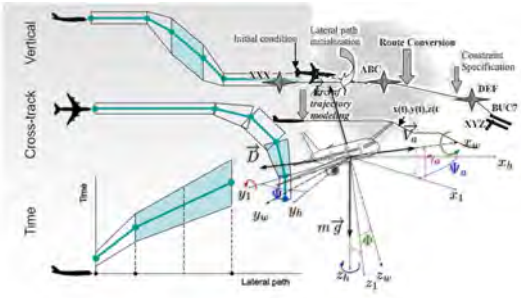
Naval Surface Warfare Center (NSWC), Naval Engineering Education Consortium (NEEC)



The main objective of this team was to optimize the synthesis of a polyimide-SiO2 nanocomposite material for the purpose of coating high temperature superconducting (HTS) cables. To meet this objective, multiple aspects of the material synthesis were explored to improve nanoparticle size and dispersion, production efficiency, and the ability to manipulate the sample for practical applications. Research has been conducted to establish a relationship between the length of the curing process and the degree of imidization of the host polymer at lower temperatures. Novel in-situ sol-gel processes were investigated to find a correlation between mixing procedures and SiO2 particle size. Further analysis of the spin coating method was also explored to produce replicable thicknesses among samples. During this testing, spin coating duration as well as spin coating speeds were changed to manipulate sample thickness. After sample development has been optimized, the polymer will be used to coat the HTS wires evenly. The composite coating was found to remain on the surface of the curved wire during constant rotation which would allow for a consistent coating for the duration of the curing process. The team, in the future, plans to explore different aspects of the material synthesis in order to produce the most evenly dispersed nanocomposite samples for insulating HTS cables.

Determination of Aircraft Trajectory Through Prediction and Modeling

TEAM MEMBERS
Brian Mulligan
PROJECT MANAGER
Dr. Yusuf Mehta
SPONSORS
FAA



The purpose of the project is to develop models to predict aircraft trajectory with reliable accuracy. The project is divided into two phases; the first phase includes determining cause of lateral deviation, while the second includes developing methods to estimate lateral deviation and predict trajectory using the data provided by the Federal Aviation Administration. The students focused on gaining extensive knowledge of the causes of lateral deviation in aircraft trajectories, which occurs when the vehicle departs from its planned course of travel. The position signals from the plane do not correspond with the flight path approved by the air traffic controllers. During the flight, the aircraft will experience conflicts with other vehicles or weather conditions which will require alternate paths to be taken. The issue of lateral deviation rises from calculated flight plans that differ from the true position data from signals on the aircraft. Aircraft trajectory models create representations of the flight path with more accuracy than theoretical routes. Models utilize algorithms to measure the deviation and predict appropriate trajectories to describe the flight of the aircraft. The variables considered for this paper include time, position, angle of direction, and normal distance to the flight plan, along with others.

The Potential of Winery Waste in Biofuels

TEAM MEMBERS
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PROJECT MANAGER
Dr. Sarah Bauer

The management of clean energy and clean water is one of society's most pressing challenges, a phenomena known as the Water-Energy Nexus. Currently, our society is reliant on depleting, non-renewable energy sources; however, growing energy demands have encouraged more research into renewable and sustainable energy sources. With our expanding population, agricultural and food industries, which consume large quantities of water and produce substantial quantities of waste, are increasing. Hydrothermal liquefaction (HTL), a process in which wet, organic biomass is converted into a liquid biocrude, shows potential for converting waste from such industries into biocrude. Specifically, the winemaking industry, which is spreading throughout the U.S. and abroad, produces substantial quantities of waste in the form of grape pomace and lees. The objective of this research is to convert waste products generated via the winemaking process into biocrude using HTL. Preliminary research indicates high carbon and water contents in the raw winery waste feedstocks, suggesting a potential for HTL conversion into liquid biocrude. Future work includes experimental research into the HTL conversion of winery waste and the characterization of HTL by-products, including biocrude. This research will provide impactful foresight into the feasibility and sustainability of generating energy out of winery waste.

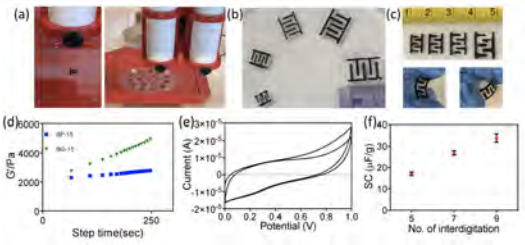
Flexible Bioelectronics

TEAM MEMBERS

Alex Hesketh, William Gray

PROJECT MANAGER

Dr. Noshadi



In this study, we harness the increase in conductivity of the natural and synthetic polymer when conjugated with biocompatible ionic liquid, for the use of this composite as electrolytes in a 3D printed energy storage device. The polymer electrolyte and graphene as an electrode in a three-electrode system exhibits a specific capacitance of 200 F/g and were 3D printed to create an electrochemical capacitor that exhibited a specific capacitance of 16.33 μF/g at a current density of 1 A/g. The volumetric capacitance of the 3D printed energy storage device was found to be 44.07 μF/cm3. The electrolyte synthesised exhibits electrochemical stability up to 10000 cycles and biodegradability, in cases where it is hard to access the implanted location such as intravascular applications biodegradable implants are favourable. The integration of an eco-friendly, biocompatible ionic liquid electrolyte provides a new perspective on energy storage.

System to Determine the Neurodevelopment Toxicity of Novel Compounds

TEAM MEMBERS

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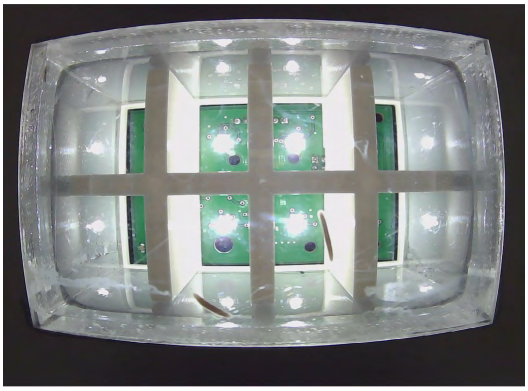
PROJECT MANAGER

Dr. Mary Staehle

SPONSORS

National Institutes of Health Grant R21ES026812; National Science Foundation Grant 1757815



With the exponential increase in the production of industrial and pharmaceutical chemicals, it is critical to develop rapid high-throughput methods to test for neurodevelopmental toxicity prior to general population exposure. We utilize planaria flatworms as a novel model organism for these tests. Planaria have a remarkable ability to regenerate, including the ability to regenerate the central nervous system within less than ten days. We are developing a high-throughput system that exploits these properties in order to examine the neurodevelopmental toxicity of known and novel compounds. This system includes a custom image-tracking algorithm for tracking multiple worms simultaneously and a multifaceted metric of planarian behavior that accounts for motility, intention, and cognitive functioning. When combined with the physical structure of the testing chamber and a custom image acquisition system, we will have the capability to test more than 150 worms simultaneously in more than 15 chemical stimulus states. This will enable high-throughput investigations of the effect of chemical dose, timing, and duration on neurodevelopmental toxicity for early screening testing of known and novel chemicals.

Formula Electric Car

TEAM MEMBERS

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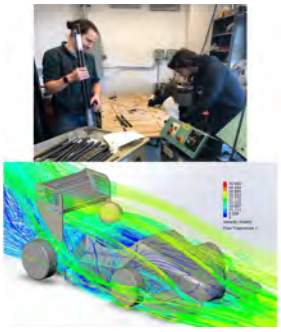
PROJECT MANAGER

Dr. Melanie Amadoro

SPONSORS

Stanley Black and Decker, MicroChip, TE Connectivity, Emrax, Unitek, OZ Racing, Wilwood, VR3, KHK Gears, Optimum G, Solidworks



The Formula Electric Competition is an interdisciplinary design and engineering challenge for undergraduate and graduate university students. This project will take two years to complete, with 2 faculty advisers and approximately 24 students involved. This semester wraps up the first year of the project. To make this project run smoothly, the Formula Electric SAE car was split up into 2 clinic projects, one for the Mechanical Engineering tasks, and the other for the Electrical and Computer Engineering domain. The approach the team used this year was to break the Mechanical Engineering team into 4 subgroups – Drivetrain, Frame and Body, Suspension, and Braking. The team has completed their design and the frame and components are being constructed. The estimated cost of this project is $50,000 which will be secured both internally and externally with numerous sponsors. The competition will occur in June 2020.

Engineering the Structure of Nanofibers to Improve Mechanical Properties

TEAM MEMBERS

Matt Murtha, Andrew Tomasulo

PROJECT MANAGER

Dr. Vincent Beachley

Understanding materials processing is paramount to engineering better materials for biological science and medical applications. We are applying a combination of post-drawing, heat treatment, and cycled cool processing (melting and annealing) to electrospun polycaprolactone (PCL) nanofibers. We have identified the resultant crystalline and amorphous ratio of the fibers and their macromolecular orientation given the above processes. Upon producing fibers with a defined nanostructure we can engineer suitable fibers, with specific mechanical attributes such as elastic modulus and ultimate tensile strength, for tissue engineering application. Through experimentation, the optimal temperature range yielding the highest crystalline to amorphous ratio was determined to be between 54oC and 70oC with a peak ratio of 2.34 at 62oC. These temperatures also correlated with an ultimate tensile strength of 1290 MPa. Overall, nanofibers with defined mechanical properties, with precise control granted by the manufacturing process, allows for the production of scaffolds with high ultimate tensile strength for rigid tissues, augment flexibility with a high elastic modulus for ductile tissues, to ultimately control cell action (via mechanobiological interaction) for tissue repair.

3D Printed Prosthetic Hand Creation

TEAM MEMBERS

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PROJECT MANAGER

Dr. Melanie Amadoro

The eNabling the Future organization is a community of volunteers that provide little to no cost 3D printed prosthetics to patients in need of them. This project involved the creation of two 3D printed hand prosthetics and submitting them for validation to the organization. Team members created the Phoenix hand and the Cyborg Beast hand. Both prosthetics were reviewed by the eNabling the Future team to assure they met design standards. The team followed successive steps to then create a chapter of the eNabling the Future organization at Rowan University. Patients in need of a 3D printed prosthetic device can now be referred to Rowan's chapter to have the device fabricated for them.

Patient-Centered Medical Transportation Model

TEAM MEMBERS

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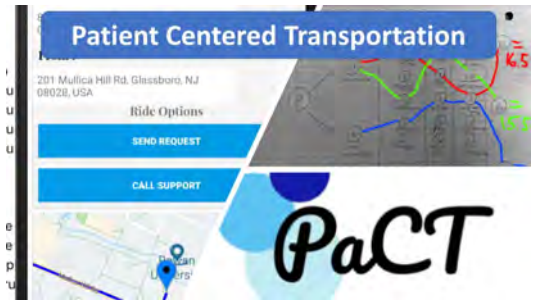
PROJECT MANAGER

Dr. Yusuf Mehta

SPONSORS

Inspira



The Patient-Centered Medical Transportation model (PCMTM) is a system for patients who are missing their non-emergency medical appointments. When an appointment is missed due to lack of transportation, it poses a serious health risk to the patient and places a financial burden on the physician who cannot fill the missed appointment window. By using the Patient-Centered Model, patients will have peace of mind knowing their transportation is secure, and physicians will benefit from a decrease in missed appointments. Drivers can also benefit by earning rewards through the volunteer sign-up program. To create this system, our team has designed a proprietary algorithm to provide more comfortable and reliable transportation to patients. The system includes an Android application for both patients and drivers which has been tested internally by Rowan University students and researchers. The students began the customer discovery process and developed the first business canvas model for commercialization with a plan to conduct a pilot study in the summer. One of the primary goals of the model is to provide free or significantly lower-cost rides to the patience. The incorporation of the PCMTM into medical facilities everywhere will lead to a better healthcare system.

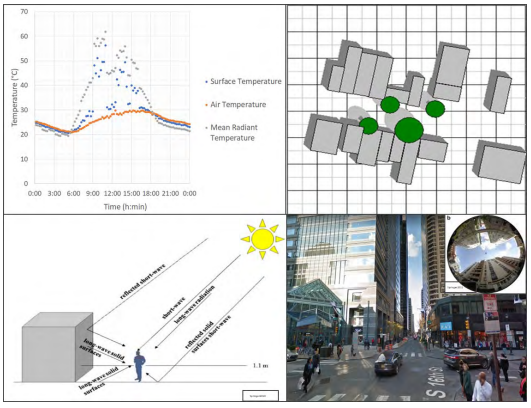
Measuring Effects of Vehicle Emissions on Camden's Residents Health

TEAM MEMBERS
William Reichard
PROJECT MANAGER
Dr. Yusuf Mehta
PROJECT MANAGER
Camden Health Research Initiative

The city of Camden in New Jersey has a long history of poor living conditions, in part due to the excessive pollution levels in the city and surrounding areas. The elevated concentration of pollution in the air has caused residents of Camden to suffer respiratory health problems at an increased rate. To address the issue, the causes of these respiratory health issues must be identified. In this project, a possible link between vehicular emissions and respiratory health will be examined. The research team will (1) utilize traffic micro simulation model VISSIM and Motor Vehicle Emission Simulator (MoVES) to estimate air pollution at selected intersections; (2) measure actual air pollution with air sampling equipment; (3) perform laboratory testing on airway cells; and (4) develop a models to estimate impacts of air pollution due to traffic congestion on patient's health. This semester, the team will focus on designing experiments, reviewing existing literature and modeling selected intersections near Cooper Medical Hospital. This study will have significant impact on designing hospital buildings near congested intersections as well as evaluating traffic congestions at intersections located near healthcare facilities. It will become the bases for further studies in various locations and ultimately developing air quality standards.

Impacts of Urban Morphology and Vegetation on the Urban Heat Island Ef-

TEAM MEMBERS
Joshua Pratt, Joshua Bryke, and Samain Sabrin
PROJECT MANAGER
Dr. Maryam Karimi



Urban Centers are susceptible to extreme heat events due to the UHI effect which is intensified due to a variety of anthropogenic activities such as: unsupervised land surface modifications, expansion of impervious areas, and lack of vegetation are all contributors to an increase in the amount of heat flux trapped by urban canopy. This project aims to propose a new innovative method to measure the impact of increased temperatures based on urban morphology, specifically the height of buildings and the width of streets, in selected metropolitan cities and measure the impact of build environment for urban and regional planning using human biometeorological evaluations (Tmrt). Our current results suggest a strong relationship between building height and increased surface temperature in mega cities. This model will help; 1. Quantify the impacts of the built environment and surface properties on surrounding temperature, 2. Identify priority urban neighborhoods by analyzing Tmrt at the pedestrian level, 3. Characterizing the need for urban green infrastructure or better urban planning- maximizing the cooling benefit from existing Urban Green Infrastructure (UGI), and 4. Developing a hierarchy of street widths and building heights for new UGI integration and propose new UGI based on site characteristics and cooling potential.

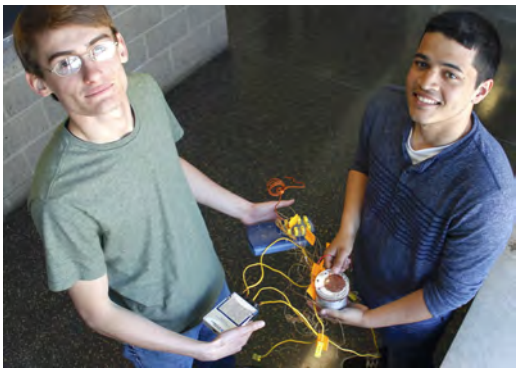
PCM-based Cooling Strategies for Lithium Ion Battery

TEAM MEMBERS

Allan M. Rios, Matthew C. Fennimore

PROJECT MANAGER

Dr. Nourouddin Sharifi, Dr. Smitesh Bakrania



Different cooling strategies of a lithium Ion battery are investigated experimentally. The vertically-oriented experimental setup consists of and inner and outer housings. The space between the inner and outer housing is occupied with different PCM composites such as mesh-PCM, Fin-PCM, honeycomb-PCM, heat pipe-PCM, and copper oxide nanoparticle-PCM. Heat is generated from a heater (mimicking the battery) and is transferred through the inner housing, PCM-composite, and outer housing (and or heat pipes) to the cold environment. The power output of the flexible heater was chosen to simulate 2C, 3C, and 4C which was experimentally acquired by discharging a lithium ion battery. Temperature histories at different locations of the setup are measured and compared to each other for different cooling approaches. A one-dimensional heat transfer analysis is also performed for the comparison with the experimental data.

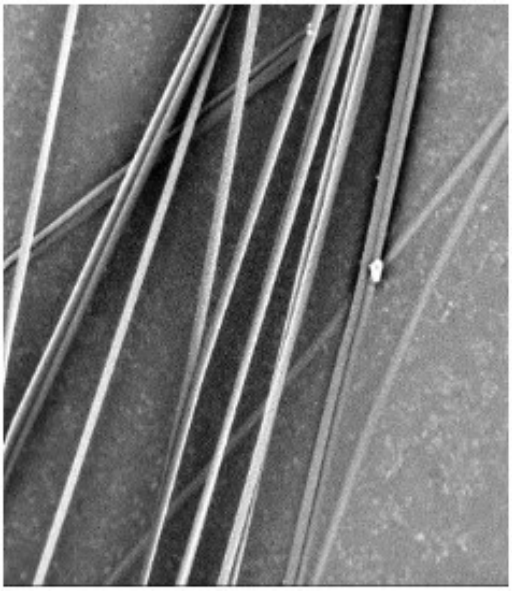
Post-drawing and Characterization of Electrospun Nanofibers

TEAM MEMBERS

Cailyn Rhoads

PROJECT MANAGER

Dr. Vince Beachley



The focus of this clinic is the fabrication, processing and characterization of PAN nanofibers in order to optimize parameters to reach the highest possible draw ratio (ratio of the final and initial lengths of the stretched fibers). Increasing the nanofiber draw ratio has been shown to produce fibers with a higher tensile strength and increased stiffness. As a result, fibers that undergo post-drawing (elongation of fibers) are especially strong. The improvements in tensile properties associated with post-drawing are due to the rearrangement post-drawing produces in the nanofiber's molecular orientation. The molecular orientation is improved by rearranging the individual polymer chains within the fiber to better line up to the fiber axis. This project is aimed toward determining the best parameters, techniques, and conditions for the fabrication, manufacturing, and processing of PAN fibers in order to further strengthen their tensile properties with the main focus of this project being to narrow down the exact relationship the speed at which fibers are drawn (the draw rate) as compared to the maximum possible draw ratio.

Headpose Estimation

TEAM MEMBERS

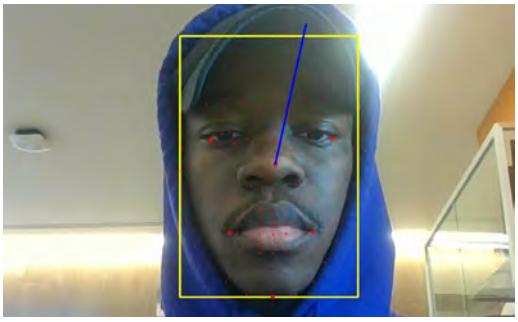
Alexander Revolus and Jason Stefanski

PROJECT MANAGER

Dr. Ravi P. Ramachandran and Eric Feuerstein

SPONSORS

FAA



One of the problems that researchers face in the computer vision field is the Perspective-n-point (PNP) problem. PNP is the problem of estimating the pose of a calibrated camera given a set of "n" 3D points and their corresponding 2D projections in the image. The pose of the camera also has 6 degrees of freedom which consist of roll, pitch, and yaw. In this research, we will be doing pose estimation on a human head by using the algorithms in the openCV and Dlib libraries to detect facial landmark features. Inside the Dlib library is a pre trained facial landmark detector that estimates 68 data points on a human's facial structure. This is how we will keep track of the head. The overall purpose of the research is the following: to gain a better understanding of the bigger pose estimation problem at hand by first trying to estimate the pose on a smaller scale, become well versed in the openCV and Dlib libraries, and finally being able to apply the research in the real world.

Cold Compaction of Asphalt Mixtures Using High-Frequency Vibrations

TEAM MEMBERS

Christopher Haughland, Ian Burgess-Linden

PROJECT MANAGER

Dr. Yusuf Mehta

SPONSORS

Department of Defense

During construction, the asphalt is laid at high temperatures and compacted by repeatedly applying external forces to reduce air voids in the material to an acceptable level. This can be achieved through several means, such as pneumatic tires and vibrations, but it is usually achieved by steel rollers. The temperature of the asphalt is influenced by the weather conditions at compaction; specifically mat temperature, air temperature, and wind speed. As asphalt cools, it hardens and stiffens to the point where, if compacted further, it would crack. It is problematic when asphalt is not compacted to the target air voids, hence many construction standards set the minimum temperature to 50 or higher for laying asphalt. This study seeks to develop and test a procedure that would reduce the time asphalt cools and utilize vibratory compaction instead of rollers in order to achieve compaction at temperatures lower than 50 , possibly as low as 25 . The study tests different combinations of vibration frequencies and temperatures to determine the optimal compaction frequency in order to achieve the target air voids (7-8%). This procedure would allow to extend the construction season for temperate climates to include late fall in cold regions.

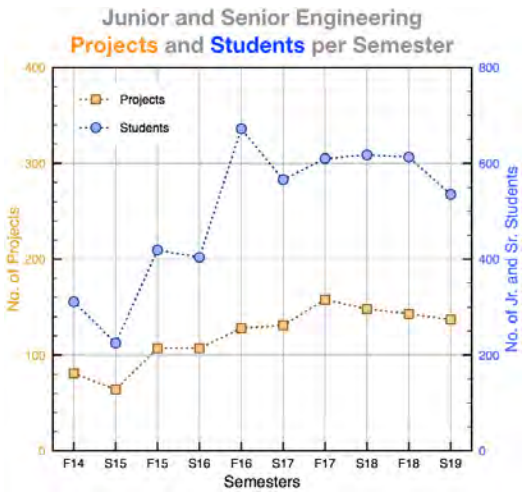
Clinic Match

TEAM MEMBERS

Kevin Meglathery

PROJECT MANAGER

Dr. Smitesh Bakrania



Clinic Match is a way to pair engineering professors with students to work on open-ended engineering projects for Junior and Senior Engineering Clinics. Previously, such a matching was conducted by hand. Now there are far too too many projects and students to handle the complex assignment process by hand. Clinic Match automates the entire assignment process end-to-end. Professors propose their projects, then students review and submit their preferences for eventual sorting into projects. Over the years, new functionality has been added to make this process flow smoothly and adapt with the evolving nature of the engineering program. This semester, several features were added and modified to improve Clinic Match's usability, including: (1) generating an accurate tally of the most popular projects to guide student selection, (2) the ability to randomize the list of clinic projects, allowing later submissions a chance to be seen by more students, and (3) the option to include images alongside project descriptions. Additionally, documentation was developed to introduce the match process to new students and assist project coordination. Past assignment data was analyzed to assess participation, project diversity and funding. Clinic Match is a crucial component for the continued success of the clinic model.

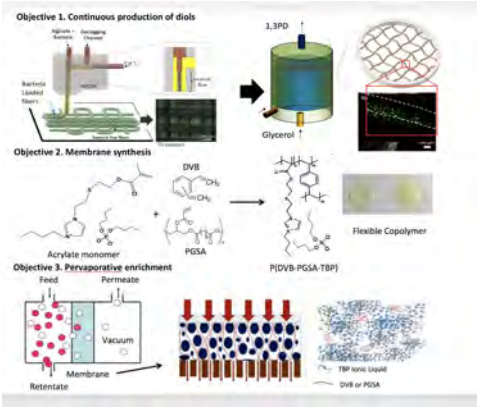
Polymer membrane for separation

TEAM MEMBERS

Connor Davis

PROJECT MANAGER

Dr. Iman Noshadi, Dr. Stewart Slater, Dr. Mariano Savelski



The overall goal of this research is to design and characterize the operational characteristics of the next generation of CFB, which features porous nets with immobilized bacteria combined with novel pervaporation membrane process for high purity diols production. We hypothesize that such a process increases the yield, productivity, and improves the purity of final product when compared to the existing methods.

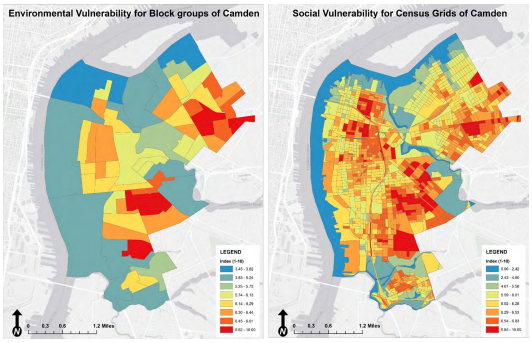
Developing an air quality impact index for Camden, New Jersey

TEAM MEMBERS

Anna Kalogiratou, Michael Cangialosi, Matthew Strauss, and Samain Sabrin

PROJECT MANAGER

Dr. Maryam Karimi



This project is designed to identify the environmental risk and social vulnerability associated with Urban Heat Island (UHI) and air pollution in the City of Camden in New Jersey. The project is divided into three parts: 1. Finding areas/ neighborhoods most affected by UHI (environmental risk) and populations at higher risk of social vulnerability related to UHI, 2. Environmental risk and social vulnerability associated with air quality to build an air quality impact index model, 3. Finding a relationship between human health and exposure to air mixture and heat. The following two models are being developed:1. Air Quality Environmental Risk Impact (AQERII)= air mixture/quality+ physical environmental data+ temperature , 2. Air Quality Social Vulnerability Impact Index (AQSVII)= air mixture/quality+ physical environmental data+ social vulnerability+ temperature. These indices will help establish a link between the air quality and UHI in the City of Camden. Our current work shows a direct correlation between locations with higher than the average temperature in Camden are inclined to lower air quality and susceptible to having Asthma, COPD, and strokes.

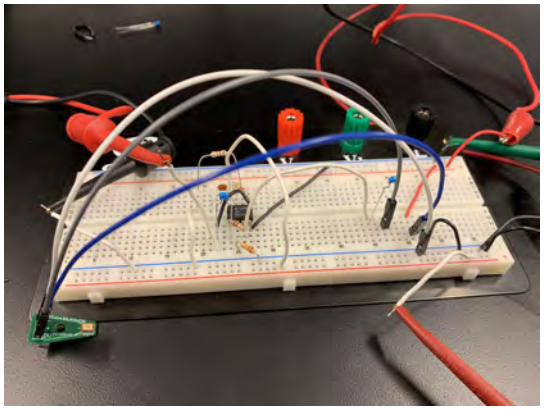
DAQ system for MEMS microphones

TEAM MEMBERS

Jan Garcia

PROJECT MANAGER

Dr. Mahmoud Al-Quzwini



The goal of this project is to develop a multichannel high-speed data acquisition board for multiple Micro-Electrical-Mechanical Systems MEMS microphones. The analog interface circuit has been designed and tested successfully. It has been connected with SPU0410LR5H-QB MEMS microphone, and the signal collected by the microphones was observed using the oscilloscope. The next step is to design the printed circuit board which will contain a 10 MEMS microphones along with their analog interfaces.

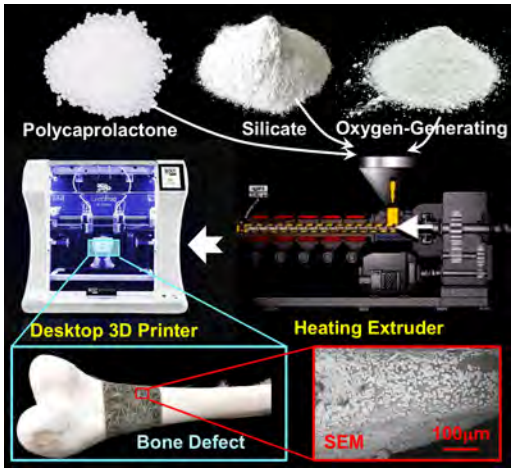
Evaluation of the Fatigue Performance of Geogrid-Reinforced HMA

TEAM MEMBERS
Morton Lee
PROJECT MANAGER
Dr. Yusuf Mehta
SPONSORS
Department of Defense

The purpose of the project was to observe and analyze fatigue cracking performance of hot mix asphalt (HMA) asphalt with geogrid reinforcement. Five different dense-graded HMA mixtures (one unreinforced and four geogrid-reinforced) were used in this study. The different geogrid types used in this study varied in terms of geogrid type, opening size, tensile strength, etc. All HMA mixtures were fabricated as beam samples to subject to allow for flexural performance testing. For this study, the HMA mixtures were subjected to the four-point bending beam fatigue (BBF) test to evaluate the fatigue performance of the HMA mixtures. The fatigue performance was quantified in terms of number of cycles to failure. Additionally, the BBF results were further analyzed using the concepts of the ratio of dissipated energy (RDEC) to determine the plateau value (PV) of each HMA mixture. The BBF results illustrated that the geogrid-reinforced HMA mixtures exhibited greater number of cycles to failure compared with the unreinforced HMA mixture. Further, it was observed that the greatest number of cycles to failure was observed in the geogrid type with the greatest tensile strength. The BBF results showed that the use of geogrids improved the cracking resistance of HMA mixtures.

In-Situ 3D Printing of Bone Implants

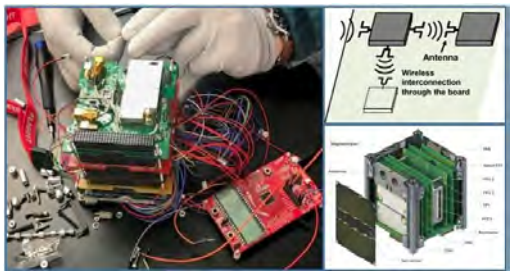
TEAM MEMBERS
Brooke Switala, Robert Kallok
PROJECT MANAGER
Dr. Amir K. Miri, Dr. Khosro Shirvani, Dr. Hamid Hosseinzadeh



We employed three-dimensional (3D) printing and polymer science to investiagte a practical solution for rapid and effective in-situ bone 3D printing in trauma surgery. The goal is to replace bone defects and osteoporotic tissue with highly-bioactive biomaterials. The solution was proposed on two parallel phases: I) controlling the material composition and mesoscale structure of printed bone constructs and II) efficient delivery of the printed construct. To design a biomimetic implant, we optimized material strength and stiffness for bone tissue, surface porosity for better in vivo response, and high bioactivity for bone regeneration. A cost-effective, biocompatible polymer, polycaprolactone (PCL), was used to provide elasticity and backbone material for tissue regeneration. Nano-platelets of silicate was used as a bioactive agent with rapid bone formation. We used an oxygen-generating salt to induce the required level of porosity (micron sized pores). These materials were blended and fed into an extruder for generating size-controlled filaments that can be used in a desktop 3D printer. We also worked on the printability of our filaments. PCL is not bioactive enough, thus in combination with silicate will act a better implant material. The novelty of our project was to induce pore formation and to improve the printability of PCL filaments. The future work will include advancing the delivery of material using hand-held printers.

Wireless Bus Interconnects for CubeSat Signal Integrations

TEAM MEMBERS
Nicholas Gorab, Tanner Smith
PROJECT MANAGER
Dr. Sangho Shin, Dr. John Schmalzel, Russell Trafford
SPONSORS
NJSGC



Design and integration of small spacecraft systems, e.g., CubeSat, require multiple steps of design/verification processes to define/simulate/test/revise all physical and system functionalities. The definition and routine maintenance of signal interconnects between subsystems are the most important element of the success of the satellite engineering. Typically hundreds or more of dense signal interfaces are integrated either for system configuration, command, and/or data exchange. Such wide Bus based signal interfacing of multiple subsystems, in particular for small form factor satellites, occupies a huge portion of overall satellite volume, and also raises critical system faults primarily caused by the complexities of integrating/maintaining physical interconnections. This project introduces and demonstrates a wireless Bus interconnect technology that effectively route satellite subsystems through a low-power wireless standard, e.g., low-power Bluetooth. For the proposed wirelessly interconnected satellite Bus system, each subsystem has an additional interface block, comprised of a simple signal serializer and deserializer for SPI together with a low-power 2.4GHz Bluetooth transceiver. For the within-system wireless interfacing, we have chosen the output wireless signal at very weak (<-50dBm) level, so that the interface signal can be confined within the satellite system. The weak wireless interfacing signal are broadcasted through a small patch antenna printed on each subsystem PCB. The project demonstrated the feasibility and effectiveness of the wireless satellite Bus technology.

Elastic Binder to Develop Construction Materials for the Arctic Region

TEAM MEMBERS
Benjamin Chierici
PROJECT MANAGER
Dr. Yusuf Mehta
SPONSORS
Department of Defense

Asphalt may need to be modified depending on the type of climate it is have to be modified. These modifications can change the properties that the asphalt has in order to counteract a variety of problems that may occur due to different climates. This paper reviews several different studies on different types of modifiers including different types of polymers, crumb rubber, polyphosphoric acid and nanomaterials, and evaluates how well they will perform in in arctic regions. Since arctic temperatures make asphalt stiffer and more susceptible to cracking, some of the key properties to look for in these studies was the viscosity, stiffness and elasticity of the binder. The polymer that performed the best in the studies researched was aged SBS modified binder with 3% rejuvenator. It showed highly elastic properties and a high amount of toughness compared to other polymers tested. The tests regarding nanoclay and hydrated lime also showed promising results. The nanomaterial modifier improved the elasticity and the fatigue life. Despite these notable performances, the binder that was found to be the best was GTR. A binder with 16% GTR was found to have the lowest about of stiffness at lower temperatures

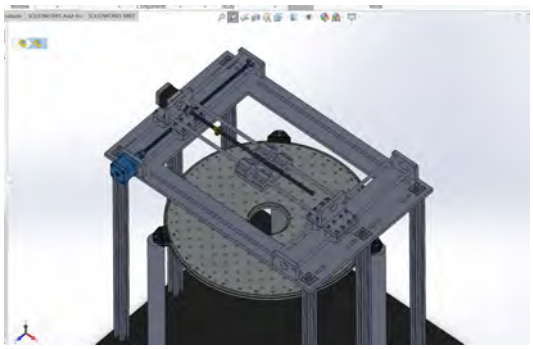
Digital-Micromirror 3D Bioprinter

TEAM MEMBERS

Lucas Scinto, Vishal Chadha, Jonathan De-Lair

PROJECT MANAGER

Dr. Amir K. Miri



We designed a three-dimensional (3D) stage with high-resolution control to be used in an optical bioprinter. The bioprinted was aimed for curing photosensitive biocompatible polymers. The main developments included designing and manufacturing X-Y gantry system which can be integrated into our system. Due to the nature of how bioprinter functions, the X-Y gantry must not burden the optical board with vibration during movement of the platform. Therefore, the team made multiple design decisions in order to mitigate the impact of the gantry on the optical board. Additionally, the team was tasked with developing a control system that allows the end user to control the stepper motors using an Arduino-Labview interface.

SB Latex Reactor Detailed Design

TEAM MEMBERS

Bridget Black, Elizabeth Kuhlman, Jodael Petit-Homme, Trevor Stebbins, Robert Matichhio, Christopher Razze, Veronica Summers, Nicholas Testa, Craig Gauthier, dhruven patel, Sarina Trapani, Justin Varvar, Marc Fuzia, Sean Siek, Mark VanNieuwland

PROJECT MANAGER

Dr. Tom Meadowcroft

Clinic members created a Piping and Instrumentation Diagram (P&ID), Batch Recipe, Batch Phases, and Functional Specification for a batch reactor capable of making Styrene/Butadiene latex suspension polymers. The P&ID includes all vessels, exchangers, utilities, instruments, control valves, and automated and manual shutoff valves necessary to carry out batch operations safely and efficiently. The Functional Specification further describes all instruments and valves and any feedback controllers, together with interlocks to ensure safety and productivity. The Recipe and Recipe Phases are documented as Sequential Function Charts. Together these documents are a complete logical specification for an automated batch reactor of this type.

Design of an Electrochemical Power Source

TEAM MEMBERS

Bruce Barrett, David DeBenedictis, Benjamin Kayhart, Alexis Lawless-Gattone, Kaitlin Milne

PROJECT MANAGER

Dr. Robert Hesketh

SPONSORS

Rowan Chemical Engineering Alumni

The purpose of this project was to design, fabricate, and test an electrochemical power source to be used in the Regional AIChE ChemE Car Competition. The constructed car was powered by thermoelectric generators (TEGs). These thermoelectric devices generate voltage through a temperature differential. On one side of the TEGs, heat is generated by the decomposition of hydrogen peroxide in combination with the redox reaction of hydrogen peroxide with iodide and acid. A reaction model was formulated based on reaction rate obtained from the literature to predict the temperature of this mixture as a function of time. On the cold side, chilled methanol in dry ice is used. With a temperature difference of 140°C, about 0.8W of power is produced. This power generation propels the car at a velocity of 1ft/s. The car follows all safety rules and regulations for 2019 National AIChE ChemE Car Competition. The goal for the competition is for the car to move a specified distance of anywhere between 30 and 100 ft in under 2 minutes. A stopping mechanism, powered by the iodine clock reaction and a control program, was implemented to stop the car at a specified distance in the allotted time frame.

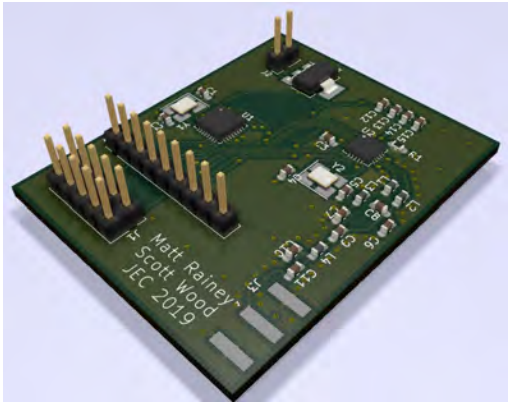
Transceiver for Future CubeSat Missions

TEAM MEMBERS

Matthew Rainey, Scott Wood

PROJECT MANAGER

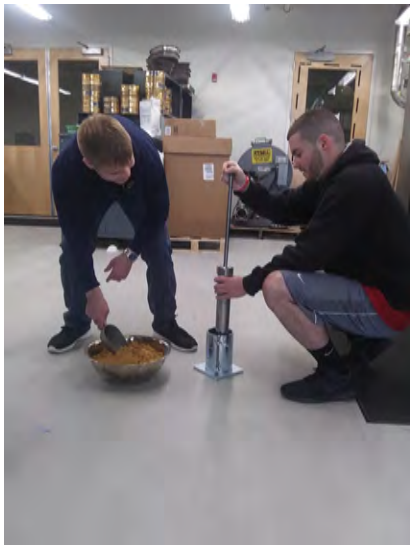
Dr. Robert R. Krchnavek



The overall goal of this project was to investigate the use of the Si4467 Transceiver Chip to develop a low-cost radio usable for future cubesat missions. It was discovered that this transceiver chip, which includes over 420 configuration registers would be too complicated and time consuming to program for the required application. Prior attempts to use this for Cubesat missions have proven to have countless issues with very limited success. As a result, other transceiver chips were investigated, and the transceiver chip: CC1101, manufactured by Texas Instruments was selected as the chip to be utilized with an ATmega328p to act as a fully functional embedded radio transceiver. This accomplished our objective, which was to enable communication between two transceivers as well as being an extremely low-cost alternative to off the shelf transceiver solutions such as the Lithium 2 (Li -2) transceiver utilized on previous Cubesat Missions. This fully functional embedded radio transceiver was designed and implemented on a PCB, and was programmed to enable simplex, and half duplex communication.

Determination of Insulation Materials Maximum Thickness in Pavement

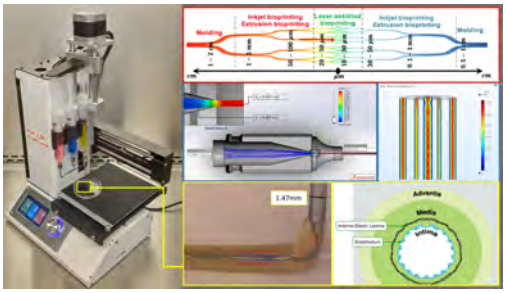
TEAM MEMBERS
Robert Church
PROJECT MANAGER
Dr. Yusuf Mehta
SPONSORS
Department of Defense



When frozen ground thaws, it creates a thin layer of saturated soil due to lower layers still being frozen that destabilizes a road. An emerging way to solve these two, interconnected problems is through installation of insulation below the subbase and above the subgrade of the road. Insulated pavement keeps the soil below a road above freezing even as the air above the road causes the pavement and subbase to freeze. The insulation materials of polystyrene XPS, bottom ash, and tire chips were studied based on their insulation properties and cost. A 5′ x 5′ x 5′ cube that consisted of hot mix asphalt, gravel, the insulation material, and the subgrade was then modeled using a multiphysics software. Temperature data for every day of the year was obtained from Chicago and the thickness of the selected insulation material at a specific depth was determined to keep the subgrade above freezing. From the simulations, it was found that the minimum depth of XPS was 2 inches, tire chips was 13 in. and bottom ash was 14 in. From these thicknesses, it was determined that tire chips would be the most expensive option, followed by XPS, and bottom ash.

Multi-Axial Bioprinter for Blood Vessels

TEAM MEMBERS
Casey Smith
PROJECT MANAGER
Dr. Amir K. Miri, Matthew Malpica



There is a great need for producing vascularized tissue models in tissue engineering and bioprinting technology. The vascular system is a multilayered architecture composed of endothelial cells, smooth muscle cells, fibroblasts, and extracellular matrix. We aimed to develop a digitally coded coaxial extrusion device that can directly bioprint 3D complex tubular fibers with multiple circumferential layers in a single step, without the need of post-processing. We designed a universal printhead that can be adapted to any standard tabletop extrusion bioprinter. This device must be usable with a range of hydrogel viscosities, variable diameters, wall thickness, and be sterilizable. Manufacturing techniques for triaxial extrusion tip fabrication are being developed to create desired geometry, for a small form factor, and a modular fluid reservoir. Alginate sodium hydrogel was proposed as the backbone because of biocompatibility, printability and rapid chemical crosslinking. The layers included a sacrificial gelatin core containing crosslinking agents, an inner sodium alginate and endothelial cell laden gelatin layer, and a stiffer outer hydrogel layer. To optimize, rheology was used to find the viscoelastic properties of the hydrogel. These properties were applied in a computational fluid dynamics model to examine the relationship between pressure, cross-sectional area, and output velocity.

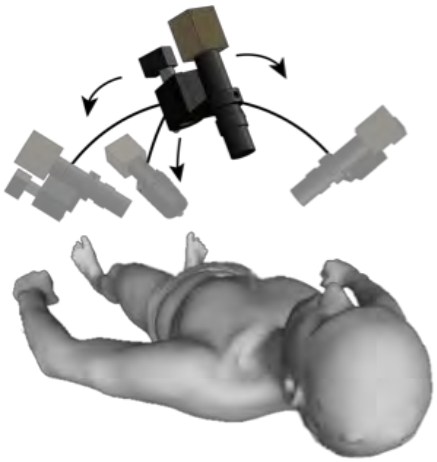
Fluorescence Microscopy Entrepreneurship

TEAM MEMBERS
Rachael Wyckoff, Karlie Naphy, Max Tensfeldt, Seamus Plunkett, Mathew Philippou

PROJECT MANAGER
Dr. Ben Wu

SPONSORS
New Jersey Health Foundation

The goal of this project is to find the potential market of our invention, which is fluorescence microscope that is able to obtain three-dimensional image. As part of this project, we went to New York City and take the I-Corp training at New York City Regional Innovation Node. On the technical side, we have built a fluorescence microscope, which is completely different from the traditional design. The applications of the microscope include skin disease detection and surgery imaging etc.



Fiber Reinforced Hot Mix Asphalt to Prevent Cracking in Cold Regions

TEAM MEMBERS
Sean Cullen, Ryan Gordon

PROJECT MANAGER
Dr. Yusuf Mehta

SPONSORS
Department of Defense

Cold regions pose a challenge when attempting to optimize the ride quality, serviceability lifetime, and the overall performance of the roadway due to cold temperatures. Engineers have begun exploring new materials to reinforce the aggregate structure of the pavement. Fiber reinforcements are among the new technologies used to increase the overall strength and lifetime of an asphalt mixture. However research is limited in this field, there is a need to conduct additional research that would further investigate the factors affecting fiber-reinforced asphalt mixtures coupled with their long-term performance. Current military engineering specifications for flexible pavements lack requirements and procedures for the use of fiber to reinforce asphalt mixture. Therefore, additional research on fiber-reinforced asphalt mixtures is needed to develop such specifications and/or procedures and requirements. This study seeks to design a better performing cost effective pavement by using the addition of fiber reinforcements. Different fiber types and dosage rates are tested and optimized to assess the best combination to reduce pavement thicknesses while increasing both fatigue rutting resistance, and pavement life by 50%. The following fiber types have been tested in lab to determine the increase in pavement durability and strength; FORTA fiber, glass fiber, basalt fiber, and carbon fiber.

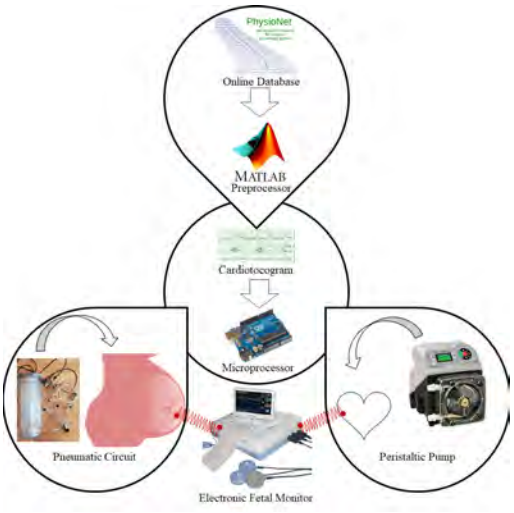
The Mummy Dummy: A Sensor Testbed for Fetal Surveillance

TEAM MEMBERS

Caroline Jorgenson and Kortnie Walton

PROJECT MANAGER

Dr. Francis (Mac) Haas and Dr. Wei Xue



Mannequins exhibiting realistic biophysical behaviors are useful for development of new biomedical devices as well as for the instruction of medical professionals. This project supports development of the "Mummy Dummy," a mannequin exhibiting key physiology-relevant electrical and mechanical behaviors of a laboring mother and her fetus. In particular, this mannequin simulates signals relevant for electronic fetal monitors (EFMs), which are in widespread use in the developed world for both pre-labor diagnosis and in-labor fetal health monitoring. For this project, students have developed a microcontroller-based interface to drive (1) an existing mechanical fetal "heart" to be detected by Doppler ultrasound and phonocardiography and (2) a flexible pneumatic "uterus" able to generate signals to be detected by tocodynamometry. For both cases, a series of real-world, correlated EFM waveforms have been downloaded from the PhysioBank Database and manipulated using MATLAB. Conditioned outputs from the MATLAB code are transferred to the microcontroller, where each record serves as a patient-specific signal driving the hardware governing the mannequin's cardiac and uterine activity.

Cost Effective Impeller Power Measurement and Modeling in M-Star

TEAM MEMBERS

Nicholas Tiwari, Anthony Salemo

PROJECT MANAGER

Dr. Robert P. Hesketh, Dr. Arthur W. Etchells III

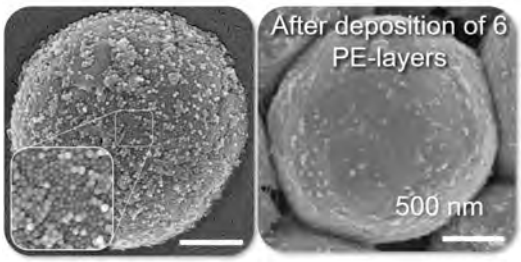
SPONSORS

The North American Mixing Forum

NAMF would like to produce a mixing experiment for undergraduates. They request that this unit be able to measure the power required to mix the fluid. Power input to fluid in an agitated tank is determined by torque on the impeller shaft and impeller speed. Torque is calculated by multiplying the force normal to the impeller by the lever arm, which is the distance from the center of the shaft to the point of measurement. The least expensive and most accurate method for torque measurement is a bearing setup, in which the tank is mounted on a bearing and the force required to prevent the tank from rotating is measured. Multiplying radius of the tank by this measurement gives the torque, and thus the power input to the fluid. M-Star is a new Large Eddy Simulation-based CFD software. The software is evaluated on ability to predict vortex height in an agitated system and minimum particle suspended speed in pipe flow. Models are designed and run in M-Star, and results from M-Star are compared with experimental data. The purpose of this project is to validate M-Star as an experimental tool.

Transport of Hydrophobic Substances across Polyelectrolyte Multilayers

TEAM MEMBERS
Troy Christiansen
PROJECT MANAGER
Dr. Martin F. Haase

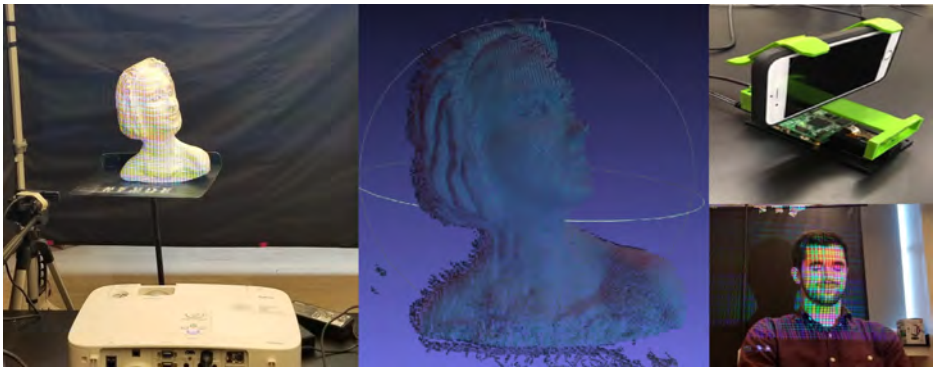


Polyelectrolyte microcapsules find many applications in drug delivery, as microreactors, or in anti-corrosive coatings. In drug delivery for instance, polyelectrolyte capsules need to be loaded with hydrophobic drugs and release their content gradually at target sites in the body. We investigate the mass transfer kinetics of the loading process to understand the polyelectrolyte shell permeability in detail. To this end, we coat droplets of a hydrophobic liquid with multiple polyelectrolyte layers. Electrophoretic mobility measurements and scanning electron microscopy show that the layer deposition results in a uniform, highly charged coating of the microcapsules. Next, we employ a charged surfactant to control the attachment of the polyelectrolyte capsules to an oil/water interface. Using confocal laser scanning microscopy we measure the diffusion kinetics of a fluorescent dye from the oil into the capsules. Astonishingly, we find that the dye uptake kinetics depend on the contact angle the microcapsules make with the oil water interface. Our results provide the basis for designing stimuli-responsive microcapsules that can load and unload their contents on demand. Future research will investigate the potential uses of these systems for drug delivery applications.

Augmented Reality and 3D Reconstruction using Structured Light (ARSL)

TEAM MEMBERS
Ryan Hare, Jordan Alberico, Will Cronin
PROJECT MANAGER
Dr. Gina Tang

The ARSL project is a project that utilizes the relationship between a camera and a projector to convert a 2D image into a 3D space. The ultimate goal of the project is to materialize our recently patented technology, entitled “use of spatially structured light for dynamic three-dimensional reconstruction and reality augmentation, patent #9,626,568, U.S.A”, into a commercial product. In particular, we are designing a mobile phone plugin system that utilizes a server hosting the ARSL program. Utilizing a phone-mounted projector, an image can be taken of an object. The phone application will then be responsible for sending the pictures to the server, where the 2D image will be converted into a 3D model and sent back to the phone. The development will eventually expand into stitching images into a full 3D render as well as accelerated rendering through machine learning techniques.



NJARNG Outreach, Planning, and Resiliency

TEAM MEMBERS

Grace Watson, Chris Rovelli, Michael Lionikis, Abigail Goger, Remo DiSalvatore

PROJECT MANAGER

Dr. Samantha Valentine, Dr. Jess W. Everett, Dr. William Riddell

SPONSORS

NJ Army National Guard

The New Jersey Army National Guard (NJARNG) has both state and federal missions to promptly mobilize and provide emergency assistance during times of war, to provide support for national, state and community natural disaster response, and to preserve peace, order and public safety. Power resilience is vital in supporting these missions, and recent extreme weather events like Hurricane Sandy have highlighted vulnerabilities and risks that impact mission assurance. To improve the power security and resilience of the NJARNG systems and operations, the NJARNG Energy and Water Plan (EWP) is being developed by the Rowan University Sustainable Facilities Center following the planning process laid out in a guidance document distributed by the US Department of the Army. The NJARNG EWP includes assessing current energy and water performance metrics, determining mission critical energy requirements, recognizing critical energy support vulnerabilities, and identifying appropriate backup power and other onsite power generation. The plan addresses various issues and standards that are necessary to improve energy security throughout the state (including conservation education and outreach), and incorporates the Army National Guard Mission and core strategies.

2019 ASME Design Contest

TEAM MEMBERS

Matthew Botti, Lucas Fox, Robert Frank, Scott Hood, Bilal Muhammad, Stephen Nichols, Sara Toner

PROJECT MANAGER

Dr. Hong Zhang, Dr. Tirupathi Chandrupatla

Each year the American Society of Mechanical Engineers (ASME) hosts a design competition in which undergraduate teams across the country compete to design a project within the constraints of the rules. This year's competition is the Pick and Place Race. It features a field of 16 cylinders with balls, ranging from a ping pong ball to a basketball, placed on top. Teams must design a robot that can collect these balls, and be able to return them to a designated scoring area. If any balls are dropped before being collected, points will be deducted. There will be several rounds, the first a five minute solo collection round and the remaining rounds are knockout rounds where teams compete at the same time. Since rounds are time sensitive, efficiency of collection and the ability to collect multiple balls at once are paramount. To meet these demands, a robot that can knock over cylinders to drop balls into a large collection basin was empirically demonstrated to be the most efficient method of collecting balls. Our robot utilizes this principal to quickly sweep up several balls at once and drop them in the scoring area to maximize points.

Algae City - Virtual Reality Game Development

TEAM MEMBERS

Anthony Brooks, Brad Anderson, Daniel Heitmuller, Ian Moffitt, Joey McNatt, Mitchell Kraft

PROJECT MANAGER

Dr. Gina Tang

SPONSORS

NSF

Algae City is an interactive and educational game that is currently being developed in the Unity Game Engine to promote STEM education. It is designed towards educating middle school students, from 5th to 8th grade, about the possible implementations of algae as a replacement sustainable resource and an environmentally-friendly solution to many of the world's pollution, energy, and other existing and potential problems. This game is currently being worked on by a combination of ECE, Civil, and Mechanical engineers, allowing each engineer to work on a distinct section to the best of their ability. Many game design strategies are used to integrate the game's educational content with classroom curriculum while maintaining a balance of fun and learning.

Road User Comprehension of the Pedestrian Hybrid Beacon Signal in New

TEAM MEMBERS

Brendan Mulvihill, Michael S. Mosley, Christopher R. Campbell

PROJECT MANAGER

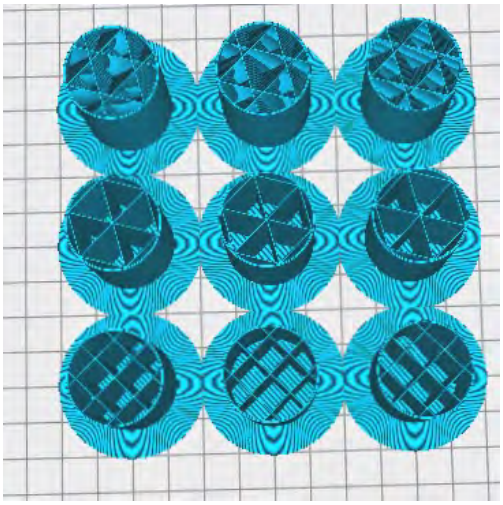
Dr. Mohammad Jalayer

The Pedestrian Hybrid Beacon (PHB) is a high-intensity pedestrian signal that can be placed at a midblock or intersection crosswalk. This system was introduced into the MUTCD in 2009, and since has increased in popularity across the country, including in New Jersey. Recent research has raised concerns about motorist and pedestrian comprehension of the PHB due to its recent introduction in New Jersey. In this study, video data was collected at PHB sites in New Brunswick, Woodbridge, and Westfield, New Jersey in order to evaluate road users' behaviors at the PHB. An online survey was also conducted in the Rowan University community including students and faculty members in order to gauge public awareness and comprehension of PHB signals in New Jersey. Together, the video data and survey results are reflective of the current level of public understanding and the effectiveness of PHB's in New Jersey.

Phase	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Motorist Signal					
Motorist Action	**Proceed** Through Crossing	**Slow Down** for Pedestrians	Prepare to **Stop** for Pedestrians	**Stop** for Pedestrians	**Stop** and Proceed when Clear
Pedestrian Signal					
Pedestrian Action	**Push Button** to Cross	**Wait** for Cross Signal	**Wait** for Cross Signal	**Begin Crossing**	**Finish Crossing**

Material Properties of 3D Printed Parts

TEAM MEMBERS
Joseph Durdan, Nathaniel Narbone
PROJECT MANAGER
Dr. Hong Zhang



The purpose of this clinic was to experimentally study the material property of 3D printed parts. Since filament based 3D printer are generally slow, people often use lower infill rate (generally ranging from 10% to 100%) to speed up the printing. The fill pattern also varies according to the users' choice, which can range from triangle, diamond, to honeycomb, or other customized shape. However, when the parts are subject to external force, the lower fill rate may lead to premature failure. In this clinic, we use an Ultimaker 2+ 3D printer and PLA filament to print multiple cylindrical samples with each infill rate from 10% to 90%. Then we tested their compressional strength using an MTS 831.10 Elastomer Test System with a 5000 lb load cell limit. The test result is compared with the stress-strain curve of the same filament material. The data will then be used as part of the 3D printer's reference manual to determine the best compromise of part strength and printing speed.

Hollow Fiber Nanocomposite Membranes

TEAM MEMBERS
Noah Hough
PROJECT MANAGER
Dr. Martin F. Haase

Nanoparticle decorated polymer membranes (nanocomposite membranes) have promising potentials in water treatment, organic solvent nanofiltration and as catalytic membrane reactors. The surface properties of the nanoparticles impart useful functionalities to the membranes, with examples ranging from enhanced selectivity, self-cleansing, or anti-fouling features. Here, we investigate nanocomposite membrane fabrication by Solvent Transfer Induced Phase Separation (STRIPS), a new technique that enables membrane formation with diverse nanoparticle materials and exceptionally high particle loadings. As a case study, we investigate silica nanoparticle coated membranes for use in water treatment. We design a coaxial extrusion device to fabricate hollow fiber nanocomposite membranes with uniform surface pore sizes. The porosity and the mechanical properties of the fibers can all be controlled by varying the composition of the membrane casting solution and nanoparticle concentrations, as confirmed by Scanning Electron Microscopy and Confocal Scanning Laser Microscopy. By varying the membrane structure, we are able to minimize the surface pore size down to a few nanometers, suitable for ultrafiltration. We are currently studying the dependency of the membrane structure and mechanical strength on the composition of the casting mixture.

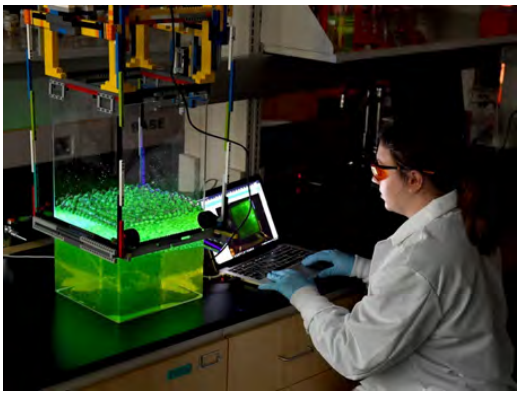
Laser Scanner for Granular Packing Analysis

TEAM MEMBERS

Alexandra Haggar, Abigail Brown, Lauren Gallo

PROJECT MANAGER

Dr. Martin F. Haase



Granular materials are unique in that they behave both like a solid and a fluid due to their packing. Because of these behaviors, it is more difficult to model how the individual particles interact with each other. Studying the behavior of packed granular material can provide improved understanding of mixtures and jamming phenomena. We developed an innovative way to easily study granular packings using laser scanning. Our experiment used clear water swollen hydrogels. A case was filled with 7,000 hydrogel balls. When fluorescein is added to this solution, it is illuminated green when penetrated by the blue laser and shows a cross section of the packing. The scanner uses a gear track, motors, and is controlled by a MATLAB. The MATLAB program also controls a camera that was used to take a photo of each cross section. The program ImageJ is then used to analyze the photos and determine the packing density. A packing density of 55% was found, lower than the expected density of 66%. We are now working to more closely match the refractive index of the surrounding solution to that of the hydrogels. This will result in higher image quality for more accurate representation of the packing.

NASA RASC-AL Moon To Mars Ice & Prospecting Challenge

TEAM MEMBERS

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PROJECT MANAGER

Dr. John Schmalzel

NASA is searching for ways to extract and use subsurface water-ice on Mars with the RASC-AL Moon to Mars Ice & Prospecting Challenge. Rowan's Clinic Team, Red Origin, is tasked with designing and building a device that harvests ice deposits from underneath the surface of Mars and prospects water-ice deposits on the moon. Our team's solution is to design and fabricate the Rowan Autonomous Mining and Selective Extraction System, RAMSES, which prospects, drills for, and refines water-ice on-site. The expected outcome for this project is to submit a technical report to NASA, detailing how to construct the device, using our prototypes of major subsystems as a proof of concepts. Over the last two semesters, the team has designed essential subsystems, developed low-res prototyping schematics, and raised over $3600 for further research and prototyping. Our plan for the future is to submit another project plan next semester and compete against the other top ten NASA RASC-AL submissions at the NASA Langley Research Center.

Improving Driver's Education Regarding Wrong-Way Driving Incidents

TEAM MEMBERS

Kevin M. Takacs, Jason C. Roberts

PROJECT MANAGER

Dr. Mohammad Jalayer

Wrong-way driving (WWD) occurs when a driver, either inadvertently or deliberately, drives in the opposing direction of traffic along a high-speed, physically divided highway or its access ramp. The nature of WWD crashes, which often tend to be head-on collisions, has drawn the attention of transportation engineers for the past few decades. Several state Departments of Transportation have adopted three key points of interest—Engineering, Education, and Enforcement— to mitigate this crash type. We note that numerous previous studies focused on Engineering and Enforcement components, but in most cases, the Education component has been underrepresented. The goal of this study is to contribute to the current research by expanding upon the education and knowledge of drivers regarding WWD incidents. Specifically, a web-based survey was designed and distributed to the Rowan University community to gauge the level of familiarity amongst drivers of different age and experience. The results of the survey indicate that WWD incidents occur much more frequently than are reported. It is evident from the responses that drivers are much less aware of WWD incidents than other issues such as driving under the influence or distracted driving. Communities throughout the state of New Jersey should consider increasing the amount of precautionary messages discussing the dangers of WWD and consider introducing further education campaigns. These programs should then be evaluated to determine their effectiveness. Overall, these results provide valuable information for policymakers, engineers, and researchers to improve the overall road safety by reducing the frequency at which WWD incidents occur.

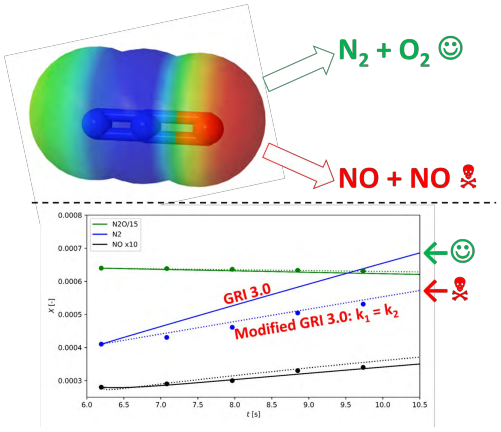
Nitrous!

TEAM MEMBERS

Haseeb Bukhari, Rory Cronogue, Gianna Oldt, Jeremy Rainey, Meagan Schweiger, Ryan Sweeney

PROJECT MANAGER

Dr. Francis (Mac) Haas



A new atmospheric pressure laminar flow reactor facility has been developed for the study of high temperature small molecule chemistry related to combustion emissions, unimolecular decomposition reactions, and chemical thermometry. The facility features a water-cooled sampling probe that translates along the reactor axis, permitting spatially-resolved species mole fraction/temperature measurements through FTIR and microGC diagnostics. Under carefully engineered conditions, these measurements constrain elementary gas phase reaction kinetics. Particular focus for this work is the formation of N2O-derived NOx, for which the branching ratio of the N2O+O->Products reactions remains uncertain by a factor of >800% near at temperatures relevant to fluidized bed combustion (950-1300 K). The dry N2O reaction system is addressed through both an analytical quasi-steady state model applied to incipient reaction conditions (low N2O conversion) and a complex kinetic modeling framework based in the Cantera/Python environment, used to plan effective experiments. While the former is particular to the dry N2O decomposition system, the latter is extensible to experimental planning for other reaction systems of interest, for example, those involving CO or CH2O. Beyond development of the Cantera experiment planning framework, facility engineering efforts in this project have given new life to between $10-15k of laboratory hardware.

AIAA Intercollegiate Rocket Engineering Competition

TEAM MEMBERS

Josh Meyer, Stephen Kovarik, Tim Miglin, Dylan Bendzynski, Cameron Bendzynski, Shane Price, Tyler Smalley, Alek Velez, Andrew Brown, Brendan Chiappa, Cayla Ritz, James Porskievies, Kevin Beenders, Kieran O'Connor, Luke Elwell, Matt Barrasso, Michael Sorce, Mike Maloney, Monica Higgins, Nate Dolnack, Shivam Patel, Timmy Gayed, Colton Jacobucci

ROJECT MANAGER

Dr. John Schmalzel

SPONSORS

NSF

The Rowan University Rocket team formed four years ago to participate in the 2016 IREC. At this point in time, the team was comprised of 5 students led by the president of Rowan's chapter of AIAA. Four years later, the team has expanded to include 24 students from 4 different majors. In 2017, the team returned for its second year at the inaugural Spaceport America Cup with the Profet II, and placed 67 of the 115 registered teams after a successful flight to 11,054 feet. In 2018, "The Fifth Day" flew to 9,672 feet, 23 out of 115 teams, and a beyond successful flight. The 2018-2019 IREC team came into the year under new leadership with new ambitions. Entering into the 30,000 foot competition for the first time gave the team a large set of challenges. Over the course of the year, the primary focus was the design of the airframe, and the manufacturing of a custom made 5-foot by 3-foot by 3-foot convection oven. The design of the rocket was inspired by the "Jarvis Method", which entails using a minimum diameter airframe design wrapped in 5 layers of carbon fiber. The custom convection oven has been designed and fabricated to cure the carbon fiber wrapped body tubes and obtain a sufficient surface temperature for the flight. The rocket is designed to break the sound barrier and must be prepared for that amount of impulse.

Cold Weather Concrete with Structural Applications

TEAM MEMBERS

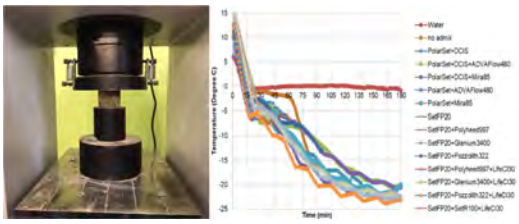
Andrew Atienza, Douglas Evans, Nick Forrester, Sean Plunkett, Mario Romano, Ken Lee

PROJECT MANAGER

Dr. Gilson Lomboy, Dr. Douglas Cleary, Dr. William Riddell

SPONSORS

Department of Defense, United States Army Core of Engineers, Cold Regions Research and Engineering Laboratory



In colder temperatures, the setting of concrete tends to be delayed and the development of strength is hindered. Without precautions, water in a concrete mix can freeze instead of cure, leading to permanently weakened concrete. Another alternative approach that avoids energy cost and potentially extends the construction season, if early-age strength development is not a primary goal, is using single or a combination of admixtures to reduce the freezing point of water in concrete mixes. This is sometimes called antifreeze concrete or cold weather concrete (CWC). The overall goal of this project is to apply cold weather concrete mixing technology developed by CRREL for reinforced concrete applications. In order to achieve this goal, a step by step process of studying characteristics of CWC with antifreeze admixtures and reinforcements must be performed. This begins with a preliminary testing of materials by mixing sample batches of concrete, molding them into 2 inch x 2 inch x 2 inch cubes and testing the compressive strength, as well as molding concrete into a cylinder mold to test the freezing point. Other tests that will be done includes a full batch to be mixed in a freezer and material properties test of steel reinforcement.

Recruitment and Retention in Engineering

TEAM MEMBERS

Piotr Lukaszek, Alissa Papernik, Julia Reilly

PROJECT MANAGER

Dr. Anu Osta, Dr. Jennifer Kadlowec

SPONSORS

Engineering Information Foundation

While women make up 56.8% of the total U.S. workforce, only 8.5% of the country's engineers are women and women continue to be underrepresented in university engineering programs. However, studies have shown that diversity within an organization or team, including gender diversity, is necessary as it is associated with improved productivity, creativity, and organizational profitability. This highlights the crucial need to increase women's representation and improve gender balance in engineering. The purpose of this research study is to determine factors that influence recruitment and retention in undergraduate engineering. An IRB approved protocol and survey have been developed to collect data on a variety of experience to determine effects on recruitment and retention in engineering. The survey questions involve family support, attitudes about engineering, engineering support resources, classroom experiences, mentorship, and engineering activity involvement. Interview questions will be asked, allowing the research team to further probe reasons for recruitment and retention through conversation and key phrases and ideas described by participants. Data results will be used to correlate factors, which influence recruitment and retention and find solutions on how to mitigate factors that may hinder female recruitment and retention.

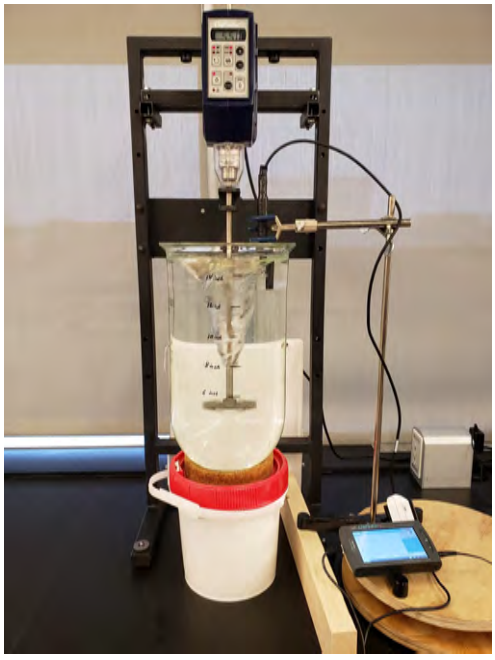
Blend Times of Unbaffled Tanks

TEAM MEMBERS

Anthony Salemo, Nicholas Tiwari

PROJECT MANAGER

Dr. Robert Hesketh



Vortex formation in unbaffled mixing tanks has not been characterized in previous literature studies. This work will quantify vortex formation as a function of the inverse Froude number and Reynolds number. This work will also determine the time required to completely mix two solutions in an unbaffled tank with a vortex. In the mixing industry this is known as blend time. Blend time is determined using conductivity measurements of salt solutions as a function of time. These measurements are converted to a 95% uniform concentration along the entire tank. The time it takes for the solution concentration to surpass 95% of the final concentration from the initial pouring time is the total blend time. The data was collected at liquid level heights from 0.75 to 1.75 of the tank diameter, impeller speeds from 150 RPM to 800 RPM, axial and radial impellers, and tank diameters of 8 inches to 2 feet. The following correlation 5.66 = Np^( )*Re/Fo based on Grenville 1996 fits the data.

In Vitro Model of Glioblastoma

TEAM MEMBERS

Christopher Niemann, Casey Garrell, Patrick Dente

PROJECT MANAGER

Dr. Gary Thompson, Dr. Amir Miri

Glioblastoma brain cancer is the most common and deadly primary brain tumor that leaves its afflicted patients with a median survival rate of one year following treatments. This in vitro study seeds glioblastoma cells (U -87 MG line) into a hydrogel microenvironment that mimics the brain's extracellular matrix. By constructing a microfluidic chamber that replicates the structures of white matter tracts and blood vessels in the brain, electric field and hydraulic forces can be controlled to be similar to those found in vivo. This overall effort tests the hypothesis that such an in vitro model system can induce a phenotypic shift so that the immortalized U-87 cells more closely resemble primary tumor cells. Cell survival will be evaluated using viability and live/dead fluorescence assays, and expression of biomarkers will be observed using immunofluorescence. It is expected that exposure to low frequency fields typical of brain activity, in addition to the soft substratum and microfluidic flow, will significantly alter expression of mechanoreceptors without inhibiting tumor cell proliferation.

RF Nonlinearity-Characterize/Mitigate

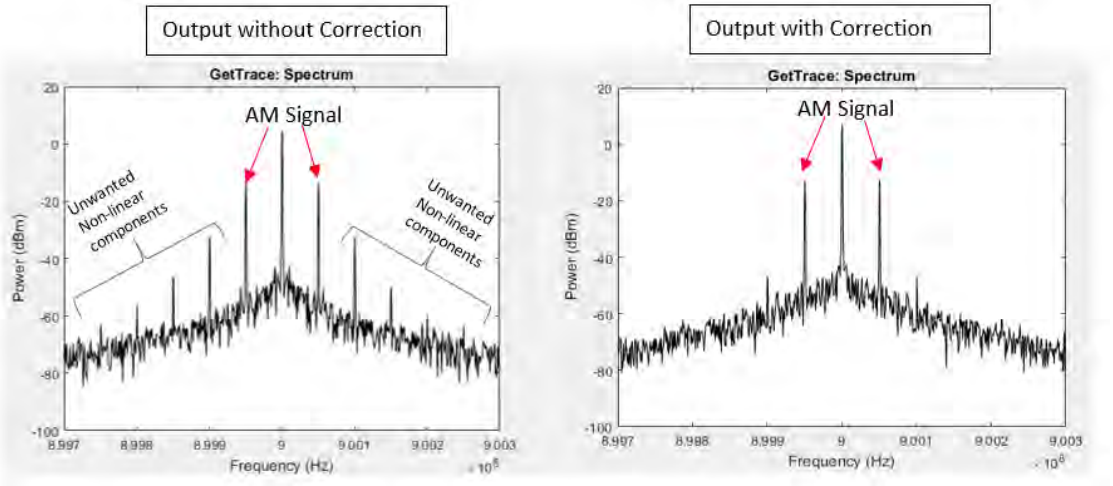
TEAM MEMBERS

Benjamin Jukus

PROJECT MANAGER

Dr. Robert Krchnavek, Dr. John Suarez

This research project focuses on the identification, quantification, and counteraction of dynamic non-linearities in radio frequency (RF) amplifiers. Being able to account for and correct these non-linearities decreases the bandwidth and power needed to transmit. This becomes increasing important as more devices need access to a greater range of frequencies. The focus on counteracting these non-linearities has been to implement a variable impedance network to correct the reflection of the output waveform from the amplifier. Work on this research would continue by creating a single device capable of all three functions.



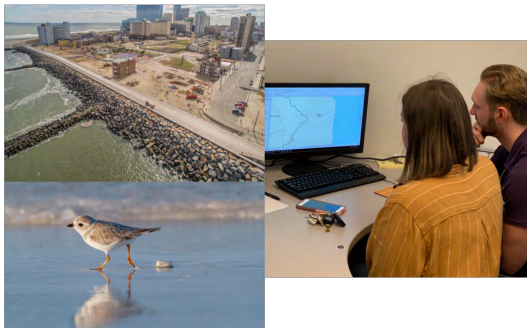
Impact of Seawalls on NJ Beach Communities

TEAM MEMBERS

Victoria Barry, Travis Bate, Jake Guertin, Sarah Conway

PROJECT MANAGER

Dr. Jagadish Torlapati



The primary goal of this clinic project is to assess the impact of seawalls on the ecology of New Jersey beach communities. Based on the zoning maps, we created three category types: residential, commercial and protected. The locations examined were Money Island, Asbury Park, Absecon Inlet, Corson's Inlet and Fisherman's Cove. Money Island was categorized as residential area type. Asbury Park was categorized as residential and commercial area type since it is a renowned tourist destination on the Jersey Shore and also has a large permanent population. Similarly, Absecon Inlet was categorized as both residential and commercial since it is home to a permanent population as well as many businesses. Absecon Inlet suffered a lot of damage during Hurricane Sandy and has constructed a seawall to protect itself from future storms. Corson's Inlet was categorized as a protected area type. Lastly, Fisherman's Cove was categorized as a protected area type due its classification as a conservation area by the Monmouth County Park System. Seawalls pose substantial risk to the biodiversity in the regions where it is constructed. We have made risk assessments to their ecology based on the visual, environmental, and economic impacts as well as public acceptance.

Design, Build, and Test of SAE Baja Vehicle

TEAM MEMBERS

unter Cundiff, Elizabeth Henning, Merve Sadak, Tyler Ziegenbein, Ryan Anderson, Kunj Parmar, Eric Blatz, Jesse Brinskelle, Travis Berner, Aaron M Genova, Matthew Rinderer, Joe Christopher, Nick Chamberlin, Brian Foley, Devan Mull, Nick Munier, Corey Orlovsky, John Garvey, Cameron Korzeniowski

PROJECT MANAGER

Dr. Anu Osta, Dr. Nourouddin Sharifi

The Society of Automotive Engineers (SAE) hosts yearly competitions in which "Mini Baja" vehicles are designed and fabricated by participating engineering colleges. The objective of the competition is to produce a reliable, safe, off-road vehicle for recreational use. Design of the Rowan Motorsports 2019 Baja Car began in the summer of 2018 with the goal of producing a lightweight car without sacrificing strength or reliability. The 2019 car also competed in Epreuve du Nord, a competition at Laval University in February - this allowed the team to test, identify design flaws and redesign. The Baja team is broken down into the following 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.

PEDC - Electrospun Fiber Stretching Apparatus

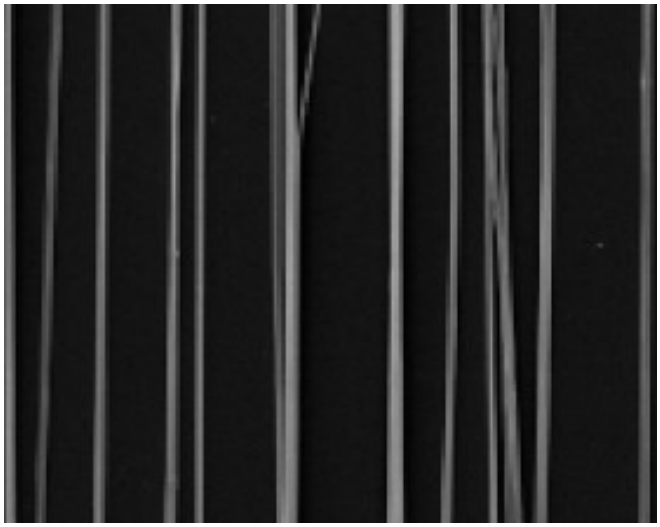
TEAM MEMBERS

Karlie Naphy, Dom Moffa, Matt Mazalewski, James Merrill, John McAvoy, Tri Do

ROJECT MANAGER

Karl Dyer, Mario Leone

Design of a high temperature stretching apparatus for the post processing of electrospun fibers.



Pressurized Fluid Flow in Fractures

TEAM MEMBERS

Kylee Applebaum, Shawn Seroka, Harry Duffield, Anthony Morici

PROJECT MANAGER

Dr. Torlapati, Dr. Lomboy, Dr. Zhu

The primary objective of this clinic project was to determine the correlation between rheological properties of fluids and change in pressures in order to develop a method for injecting fluids into a fractured surface with pressure. The experiments helped understand the flowability of fluids and their applications for real world applications, such as fracking. The fluids chosen for this study were: maple syrup, glycerin, Portland Cement, Portland Cement with Fly Ash, Portland Cement with Silica Fume, Portland Cement with two different viscosity modifiers. To accomplish the objectives of this project, we have divided it into three phases. Phase I of this project included the study of the rheological properties of various fluids. The Bingham plastic model was applied to the fluids which were non-Newtonian. Phase II was developed based on the results from the previous phase to observe the change in the rheological properties under changing other factors such as pressure. The objective of Phase III is to be able to study the flowability of fluids in 3D-printed fractures, eventually developing a numerical model to predict this behavior. This will be done by injecting a fluid into a 3-D printed fractured flow sample with and without pressure.

Development of a Low-Cost, Portable Mechanical Tester

TEAM MEMBERS

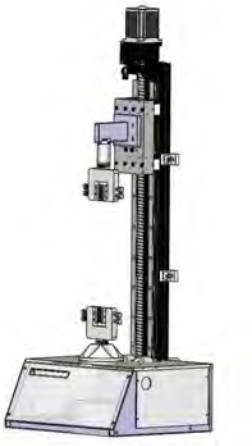
Quinn McHugh, Tyler Bursa, George Baals, Alaoudi, Ridwan

PROJECT MANAGER

Dr. Anu Osta, Dr. Jennifer Kadlowec

SPONSORS

Engineering Information Foundation



Mechanical testers, devices that can perform compression, tension, and hardness tests on different materials to determine their material properties, are regularly used by materials scientists, researchers, and companies alike for a wide variety of applications. These mechanical testers, however, often cost multiple thousands of dollars and are extremely heavy, making them too impractical to be purchased by academic institutions for educational purposes. Thus, Prof Instruments, an engineering clinic group made up of Rowan University students, is currently developing a portable, low-cost mechanical tester that could make hands-on, materials science education in the classroom a reality. The device design and manufacture involves integrating the various electromechanical components such as screw driven linear actuator, load cell, encoder, Raspberry Pi and arduino microcontrollers, power supply, data acquisition interface, HMI interface, control panel, and python based test software.

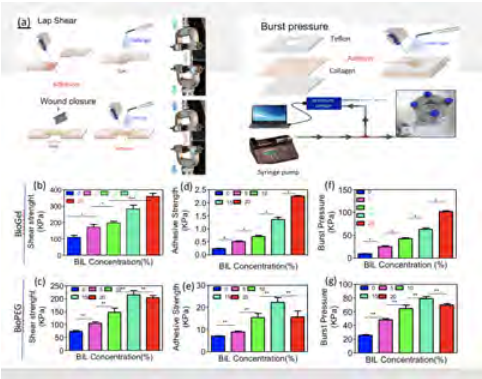
Bio-Ionic Liquid Conjugated Gels (BioGEL)

TEAM MEMBERS

Caleb Miller, Tyler Hannah, Ethan Ellis , Andrew Kapetanakis , Akshar Patel, Vaishali Krishnadoss

PROJECT MANAGER

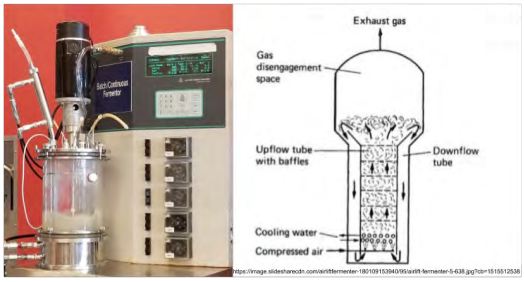
Dr. Iman Noshadi



Adhesion to wet and dynamic surfaces, including biological tissues, is vital in many areas but has shown to be notably challenging. Tissue adhesives require a combination of properties including mechanical characteristics comparable to the native tissues, high adhesion, biodegradability, high biocompatibility, and ease-of-use. We report a bioinspired design based on conjugation of gelatin and PEG with bio-ionic liquid (BILs) to engineer multifunctional highly sticky, biodegradable, biocompatible and hemostatic adhesives, BioGel and BioPEG hydrogels. Choline-based BILs are a structural precursor of the phospholipids cellular membrane bilayers, and we showed that the conjugation of choline molecules to naturally derived polymer gelatin methacryloyl (GelMA) and synthetic polymer polyethylene glycol diacrylate (PEGDA) significantly increases the adhesive strength and hemostatic properties. Different ratios of polymer and bio ionic liquid were mixed at room temperature and crosslinked into hydrogel adhesive via visible light photopolymerization. The final concentration of the polymer and ionic liquid plays a vital role in determining the physical properties such as degradation, swelling and mechanical stability of the sealant. The hydrogel adhesive exhibit a notable decrease in the total blood volume loss in tail cut and liver laceration in a rat animal model. This family of adhesives may be useful in many areas of application, including tissue adhesives, wound dressings, and tissue repair and flexible electronics.

Comparison of a Novel Bubble Column Fermentor with Standard Fermentors

TEAM MEMBERS
Jacqueline Sheaffer
PROJECT MANAGER
Dr. Zenaida Otero Gephardt



A novel bubble column fermentor equipped with a draft tube was designed and all calculations and parts list were completed for construction. The draft tube contains the air sparger and the two-phase region (air/liquid). This design provides the necessary oxygen to the fermentor and, by using the density difference between the two-phase region inside the draft tube and the single- phase region outside, generates a liquid circulation. This liquid circulation mixes the content of the fermentor without employing an impeller. The draft tube design can be used as a variable to optimize system oxygenation and mixing. This type of mixing may be cost effective and provides a more protective environment for the organisms in the fermentor than an impeller equipped vessel. A statistical factorial experimental design has been developed to compare the novel fermentor to standard tank-type fermentor vessels equipped with impellers. Experimental runs in standard vessels were completed using yeast as the organism. Glucose concentration and cell mass were used to characterize the system. These results can be directly compared with results obtained from the novel bubble column fermentor.

PEDC – Planaria Testing Apparatus

TEAM MEMBERS
Janelle Diesburg, Helen Pan, Kristin Potocki, Bryan Regn, Carla Silvestri, Kim Tran
PROJECT MANAGER
Karl Dyer, Mario Leone

Design of a patterned light testing apparatus to detect neurological damage in planaria.

Engineers Without Borders

TEAM MEMBERS

Katherine Villacis, Karen Tayar, Brandon Kreusch, Robert Schablik, Samantha Struble, Joseph Jackson, Bernard Bogus, Jessi Bundz

PROJECT MANAGER

Dr. Jagadish Torlapati and Dr. Yusuf Mehta

Rowan University's Engineers without Borders 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 Ranshet School community in India experiences frequent power outages causing water accessibility problems. We assessed ten alternatives and combined them into different "packages" to prepare for an implementation trip. The team will travel to India during the summer to complete Phase I which includes fixing leaks and water-management training. Vietlead is a non-profit community organization that works with a community garden called Resilient Roots located in Camden, NJ. We have completed a rainwater catchment system, created a bicycle-powered water pump which was done by modifying a pump to be operated via the friction of a bicycle tire. We plan to continue our partnership with Vietlead with the construction of a greenhouse and the inclusion of aquaponics to further enhance the garden in the spring. We also collaborated with Ronald McDonald House (RMH) foundation as well as the Cedar Run during Spring 2019 semester. We are designing and constructing a cart that will be utilized in local children's hospitals for RMH. We are building enclosures for Woodford Cedar Run Wildlife Refuge.

Human Machine Interface Development

TEAM MEMBERS

Sean Dugan, Patrick Wilk, George Baals

PROJECT MANAGER

Dr. Anu Osta, Dr. Jennifer Kadlowec

SPONSORS

Genesis Packaging

The pharmaceutical industry relies on vials to contain and ship lifesaving medicine to its intended recipient. To ensure that the medicine contained within the vial is properly sealed the residual seal force (RSF) of the vial must be checked. The RSF value of a vial determines if a vial is sealed well enough for the contents to remain sterile. To accurately measure the RSF value the Rowan team was tasked with creating a bench top testing device which was easy to use, reliable and accurate. To accomplish this a human machine interface (HMI) was developed using Blue Open Studio and a Programmable Logic Controller (PLC) was used to control the operations of the device. Using Blue Open Studio an intuitive user interface face was developed which doesn't require the device to be operated by specialized employees.

PEDC - Bone Void Training Device

TEAM MEMBERS

Anwar Hussein, Larry Hannawacker

PROJECT MANAGER

Mr. Karl Dyer, Mr. Mario Leone

Design of a training device for doctors to fill bone voids.

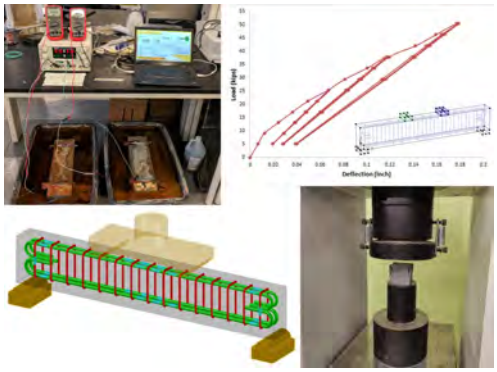
Ultra-High Performance Concrete and Retrofitting Deteriorating Infrastructure

TEAM MEMBERS

Kyle R. Selle, Alexander C. Semler, Kyle C. Taylor, William H. Weise

PROJECT MANAGER

Dr. Gilson R. Lomboy, Dr. Harshdutta Pandya



Ultra-high performance concrete (UHPC) is a portland cement based composite with very low water-to-cement ratios, optimized gradation, and short discontinuous fibers. The mixture has a high flowability and has compressive strengths greater than 22 ksi. The present work is to develop a UHPC mix design using local materials available in New Jersey, gather flexural strength data on corroded rebar reinforced HPC beams, and model corroded rebar reinforced HPC beams with UHPC used as a repair material as well as simulate their flexural strength performance. The current composition is Keystone Type I portland cement, undensified silica fume, Sika ViscoCrete 2100 high range water reducer, silica aggregates from New Jersey, and 12 mm steel fibers. Current results show strengths of 21 ksi at 28 days. Further improvements for the UHPC mix design are being made on optimizing gradations to increase the composite strength. Additionally, the corrosion process for the HPC beams is being improved for increased accuracy and reliability.

Explosive Detection Wand for the Transportation Security Agency

TEAM MEMBERS

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PROJECT MANAGER

Dr. Anu Osta

SPONSORS

Princeton Security Technologies

In response to increased terrorist threats the world over, the US Transportation Security Administration (TSA) was formed. They use a hand held wand to screen passengers and luggages for trace explosive particles that might be left on the clothing or luggage of the passengers. The existing explosive detection wand used by the TSA has been proven to be unreliable, with a 25% failure rate, is extremely overpriced costing approximately $400 per wand and ergonomically inconvenient to use. The goal of the Explosive Wand Clinic is to design and fabricate a wand that would compete with the existing devices in the market. The prototype must hold a swab that is able to collect the explosive particles as well as include a trigger design to mechanically hold the swab in place. The electronics of the detection wand includes a pressure activated sensor which alerts the user that optimal pressure is being applied, a mini LED flashlight, and a rechargeable lithium-ion battery. The swab can be tested in ion spectrometry based chemical analysers. The team utilized SolidWorks to optimize the design through several iterations and then fabricated each iteration using PLA 3D printing. The final prototype will be tested at airports and the research labs.

Bio-Based Resins for Additive Manufacturing

TEAM MEMBERS

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PROJECT MANAGER

Dr. Joseph F. Stanzione, III

SPONSORS

US Department of Defense Army Research Laboratory

Vinyl ester resins (VERs) are used to produce polymeric materials for a variety of commercial and military applications due to their relatively high strengths, moduli, thermal stabilities, and chemical resistances. To achieve similar properties to industrial, petroleum-based VERs, bio-based resins need to possess some aromatic content to impart favorable thermal, viscoelastic, and mechanical properties. Lignin is an abundant natural source of aromaticity and among the many lignin derived compounds, vanillin has been shown to be a viable platform for the development of VERs. Additionally, additive manufacturing, more commonly known as 3D printing, has gained significant traction as a favorable manufacturing technique over traditional methods due to the ability to create customizable parts on demand with complex geometries. In this project, a low viscosity, vanillin-based VER was synthesized in a solventless, two-step, 100 % atom efficient reaction. Photorheology was utilized to determine the feasibility of the resin to be polymerized using stereolithography (SLA). The vanillin-based resin was cured via SLA to determine polymer performance. Extent of cure analysis demonstrated that the printed resin, after a mild post cure, achieved favorable extents of cure. Viscoelastic, thermogravimetric, and mechanical testings were performed to investigate the properties of the resin cured via SLA.

Preparation and Characterization of Bio-Based Polyesters

TEAM MEMBERS
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PROJECT MANAGER
Dr. Joseph F. Stanzione, III

SPONSORS
US Department of Defense - Army Research Laboratory

The utilization of wood-derived building blocks (xylochemicals) to replace fossil-based precursors is an attractive research subject of modern polymer science. The continuing development of new bio-based feedstocks opens opportunities to increase the resource base from which chemical and materials engineers can draw to meet specific polymer property requirements. Recently, significant efforts have transpired to obtain bio-based polymers and copolymers with enhanced thermomechanical properties for a wide variety of applications. In continuing these efforts, we have prepared and examined novel linear polyesters derived from xylochemicals. Bio-based analogues were utilized with other naturally derived diols and were subsequently polymerized to prepare a series of polyesters with varied and well-defined thermal properties. These novel thermoplastics were characterized to assess their structure-property relationships and compared to industrial, fossil-based "equivalents". The results of our study illustrate that these new polymers are valid alternatives to petroleum-based materials currently employed in the plastics industry.

Brewery Power Quality: Phase 2

TEAM MEMBERS
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PROJECT MANAGER
Dr. John Schmalzel, Dr. Robert Krchnavek

SPONSORS
Flying Fish Brewery

Flying Fish brewery has been experiencing power related issues with their equipment which has caused substantial cost both in replacement equipment and lost product. Specific problems manifested in both de-synchronization of the main brew-house computer as well as through failures of variable frequency drives. The team has discovered, through anecdotal evidence, that brownouts have occurred at times coinciding with failures of the brew-house computer. With this information, it is believed that these periods of low voltage are causing issues with the computer thus interrupting recipes and cleaning cycles. In order to resolve this, an uninterruptible power supply (UPS) is recommended in order to maintain continuity in operations and integrity of the product. Additionally, power line monitoring is to be implemented such that recurrent issues may be observed to identify issues causing stress on the VFDs. This will lead to determinations of root cause and potential solutions.

Ternary Blended Concrete with Recycled Concrete Aggregate

TEAM MEMBERS

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PROJECT MANAGER

Dr. Gilson R. Lomboy, Dr. Douglas Cleary, Seth Wagner

SPONSORS

USDoD/ERDC/CRREL

Ternary Blended Concrete with Recycled Concrete Aggregate Clinic focuses on increasing the use of by-products as supplementary cementitious materials and increase the utilization of recycled concrete as aggregates. As the supply of natural aggregate and cement begins to dwindle, increasing the use of recycled materials in concrete is necessary to provide a sustainable option for the industry. The objective of this project is to confirm the optimal ternary blend of portland cement and secondary cementitious materials (SCMs) found in previous testing is compatible with recycled concrete aggregate (RCA) and the mixtures benefit the hardened properties of the concrete. This was done by creating 0.165 m^3 batches of concrete with the optimal cementitious material mixture and replacing natural aggregate with RCA at 0%, 30%, and 50% dosages. This concrete was then tested for its fresh and hardened properties to ASTM standards. It was determined through experimentation that ternary blended cements in large scale testing extended the setting time of concrete, improved resistivity, and reduced the effect of drying shrinkage. The usage of RCA is resulted in higher compressive strengths and higher drying shrinkage values compared to mixtures with solely natural aggregate. Future experimentation with higher replacement percentages of RCA and with different sources of RCA are being tested to ensure that the trends found in this set of testing hold true on a larger scale.

Developing a Modular Fabrication System

TEAM MEMBERS

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PROJECT MANAGER

Dr. Anu Osta

SPONSORS

Rowan Venture Fund

Engineering as a whole has seen a revolution in the last decade as the “Maker Movement” has had a resurgence in individuals and small businesses creating and designing new and original products. At the heart of this movement was the advent of consumer-grade 3D printers, Laser engravers and CNC milling machines. A system that encompassed all three devices was conceived. This modular fabrication system would consist of a robust frame and quick-swap tool head that would allow the user to rapidly and easily transition between these various devices. Additionally, the system would be modular in such a way as to allow to the user to configure the physical dimensions of the machine to best fit their needs. A rigid fame was constructed from 8020 extrusions, a common structural component that is easy to use and modify. To this was attached two motion systems. One moves a build plate in the vertical (Z) direction using ball screws for precise yet forceful movement. The other motion system controls the movement of the head in the XY direction, using a configuration of belts and pulleys known as CoreXY, which allows a more even distribution of loads to the drive motors than a traditional single-motor, single-axis system. A quick-swapping head mechanism is mounted to the CoreXY motion system to allow the user to swap end effectors. 3D printer and laser engraver heads have been fabricated. Finally, the electronic control system has been integrated with the frame, and we can currently jog all three axes of motion electronically. We are on track to perform actual 3D prints and laser engraving by the end of 2019.

Diesel Tachometer

TEAM MEMBERS

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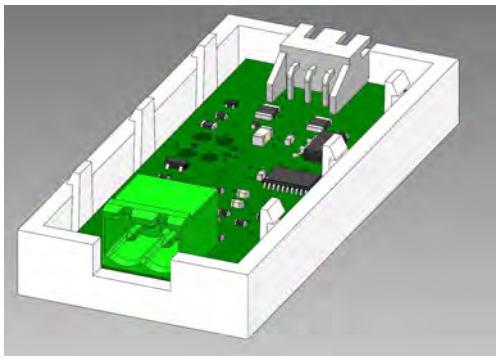
PROJECT MANAGER

Michael Muhlbaier



Most commercial vehicles on the road today have tachometers, but some diesel engine vehicles, such as older trucks or farm vehicles, do not. Typical tachometers in gas engines may tap off the electrical signals from the spark plugs. However, since diesel engines instead use glow plugs which do not provide much useful data, diesel tachometers sense and measure using different methods. Our method involves sensing the changing external magnetic field on the alternator. Using DSP methods, the measured signal is filtered and converted into a digital waveform. In this clinic, we design, build, and test a low-cost digital tachometer filtering circuit and housing.

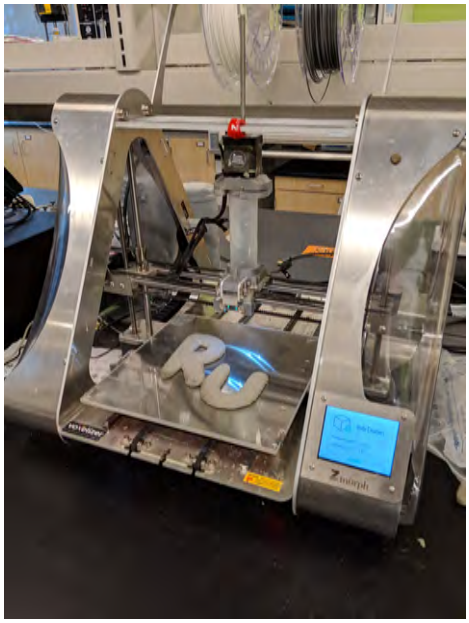
3D Printing of Cementitious Pastes

TEAM MEMBERS

Boonstra, Tyler, Malaran, Jerome, Tartarilla, Anthony

PROJECT MANAGER

Dr. Gilson R. Lomboy



3D printing technology has seen significant advancements in recent years, opening up its potential applications. One such application that shows extraordinary promise is construction through 3D printing. However, 3D printing cementitious materials requires a balance between printability and strength. In this study, the procedures and parameters required to produce consistent cement prints are investigated. In addition, the relationship between printability and rheological properties are explored. This study used cement paste mixtures consisting of Type I Portland cement and water. Different water to cement ratios were tested for printability and buildability, which were visually assessed for extrusion consistency and structural integrity. Pastes were tested for yield strength, viscosity, and thixotropy before printing. Printer settings were adjusted to optimize printing procedures. It was found that a water to cement ratio from 0.33 to 0.35 was optimal for 3D printing. It was also found that by reducing printing speed, extrudability was improved. Pastes with a viscosity of 2.5 Pa-s were found to be extrudable with sufficient buildability. No relationships could be established for yield strength and thixotropy. The procedures and parameters presented in this study allow for consistently extrudable and buildable prints. Future studies may examine the mechanical properties of prints produced through these procedures and the effects of admixtures on printing.

Bioinspired Small Mechanical Spider Robot

TEAM MEMBERS

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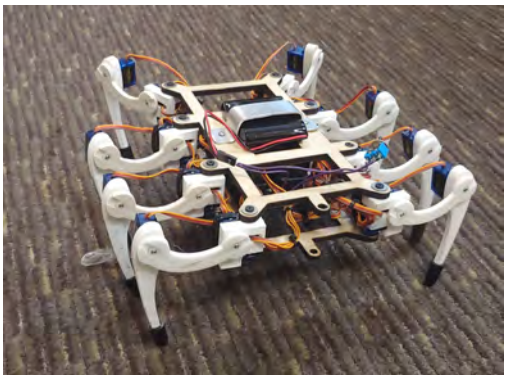
PROJECT MANAGER

Dr. Hamed Hosseinzadeh



In this project, we are designing two small mechanical octopod spider robots. First stage is the fabrication of one small octopod robot at larger scale and optimizing its control and locomotion systems. Then we are working to design smaller one based on our first try. When we have one stable robot, we will design second one and add GPS for each of them. Then we will develop brain like facility for each of them to set up a communicate system between them. First plan for communication is ordering one robot to reach a position by another robot autonomously.

Adding Value to Soy Meal

TEAM MEMBERS

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PROJECT MANAGER

Dr. Joseph F. Stanzione, III

Most polymeric materials today are manufactured from petroleum-derived chemicals. With the influx of demand for these materials, petroleum feedstock is continually depleted without renewability. To address the issue of sustainability, this research has aimed to find alternative bio-based feedstocks for the creation of value-added materials. Soybean meal was explored as a possible option due to the appreciable concentration of specialty chemicals naturally present. Following the necessary extraction and purification, these chemicals become viable for functionalization into monomer and eventual polymers. Preliminary data has shown that the integration of soy-derived bio-based monomers has increased the thermal and structural stability of common thermoplastics such as polystyrene and polyacryloylmorpholine. Depending on material types, conventional characterization techniques such as differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), Fourier-transform infrared spectroscopy (FTIR), advanced polymer chromatography (APC), and nuclear magnetic resonance (NMR) were employed. This research provided insight into the possibility of utilizing soy-derived chemicals as a sustainable source to synthesize high-performance polymeric materials.

Designing Advanced Stereolithography (SLA) Resins and Printer

TEAM MEMBERS
Elizabeth Amory, Amanda McCahill
PROJECT MANAGER
Dr. Joseph F. Stanzione, III
SPONSORS
US Department of Defense - Army Research Laboratory

In this project, we designed and built a DLP printer with the ability to incorporate nanofibers into optimal resins to produce highly durable prints for military applications. We chose a bottom-up printer model as the top-down model requires more resin, which is considered not practical. The main difference between the prototype and any existing commercial printers is the aligned nanofibers integrated in the design. This creates prints that will have greater tensile strength along the axis of fiber alignment. We chose PR48 resin, initially, as it is an open source formula with commercially available components. Two variations of PR48 were developed to create both a light curable resin and a thermally curable resin to compare the resulting polymer properties. Viscosity data for PR48 resin was determined to be 230.6 cP ±2.6 cP, at room temperature, using cone and plate rheology. Thermal properties were probed via differential scanning calorimetry (DSC) and thermal gravimetric analysis (TGA) testing. Extent of cure data was calculated using FTIR spectroscopy and found that the thermally cured polymer had a 90.66% extent of cure and the light cured polymer had an extent of cure of 67.13%. All in all, significant advancements in designing systems to produce high-performance polymeric composites via SLA have been accomplished.

WiFi Solar Power Monitor

TEAM MEMBERS
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PROJECT MANAGER
Michael Muhlbaier

The main focus of the WiFi Solar Monitor clinic project is to develop and produce a low cost device with the capabilities of measuring and reporting location specific solar information. This device is able to measure both the amount of solar power generated by the panels, as well as the total load consumed using the analog front end. This information will be displayed to both the user, through the use of an OLED display, as well as to the solar panel installation company via WiFi transmission. The device was designed to be very small, with the case dimensions being approximately 2 inches in all directions. The main reason for creating such a device is to cut back on solar panel maintenance costs. With the ability to remotely monitor this solar data in real time using a server, the need to send someone out for service every time there is a problem can be greatly reduced. Not only does this solution provide a more efficient way of troubleshooting, it will save both time and money for the company utilizing it.

Development of Conductive Cold Weather Concrete

TEAM MEMBERS

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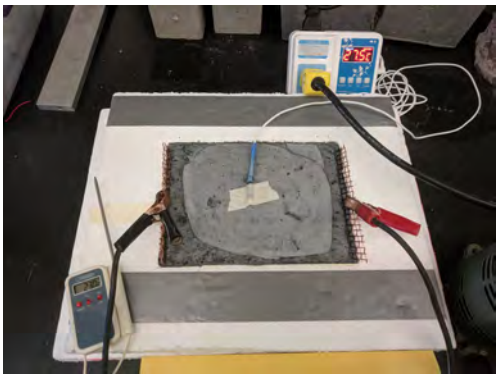
PROJECT MANAGER

Dr. Gilson R. Lomboy

SPONSORS

USDoD/ERDC/CRREL



The project is to identify methods of improving the conductive of cold weather concrete (CWC). CWC is a type of Portland cement based mixture that can be safely mixed, cast, and cured at below freezing ambient temperatures. Conductive concrete is a type of concrete that has low resistivity, which allows a current to pass through the concrete. Conductive concrete may be used as a heating device to further reduce cure temperatures and remove snow or ice. We are currently testing various concrete admixture systems, which include medium to high-range water reducers and accelerators by GCP, Sika, and Euclid, to determine the optimum system that will prevent a concrete mixture to freeze. Along with this, we are curing concrete samples at minus 5 degree C, and testing the compressive strength development with time. The conductive materials we will use are carbon nano-fibers and 6 millimeter sized chopped carbon fibers. Other tests we will conduct measure freezing point, resistivity, heating, elastic modulus, flexural strength, shear strength, and freeze-thaw durability.

Robotic Arm Manipulators for 3D Printing

TEAM MEMBERS

Andrew Biss, Matthew Jenkins

PROJECT MANAGER

Dr. Hamed Hosseinzadeh

The purpose of this project was to design, and build a serial robotic arm capable of 3D printing and a code that will convert STL files into a runnable program for the serial robotic arm to use. Then we will copy and add more robotic arms to have multi-materials 3D printer and with more controlling function during and post printing.

Rowan Formula Racing ECE Clinic

TEAM MEMBERS

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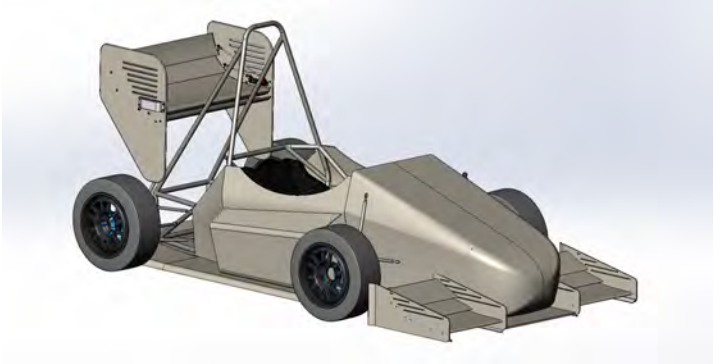
PROJECT MANAGER

Michael Muhlbaier

PROJECT MANAGER

Stanley Black and Decker, MicroChip, TE Connectivity, Emrax, Unitek, OZ Racing, Wilwood, VR3, KHK Gears, Optimum G

The Formula Electric Competition is an interdisciplinary design and engineering challenge for undergraduate and graduate university students. This project will take two years to complete, with 2 faculty advisers and approximately 20 students involved. To make this project run smoothly, the Formula Electric SAE car will be split up into 2 clinic projects, one will be for the Mechanical Engineering tasks, and the other will be in the Electrical and Computer Engineering domain. The estimated cost of this project is $50,000 which will be secured both internally and externally with numerous sponsors. The ECE clinic focuses on all electrical components of the vehicle, including but not limited to the electric motors propelling the vehicle, a custom built 18650 battery pack, and all sensor communication and vehicle control through a robust CAN Bus with integrated wireless firmware upgrade.



Cold Weather Concrete for Structural Applications

TEAM MEMBERS

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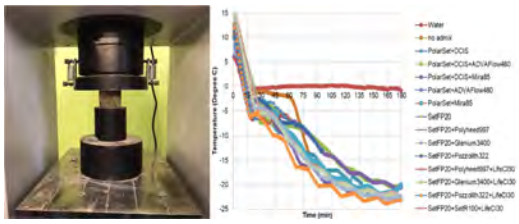
PROJECT MANAGER

Dr. Gilson R. Lomboy, Dr. Douglas Cleary, Dr. William Riddell, Ken Lee



In colder temperatures, the setting of concrete tends to be delayed and the development of strength is hindered. Without precautions, water in a concrete mix can freeze, leading to permanently weakened concrete. Another alternative approach that avoids energy cost and potentially extends the construction season, if early-age strength development is not a primary goal, is using single or a combination of admixtures to reduce the freezing point of water in concrete mixes. This is sometimes called antifreeze concrete or cold weather concrete (CWC). The overall goal of this project is to apply cold weather concrete mixing technology developed by CRREL for reinforced concrete applications. In order to achieve this goal, a step by step process of studying characteristics of CWC with antifreeze admixtures and reinforcements must be performed. This begins with a preliminary testing of materials by mixing sample batches of concrete, molding them into 2 inch x 2 inch x 2 inch cubes and testing the compressive strength, as well as molding concrete into a cylinder mold to test the freezing point. Other tests that will be done includes a full batch to be mixed in a freezer and material properties test of steel reinforcement.

Active Human Exoskeleton

TEAM MEMBERS

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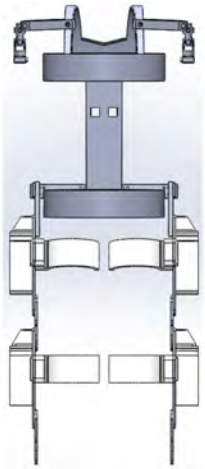
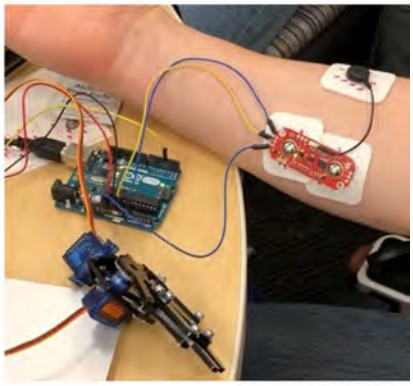
PROJECT MANAGER

Dr. Hamed Hosseinzadeh, Dr. Hamid Seyyed, Dr. Melanie Amadoro

We would design and fabricate passive and active (motorized) exoskeleton for patients with muscular weakness (Duchenne Muscular Dystrophy) to walk and lift objects better. First, we are developing 3D computer graphical model of the exoskeleton and computer motion study to check dynamical response of the exoskeleton then we would fabricate the designed exoskeleton. We are also working to activate motorized exoskeleton with the muscle sensors attached to the patient's skin. This is a shared project between Energy, Materials and Mechanics Research lab and Orthopedic Research Group of Rowan University.





Renewable Polymer Electrolytes for Lithium Ion Batteries

TEAM MEMBERS

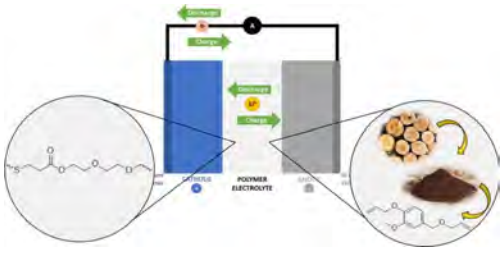
Christopher Strekis, Dominique Rousseau

PROJECT MANAGER

Dr. Joseph F. Stanzione, III

SPONSORS

US Department of Defense - SMART Program



The dangers of liquid electrolytes in batteries are well known and include possible leaks, erosion, and toxicity. Polymer electrolytes are promising alternative membranes that can mitigate these safety concerns. Di-allylated vanillyl alcohol (DAVA), a compound derived from lignocellulosics, was explored as a monomer in the development of polymer electrolytes. Vanillyl alcohol was chosen for exploration because of its commercial viability, sustainability, and unique aromatic structure which can add stability to polymer electrolytes. DAVA-based polymers were formed through a photo-initiated free radical step growth thiol-ene polymerization using ETTMP-1300. ETTMP-1300 has long chains with repeating ether oxygen units thought to provide flexibility and promote cationic transport. The thermal properties of the neat polymers were tested using thermogravimetric analysis (TGA), differential scanning calorimetry (DSC) and dynamic mechanical analysis (DMA). DAVA-based polymers were tested as both gel polymer electrolytes (GPEs) and solid polymer electrolytes (SPEs). GPEs were created by swelling cured polymers in an electrolyte solution (1 M LiPF6 in 1:1 (w/w) ethylene carbonate:diethyl carbonate solution). SPEs were created by mixing solid lithium salt into the resin followed by curing. The results of this study have shown that polymers created with bio-based monomers, like DAVA, can provide benefits to electrolyte materials.

Bio-Based Flame Retardants

TEAM MEMBERS
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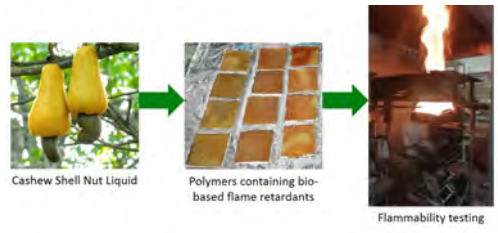
PROJECT MANAGER
Dr. Joseph F. Stanzione, III
SPONSORS
US Department of Defense - Army Research Laboratory



Three bio-based flame retardants were synthesized from cardanol derivatives as alternatives to current halogenated flame retardants that are carcinogenic and sourced from petroleum feedstocks. These new molecules are considered less toxic with cardanol sourced as a byproduct from the cashew nut industry. Their molecular structures were characterized via NMR and FTIR. A standard epoxy resin system was utilized as the surrogate and benchmark for the performance of these newly developed flame retardants in a high-performance polymeric material. Their effect on thermal and mechanical properties were tested through differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), dynamic mechanical analysis (DMA), and tensile and flexural testing. Furthermore, their effect on flammability was tested on a cone calorimeter. Overall, this project has found that low loadings of the developed bio-based flame retardants are needed to promote flame suppression while not detrimentally affecting cured epoxy thermal and mechanical behavior.

FAA Virtual Reality Helicopter

TEAM MEMBERS
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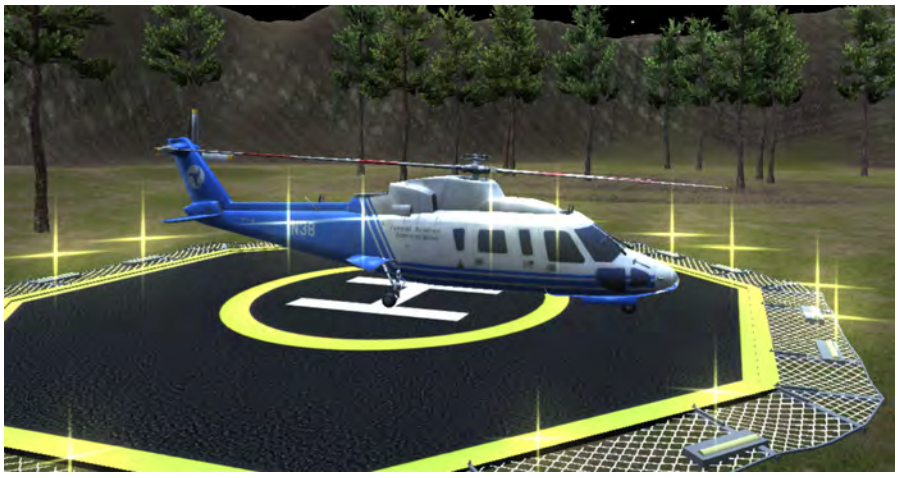
PROJECT MANAGER
Dr. Shreekanth Mandayam, George D. Lecakes, Jr.
SPONSORS
Federal Aviation Administration (FAA)

Students are collaborating with the FAA Technology Center in Pomona, New Jersey, to continue their work in the simulation of manned and unmanned aircraft in the commercial airspace. This semester, students will develop the simulation of a helicopter with flight instrumentation in both virtual and augmented reality.



ASCE Concrete Canoe

TEAM MEMBERS

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PROJECT MANAGER

Dr. Douglas Cleary

The concrete canoe competition is a competition held by the American Society of Civil Engineers every year. Each school in the competition must design, build, and race a canoe made entirely of concrete. At the competition each team must give a presentation and then take part in a series of races with their canoe. This year's Rowan University concrete canoe is an evolution of the previous year's design. The new canoe is narrower, taller, and has the addition of a keel to aid in stability. The concrete mix design used in the canoe consists of white portland cement, slag, type C flyash, VCAS, various lightweight aggregates made of expanded glass, fibers, and several admixtures. The concrete is lightweight with a density of 69 lb/ft3. Compressive strength is approximately 1470 psi. Two layers of fiberglass reinforcing mesh were used to help prevent cracks. The competition takes place in April. The races consist of men's and women's 200 meter slalom, men's and women's 200 meter sprint, and a co-ed 400 meter sprint.

Students' Informal Reasoning when Approaching Classroom Scenarios

TEAM MEMBERS

Darby Riley, Joshua Reed

PROJECT MANAGER

Dr. Cheryl Bodnar, Dr. Richard Cimino, Dr. Stephanie Farrell

SPONSORS

Rowan REDI Grant for Research in Educational Diversity and Inclusion

This clinic project analyzed first-year engineering student responses to classroom-based scenarios focused on diversity and inclusion and the informal reasoning strategies students apply in these situations. Understanding how students view these types of situations will allow for changes to be made in curriculum that can lead to a more inclusive classroom environment. A think aloud study was performed with 11 first-year engineering students representing all disciplines. Responses were transcribed by a third party and analyzed using two cycles of qualitative data coding. A holistic coding method identified larger themes in each response, while provisional coding was used to identify specific informal reasoning strategies including rationalistic, emotive, and intuitive reasoning. Results thus far show that, while students may approach resolving these problems in a variety of ways, many responses follow similar trends. Certain scenarios, such as those focused on gender and mental health,draw out specific overall reasoning archetypes, typically displaying a split between two opposing approaches. Most students also relied on rationalization, with auxiliary emotive elements and rarely intuition. Further analysis will refine understanding of the engineering classroom environment, and can motivate embedded lessons related to diversity and inclusion, leading to an overall improvement in the classroom climate.

Augmented Reality Simulation for NAVSEA

TEAM MEMBERS

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PROJECT MANAGER

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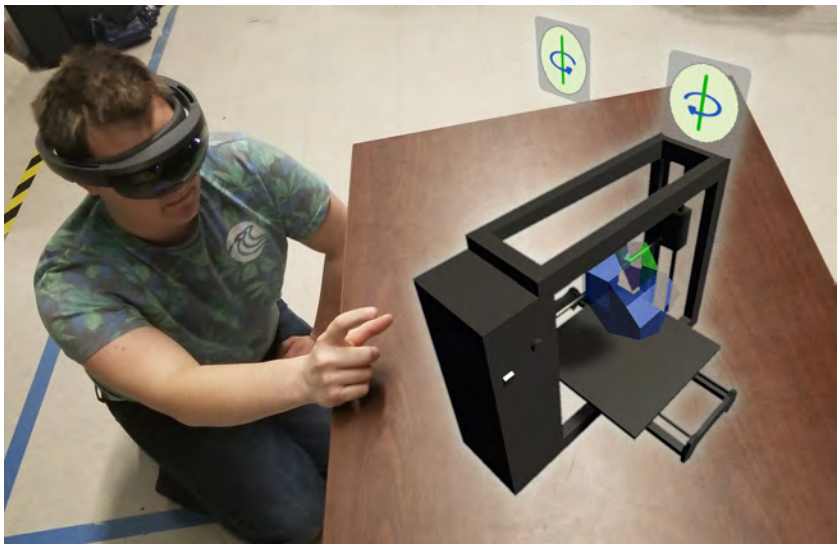
SPONSORS

NAVSEA

Students are collaborating with personnel from the Naval Sea Systems Command (NAVSEA) in Philadelphia to explore the use of commercial off-the-shelf augmented reality technology for inspecting shipboard systems during manufacture and assembly. Technologies include the Microsoft HoloLens, Vuzix, Daqri, etc.



Augmented Reality Demonstration for Anthem

TEAM MEMBERS

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PROJECT MANAGER

Dr. Shreekanth Mandayam, George D. Lecakes, Jr.

SPONSORS

Anthem, Inc.

Students will collaborated with an Atlanta-based digital healthcare company to develop demonstrations of the application of augmented reality technologies in the digital healthcare space. As part of this project, students will storyboard and demonstrate simulations of patient and provider experiences deployed using the Microsoft HoloLens platform.

Virtual Reality for Orthpedic Resident Training in Camden

TEAM MEMBERS

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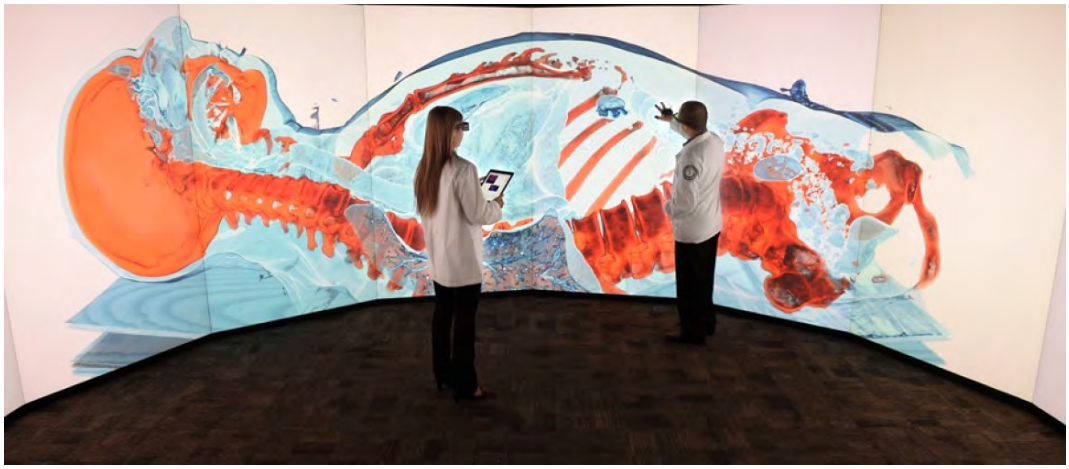
PROJECT MANAGER

Dr. Shreekanth Mandayam, George D. Lecakes, Jr.

SPONSORS

Camden Health Research Initiative

Engineering students are collaborating with students in the Art department and orthopedic medical residents in Cooper Hospital in Camden to develop simulations of hip replacement surgery in virtual reality. The objective is to develop of virtual reality training platform for orthopedic surgery that has the potential to improve entrustability of residents by attending surgeons.



Laser Scanning of Granular Packings

TEAM MEMBERS

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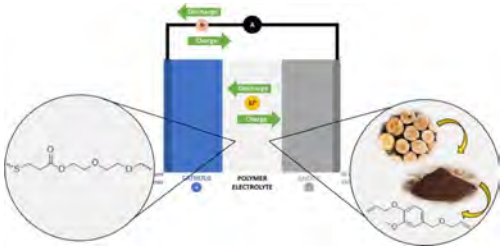
PROJECT MANAGER

Dr. Martin Haase



Studying the behavior of packed granular material can provide improved understanding of mixtures and jamming phenomena. It is important to study granulars because they are commonly found in everyday applications like agriculture and chemical reactors. The goal of the LEGO laser scanner is to provide an inexpensive and small scale device for analyzing the packing of granular materials modeled by hydrogel spheres. These hydrogels are made of a Super Absorbent Polymer that swells when submerged in water. A MATLAB program was developed that simultaneously controls two LEGO EV3 motors and a camera. Fluorescein sodium salt is added to the surrounding water and is illuminated when penetrated by a blue laser line. The program ImageJ is then used to make each photo binary and determine an average packing density for the entire volume. After completion of the first iteration, it was found that the LEGO scanner output a packing density of 55%; significantly lower than the expected density of 66.00%. Moving forward, work is being conducted to more accurately represent the behavior of the spheres by improving the image quality, including refractive index matching and uniformity of the dye.

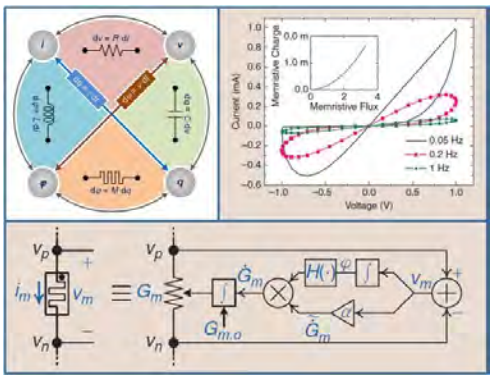
Design of Hardware Memristor Emulator with Adjustable Device Parameters

TEAM MEMBERS

Cheyne Brady

PROJECT MANAGER

Dr. Sangho Shin



This work presents a hardware emulator design for nonlinear memristor devices. The memristor is an emerging two terminal resistive device that exhibits nonvolatile memory characteristics. For its recent emergence as a physical device, availabilities of those devices are very limited for developments and investigations of new circuit and systems applications with memristors. Motivated by the limited device availability and to support early research in circuit and systems community by providing highly flexible memristor hardware model, this work focuses on implementing and demonstrating a memristor hardware emulator that can fully mimic memristive nonlinear dynamics, while providing adjustable memristor device parameters, such as minimum and maximum resistance, switching time, among many others. Basic constraints and ranges of adjustable device parameters of the designed emulator hardware have been set in concern of practical memristor parameters. Implemented with discrete COTS components, the designed emulator demonstrates full memristive dynamics incorporating adjustable memory effects.

Student Steel Bridge Competition

TEAM MEMBERS

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PROJECT MANAGER

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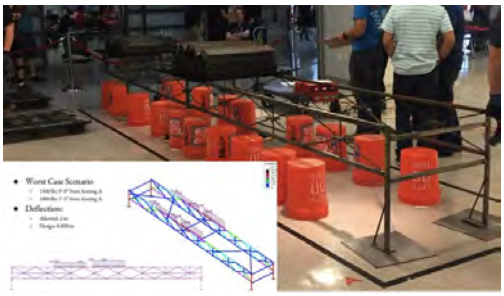
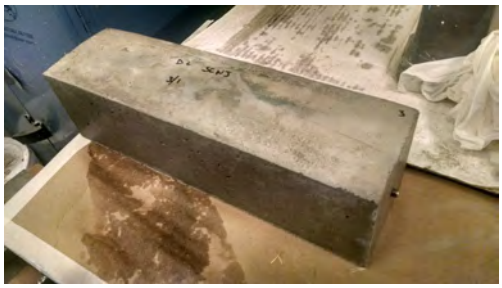


Every year AISC runs a regional and national steel bridge competition. The competition offers a chance for civil engineering students to gain valuable experience designing a bridge. In addition to this, mechanical engineering students are provided the opportunity to practice machining steel parts. For the competition, teams from participating schools are given a scenario with certain constraints to design a bridge for. At the competition, the bridges are ranked based on weight, structural safety, construction economy, assembly speed, deflection, aesthetics, and overall performance. The program Risa 3D was used in order to design and perform analysis on the bridge. Using the LRFD method and following the given constraints by the judges; a 23 foot long, 32 member bridge design was selected for the competition bridge. As of now students are working on the machining of the designed parts. Mechanical engineers in the group used a lathe in order to manufacture the female and male connections between the different truss members. A water jet was also used in order to cut out the triangular connections between the top and bottom truss members on each side. The nipple connections were manufactured using a mill and then the holes were drilled by hand of one of the team members. On April 27th, the Rowan steel bridge team will participate in the metropolitan regional competition.

Shrinkage Cracking in Concrete

TEAM MEMBERS
Quinn Collins, Chris Barna
PROJECT MANAGER
Dr. Cleary and Dr. Lomboy



In the state of New Jersey, high performance concrete mixtures used in transportation infrastructure have high cementious content, finer portland cement, and low water-to-cementious material ratios. This collection of variables results in a concrete material that is highly susceptible to shrinkage cracking. Thus, the goal of this project is to increase the lifespan of New Jersey transportation infrastructure and develop methods to combat shrinkage cracking and lower cracking potential. These improvements will restrict the admission of water and other detrimental substances into the material. It is proposed that shrinkage reducing admixture, shrinkage compensating admixture, internal curing, coatings, and fibers be part of the research. Their effectiveness in preventing shrinkage cracking, effects on fresh, short and long term hardened properties, durability, and performance in New Jersey field conditions will be investigated. The properties and shrinkage parameters, such as strains and strain rates, will be analyzed to provide specific recommendations for adoption with New Jersey materials and climate.

ISS Compliant Battery Testing Platform for Small Satellite Missions

TEAM MEMBERS
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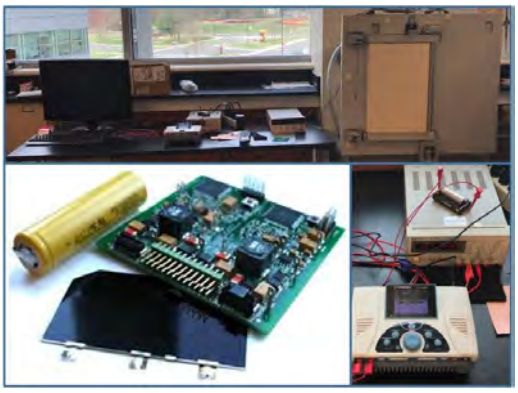
PROJECT MANAGER
Dr. Sangho Shin, Dr. Robert Krchnavek, Dr. John Schmalzel
SPONSORS
NJSGC



This work presents Rowan CubeSat team's development of an in-house battery testing platform that can certify regulatory and safety compliances of battery cells for NASA's space applications and operations in International Space Station (ISS). The designed testing protocol and its supporting hardware system enables Rowan CubeSat team to certify space mission compliances of battery systems, providing full in-house capabilities of certifying ISS compliances. In general, the battery compliance testing for space missions is outsourced to companies that specialize in certifying batteries to NASA's standards and regulations. Rowan's prior CubeSat project has used this method at the testing cost of ~$8,000 which took the major portion of the total CubeSat development costs. Goals of this research are to create a low-cost in-house solution for the costly battery certification process, and thus significantly lowering the satellite development costs. The designed in-house semi-automated battery testing platform has capabilities of testing battery cells for every designated performance factors specified by NASA: short-term charging and discharging and long-term battery voltage degradations in conjunction with vacuum and pressure chamber. The developed in-house battery testing platform allows rapid prototyping and certification of flight-ready electronic power systems, significantly lowers the small satellite development costs, and thus extends Rowan's capability on small satellite design missions as a whole.

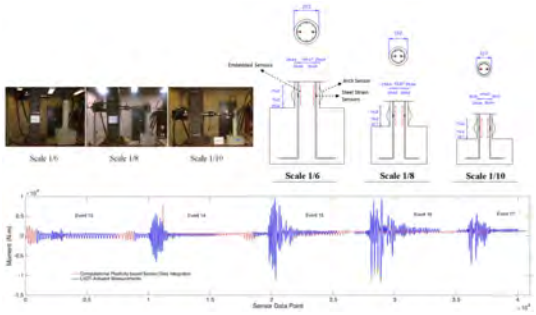
Structural Health Monitoring of Bridges Using Fiber Optic Sensors

TEAM MEMBERS

Patrick M Callan, Jacob M. Hall

PROJECT MANAGER

Dr. Amir Iranmanesh



Bridges form crucial links in the transportation networks, especially in the aftermath of disasters such as hurricanes or earthquakes. Currently the post-disaster damage evaluation and capacity assessment of the bridges are based on visual inspections. To properly assess the condition of the bridges it is essential to develop methodologies that go beyond visual inspection. Consequently, structural health monitoring (SHM) is emerging in response to the need for post-disaster evaluation of the bridge structures. Over the past three decades, fiber optic sensors have been evolved remarkably in various fields of aerospace, mechanical, biomedical and civil engineering. The objective of this project is to develop a damage assessment methodology based on the fiber optic sensor data available from concrete bridge columns tested to failure under gradually increasing intensities of loading.

Resilience Assessment of Bridges Subjected to Hurricane Induced Scour

TEAM MEMBERS

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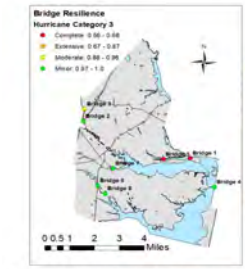
PROJECT MANAGER

Dr. Amir Iranmanesh



Resilience Map of the Bridges in a Case Study Area

Bridge Failure due to Scour

Scour is the largest cause of highway bridge failures in the United States every year. Although there have been many models and equations developed to determine scour at bridges, not many incorporate the time factor that is involved in major floods or hurricanes. These conditions are hard to simulate in the laboratory and lead to the underestimation and poor design of bridges that end up failing in extreme conditions. The primary approach used to analyze scour at bridges in this study is the Probabilistic approach. This approach takes into consideration some of the uncertainties in the influential parameters. These parameters include discharge, velocity, flow depth and particle size. A Monte Carlo Simulation is used to model these uncertainties using certain probability distribution functions. All of these parameters besides particle size will need to be analyzed during a certain time period simulating the duration of a hurricane storm surge. Under these conditions the flow and depth in a channel change drastically and can seriously impact the soil depth around piers and abutments. The reason this is so difficult to simulate is because under normal conditions the flow and depth are relatively constant and can be measured accurately in the field. However, during a storm surge lasting only a couple of hours these conditions can fluctuate rapidly leaving little room for accurate measurements. This leaves a simulation being the only truly reliable way to accurately determine the scour during a hurricane.

Precision Agriculture: Mighty Mites Ph1

TEAM MEMBERS
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PROJECT MANAGER
Dr. John Schmalzel
SPONSORS
A. Nielsen (Rutgers), A. Merlino (Verge Aero)

Problem: A local farmer grows tomatoes organically under high-tunnel structures (5.5m x 100m). Tomatoes may become infested with Twospotted spider mites (T. urticae). One method of organic pest control uses predatory mites such as P. persimilis or N. californicus. Typical density of predatory mite application ranges from 10-100 mites/ m2 depending on the degree of control needed (Prevention, Moderate/ Severe Infestation). Currently, mite applications are performed manually: The farmer walks up and down each row, shaking out predatory mites that have been mixed with a carrier of corn grit. Approach: Precision agriculture applications are exploding—ranging from automated tractors that plant, cultivate, and harvest, with high spatial accuracy, to aerial drone platforms performing aerial survey and data collection applications. Emphasizing COTS technology, formation-flying drones combined with IoT technology will provide the foundation for a mite dispensing system. The key missing element is the mighty mite dispenser (MMD) mechanism. Following prototype development, MMD validation will be performed using a tests that mimic motion of the MMD over a crop row. After iterative improvements, field tests will be designed to demonstrate the performance of the MMD proof of concept flown as a drone payload. A Phase 2 development and commercialization plan will follow.

Resilience Assessment of Buildings Subjected to Hurricane Induced Scour

TEAM MEMBERS
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PROJECT MANAGER
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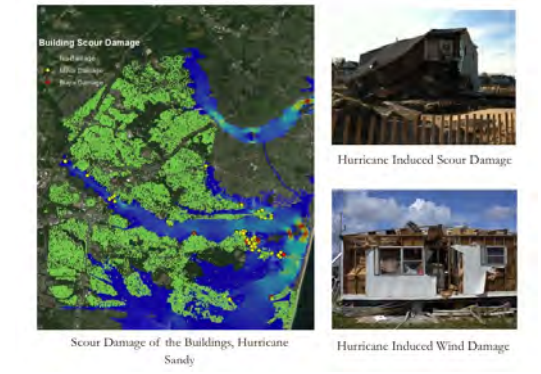

Scour Damage of the Buildings, Hurricane Sandy

Hurricane Induced Scour Damage

Hurricane Induced Wind Damage

Annually, hurricanes put the lives of millions of people at risk and cause billions of dollars worth of damage in the United States. In this study, the effects of wind-based and scour hazard on the resiliency of residential buildings are investigated using a probability-based framework. The developed framework presents a rational methodology for probabilistic risk assessment and subsequent design of future buildings. The objective of this research is to determine the resiliency of existing buildings in hurricane-prone regions by accurately modeling of associated structural limit states and time of recovery after major hurricane events. The framework utilizes a general Monte Carlo Simulation (MCS) approach which takes into account the uncertainties associated with various capacity and demand models for the buildings. Wind Hazard modeling is derived from the 3-second gust wind speed at 10m above the ground, obtained via ASCE-7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures. Scour Hazard modeling is based on existing equations available in the literature. Combined with an adopted restoration model to quantify resilience indices for individual buildings, the developed framework is applied to an inventory of buildings located in the case study area of Brick Township at New Jersey.

Effects of Substrate Stiffness and Cell Contact on Stem Cell Signaling

TEAM MEMBERS

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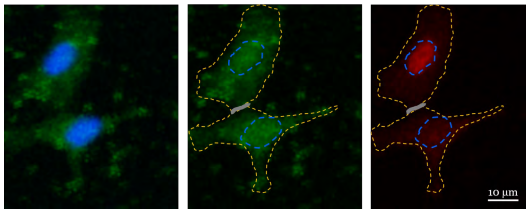
PROJECT MANAGER

Dr. Sebastian L. Vega

SPONSORS

Center for Engineering MechanoBiology (CEMB) National Science Foundation Grant 15-48571



Microenvironmental factors, including substrate stiffness and cell-cell interactions regulate stem cell behavior; however, the interplay between outside-in stimuli and stem cell signaling is poorly understood. Notch signaling is one of the most established mediators of short-range signaling between cells, and Yes-associated protein (YAP) signaling has been implicated as a mechanotransductive regulator. Human mesenchymal stem cells (MSCs) were cultured atop polyacrylamide (PA) hydrogels of varying stiffness (500 Pa, 10 kPa, 20 kPa) and MSC pairs (Notch, green; YAP, red; nuclei, blue) were found (Fig. 1). To investigate cell-cell signaling and mechanotransduction in MSC pairs, several single-cell metrics (area, nuclear YAP, Notch intensity, cell-cell contact length) were acquired using ImageJ software. Prior to analysis, MSC pairs with lower and higher total Notch fluorescence were demarcated as “Sending” and “Receiving” cells, respectively. Surprisingly, cell area and nuclear YAP of Sending cells was greater than those of Receiving cells. This finding was more pronounced in MSC pairs on stiffer PA hydrogels. Currently, photolithography is being used to create PA hydrogels with adhesive micropatterns that control cell shape and cell-cell contact length in MSC pairs. This improved setup will allow for investigating Notch and YAP signaling in tightly controlled environments.

Controlling Environmental Conditions During Nanofiber Fabrication

TEAM MEMBERS

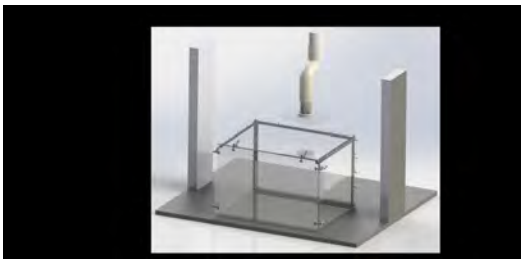
Melvin Roberts

PROJECT MANAGER

Dr. Vincent Beachley

SPONSORS

National Science Foundation



The goal of this project is to design and create an environmental control box to examine the properties of electrospun nanofibers fabricated and processed under controlled conditions such as relative humidity, ambient vacuum, temperature, and pressure. The objective of this experiment is to maintain the control box’s relative environment to analyze the effects of these conditions on nanofiber properties. Our goal is to use these findings to engineer optimal procedures to produce high specific strength polymer nanomaterials. Key design parameters for the environmental control box include: resistance to solvents, transparency from the front, left, and right sides, airtight to contain solvents, ventable chamber, and ability to manipulate objects inside of the control box without being exposed to solvents. Using such parameters, the environmental box is made of acrylic panels for its resistant properties and transparency. The control box was designed using SolidWorks CAD Design. Silicone caulk and rubber gaskets create an airtight seal around the edges. Arm length gloves are entered through the front panel, achieving the utility to manipulate objects inside the chamber without being exposed to solvents.

Novel Silicone Hydrogel Contact Lenses with Advanced Properties

TEAM MEMBERS

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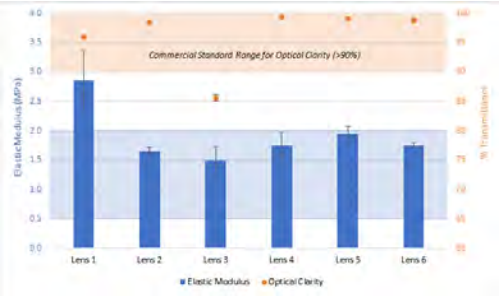
PROJECT MANAGER

Dr. Mark E. Byrne

SPONSORS

Ocumedic



In this work, we use novel siloxane containing macromers that differ in size and functional chemistry, and testing them as contact lens materials. These new macromers possess functional chemistry and structural repeat units that result in hydrogels with different physiochemical properties and show potential for advanced applications such as extended delivery of therapeutics or comfort agents via contact lenses. This work seeks to analyze the physical properties of these new materials, including optical clarity, oxygen transport, wettability, and elastic modulus. Contact lenses and polymer sheets were prepared using siloxane containing macromer units with different sizes and functionalities, methacryloxypropyl-tris-(trimethylsiloxy) silane (TRIS) to facilitate oxygen transport and reduce elastic modulus, and a hydrophilic unit to increase water uptake and wettability. Mechanical studies showed that synthesized polymers had elastic moduli within the commercial standard of 0.5-2 MPa. Optical transmittance of all synthesized lenses was within the commercial standard of >85% optical transmittance. Plasma coated hydrogels had a contact angle with water of less than 90 degrees, which signified a hydrophilic surface. Dk/t was measured to be within the range that is acceptable for daily wear contact lenses. Results showed a high degree of control over polymer properties through modification of the prepolymer formulation.

Vial Shield

TEAM MEMBERS

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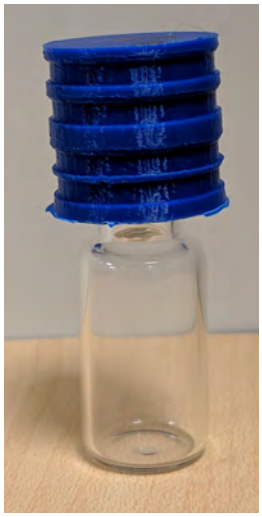
PROJECT MANAGER

Dr. Erik Brewer

SPONSORS

MEDAssurance



Hospitals are spending an average of $36.5 billion annually due to nosocomial infections. Recently, multi-dose medication vials have shown to be sources of bacterial infection, with randomized testing showing that 4.2% of previously-used vials tested positive for bacteria. Despite established protocols in the hospital, these methods can sometimes fail in practice during both routine injections and high-stress emergencies. The goal of this project is to design a novel device to improve upon the current disinfecting protocol involving multi dose vials as a tool to reduce the risk of nosocomial infections. The design encompasses an improved physical barrier that better prevents bacterial migration, and a built-in chemical barrier that would eliminate human error of standardized disinfecting protocols. A contamination and disinfection protocol was developed to prove that infection causing microorganisms are transferred from the vial to the sterile needle that is then being injected into the patient. The results of the testing confirmed this hypothesis. Early prototype development provided promising results that showed disinfection of the vial after direct contamination. Utilizing the technology of 3D printing, the team hopes to produce a marketable disinfecting cap that can reduce human error during injections.

Study of Degradation in Omeprazole

TEAM MEMBERS

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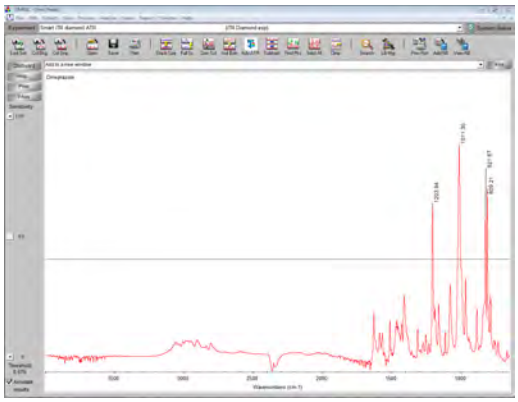
PROJECT MANAGER

Dr. Erik Brewer

SPONSORS

Wedgewood Pharmacy



Random discoloration in omeprazole, injectable, oil suspensions has been observed after gamma ray sterilization. The variation of color of the injectable deters clientele from using it because of the stigma that a purple omeprazole solution indicates degradation. Omeprazole is used to treat many gastrointestinal problems such as gastroesophageal reflux disease and stomach ulcers. When used in an oil suspension, the drug is more vulnerable to degradation factors such as light, changes in pH, and heat. Regardless, the injectable form of omeprazole is preferred by many veterinarians due to the difficulties regarding the ingestion of oral formulations by horses. Wedgewood Pharmacies has an injectable form of omeprazole and has tasked Rowan University engineers with investigating the degradation pathways and analyzing formulation parameters in the injectable. The current degradation pathways that are suspected to cause the color change are hydrolysis, oxidation, and photodegradation. To determine the cause of the degradation, infrared spectroscopy (IR), high-performance liquid chromatography (HPLC), and mass spectroscopy (MS) will be utilized to identify the differences between the omeprazole before and after sterilization. Additionally, the individual ingredients of the suspension are going to be evaluated with these tests to ensure that the additives are not the cause of the degradation.

On Site Detection and Differentiation of Ischemic and Hemorrhagic Stroke

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SPONSORS

Cooper Medical School at Rowan University

According to the CDC, about 140,000 Americans die from stroke every year, which is 1 out of every 20 deaths. There are two different types of stroke, ischemic and hemorrhagic, and they require different treatment. Detecting and differentiating between an ischemic and hemorrhagic stroke as quickly as possible is important in determining how to proceed with the patient. Tissue plasminogen activator (tPA) acts as a blood thinner to treat ischemic strokes and the sooner it is administered the more effective it is. Meanwhile it would create more problems for hemorrhagic strokes and could lead to the patient bleeding to death. Currently a CT scan is required in order to diagnose the type of stroke before progressing with treatment. It is imperative to find a way to create a more portable and time-effective solution to diagnose and differentiate a stroke. In collaboration with neurologists at Cooper University Health Care, the plan is to use Microwave Hemorrhage Detection technology as a solution. This detection method will allow for quicker stroke detection and differentiation which would allow for a faster administration of tPA depending on the diagnosis.

Polymer-Coated tPA-Eluting Guidewire for Localized Drug Delivery During

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An acute ischemic stroke occurs when blood flow through the brain artery is blocked by a clot. Currently, the main treatments methods for acute ischemic strokes are tissue plasminogen activator (tPA) and mechanical thrombectomy. tPA is a strong anticoagulant drug that is delivered intravenously. Mechanical thrombectomy is the active removal of the clot. However, these methods can cause internal bleeding in the patient due to contraindications. Therefore, the team is actively determining a method to lyse a clot in situ using tPA to allow for localized drug delivery. The solution that the team is currently working on is the use of a polymer-coated tPA-eluting guidewire. The guidewire will be coated in a tPA and polymer matrix and then inserted into a patient. Once the guidewire arrives at the site of the clot, the polymer matrix will degrade and release tPA allowing clot breakdown without retrieval. Preliminary studies determined that solutions mixed in a PVA polymer matrix release quickly in the span of 10 minutes and slowly level off after.

Crystallinity, Reversibility, and Injectability of PVA/PEG Hydrogels

TEAM MEMBERS

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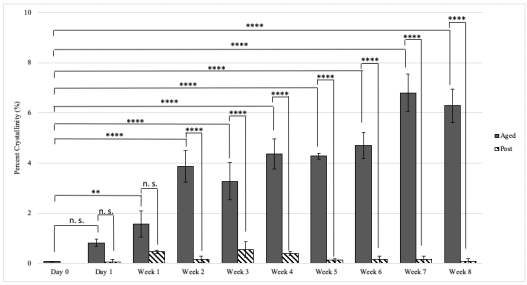
ReGelTec, Inc.



Degenerative Disc Disease is the leading cause of back pain and will affect 90% of adults in the US at some point in their lives. Current treatments involve highly-invasive surgical methods, such as spinal fusion and disc replacement, that fail to fully restore the native mechanics of the disc and can lead to adjacent disc degeneration. ReGelTec has developed a thermosetting hydrogel that, when heated, can be injected into the degenerated spinal nucleus in a minimally-invasive procedure, cool, and restore the mechanical properties of the spine. This team is investigating the tendency of the amorphous gels to form crystalline structures over time that can hinder their ability to transition from a solid to a liquid when heated during a surgical setting. Using x-ray diffraction (XRD), the crystallinity of aged is quantified using percent crystallinity for samples aged up to eight weeks. The reversibility of crystallinity in aged samples is also quantified using percent crystallinity after subjecting samples to high temperatures. Finally, the injectability is evaluated based on hydrogel viscosity.

Delivery Strategy for Percutaneous Fixations of Bone Marrow Lesions

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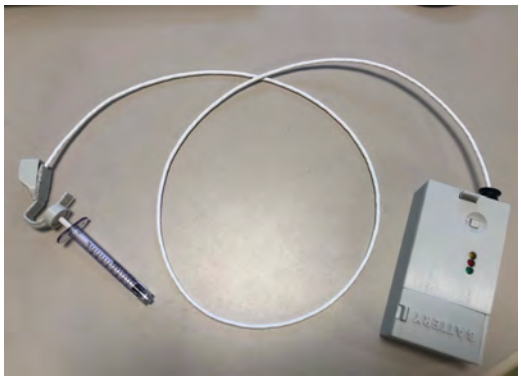

Damage to subchondral bone, and subsequent deterioration of the overlying articular cartilage is a major contributor to pain in Osteoarthritis, which affects approximately 25% of the U.S. population. Bone marrow lesions (BMLs), a symptom of the disease that results in pain, can be treated by a percutaneous injection of a calcium phosphate-based bone substitute material (BSM) at the damaged site to stop deterioration. However, the injection procedure relies on the surgeon's perception for when it is complete. Furthermore, under or overfilling of the site, which is estimated to occur in 30% of injections, can result in either further progression of the disease or osteonecrosis and pain to the patient. Rowan engineering has developed a solution that fulfills this unmet need by providing a controlled injection monitoring system. The device consists of a capacitive force sensor within a 3D printed clip that affixes to the top of the bone-filling syringe between the plunger and surgeon's thumb. The sensor is connected to a printed circuit board with three LEDs that is powered by two lithium batteries. The LEDs provide real-time feedback to the surgeon when pressures have exceeded predetermined levels, indicating risky injection speeds or overfilling of the BML.

Redesigning a Medical Stroller

TEAM MEMBERS

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Weisman Children's Rehabilitation Hospital

Weisman Children's Rehabilitation Hospital is a small sixteen bed hospital. Children staying in their inpatient facility typically have numerous medical conditions. Some children may have a ventilator, feeding tube, and an oxygen tank. Throughout the day the children get moved from their rooms to various rehabilitation rooms. Currently, the nurses at Weisman have to transport the children in a stroller and push each of the medical devices separately. At any point in time, one nurse may be pushing up to three carts with three different sets of wheels through the halls to transport the children. With all of these medical devices comes a lot of tubing and chords. The chords and tubes can get tangled very easily. Overall this process is not only cumbersome for the nurse, but it could potentially be dangerous for the patient. The ideal design would be a single cart or transportation device that will be able to hold all of the patient's medical devices in an organized and safe manner. If executed properly, the final design will be a transportation device that can fit the wide range of patient sizes and their medical devices comfortably. Furthermore, the various tubes and wires must be properly organized.

Early Detection of Implant Loosening to Prevent Total Implant Failure

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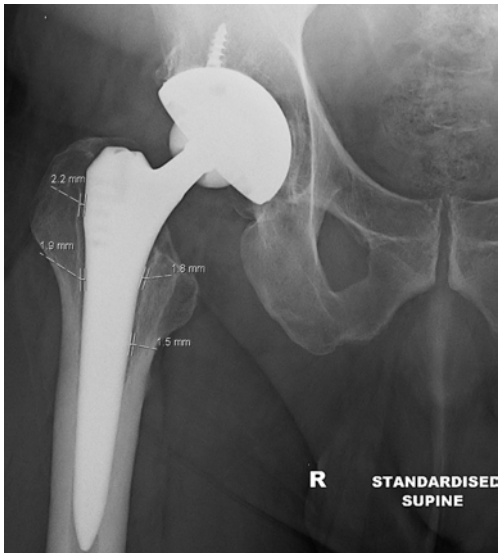

In 2016, 150,000 total hip replacement surgeries were performed in the US. Historically, the 10-year failure rate of implants is approximately 10%, of which 75% are expected to be caused by aseptic loosening of the implant. Failure of an implant requires a total revision procedure, an invasive, costly, and painful operation to the patient. Currently, there are no existing solutions to tracking early implant loosening. The development of an implant loosening detection system would allow for less-invasive and early corrective procedures that would diminish the costs associated with total implant failure. Our design incorporates a secondary reference implant that fulfills this need by enabling doctors to track the relative migration of the primary joint implant. It utilizes pre-existing surgical tools that are required for arthroplasty procedures and the use of an electronic-assisted detection system. Radiographic imaging was selected as the primary visualization method since radiographs are readily available in healthcare facilities. X-ray image testing was completed for our design to validate our image analysis. A metal implant was translationally and rotationally moved at 1 mm and 1° increments, respectively. The x-ray was then tested against the non-rotated, non-translated x-ray to test the known displacement against the measured displacement. Translational tests successfully verified movement with 2.1% accuracy. Rotational movement requires further optimization of our imaging algorithm before it can meet our design criteria. A patent was filed in February 2019 to protect the findings of

A Clinical Path to Cartilage Biopsy Procurement for the MACI Procedure

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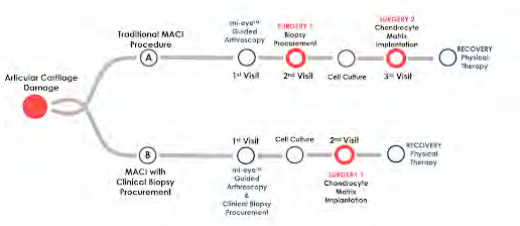
Trice Medical



Damaged articular cartilage is a debilitating condition that causes inflammation to the knee and limits the range of motion available to individuals affected. It affects close to six million people each year in the United States. Excessive wear and tear on the knee joint eventually leads to a knee replacement. However, in young individuals, procedures like the MACI (Matrix-Induced Autologous Chondrocyte Implant) are recommended to avoid the limited lifespan of a knee replacement. The MACI procedure requires a 200-mg biopsy of healthy cartilage, where the chondrocytes in the sample are extracted and cultured. Two invasive surgeries are required, one for initial biopsy and the collagen membrane implantation. A design team at Rowan University, in partnership with Trice Medical, aim to eliminate the need for a surgical biopsy by creating a minimally invasive, clinical cartilage biopsy device, capable of harvesting live cartilage from the non-load bearing condylar surfaces of the knee. The device would be used in conjunction with the mi-eye® tool, a single-use endoscopy device for use in an office. The device would be able to harvest 200-mg of live cartilage in 1-2 passes from the non-weight bearing surfaces of the knee and will be tested using a bovine knee.

Classification of Lung Tumor Grade Using Convolutional Neural Networks

TEAM MEMBERS

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SPONSORS

OncoPath Genomics; Rutgers Cancer Institute; Rutgers Robert Wood Johnson Medical School

Lung cancer is responsible for 1.38 million annual deaths worldwide. More than 80% of people diagnosed with lung cancer are already in an advanced stage where curative treatments are no longer an option and the 5 year survival rate is only 10%. Thus, there is a need for early screening of lung cancer to improve prognosis in patients. Chest computed tomography (CT) is a widely accepted tool for the detection of lung tumors, but is always followed by surgically-obtained tissue biopsy, as CT imaging is unable to distinguish between benign and malignant tumors. Artificial intelligence has shown promise is the field of diagnostics. Rowan engineers, in collaboration with Oncopath Genomics of New Jersey and the Rutgers Cancer Institute have created a prediction model that was developed for improving discrimination of malignant nodules from benign nodules in patients who underwent lung screening CT. The CT images used to train the algorithm were acquired the National Lung Screening Trial (NLST), National Cancer Institute, and the Cancer Imaging Archive. Our current model is being trained outsourced data from TCIA, NLST, and Rutgers Cancer Institute. We have achieved various results from different models but plan to reach a validation accuracy of 85% utilizing CT images alone.

Mesh Rolling and Implantation Device for Hernia Repair

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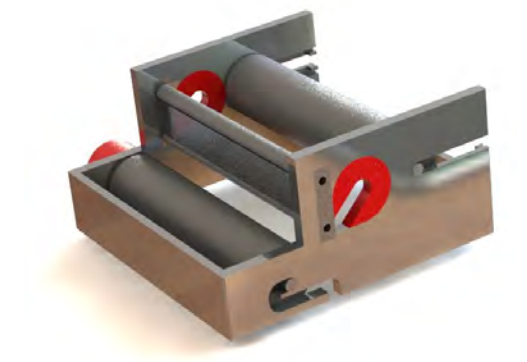
SPONSORS

ZSX Medical; Drexel College of Medicine



Over 1 million minimally invasive hernia repair procedures are performed annually in the U.S. Most laparoscopic ventral and inguinal hernia surgeries use mesh to cover the defect in the abdominal wall to minimize recurrence rates. Surgery staff struggle to roll hernia meshes small enough to fit through trocars of 8mm or smaller during surgery. Frequently, this process takes longer than ten minutes. This is a significant amount of unnecessary time in an operating room, and can indirectly correspond to later complications. There is a need for a more efficient method of mesh insertion for these hernia repairs. A mesh rolling and insertion device was created to enable a professional in the operating room to roll the mesh quickly and insert it into an 8mm trocar. The device was tested with six different types of hernia mesh, both drug eluting and non-drug eluting, to ensure the mechanical properties of the meshes remain unchanged. Baseline and post-rolled stiffness measurements were taken. The time of rolling and administration of the rolled mesh through an 8mm trocar were also observed and analyzed. The testing and implementation phase will take place within an OR at Hahnemann University Hospital and overseen by Dr. Elizabeth Renza-Stingone.

Enhancement of the Epidermis Through LED Therapy and Cell Manipulation

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PROJECT MANAGER

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SPONSORS

MySkinBuddy

Light-Emitting Diode therapy and other skin therapies such as microcurrents, nano-needles, and scrubbers, are used in the medical field and beauty industry to promote cellular metabolic activity and improve skin health and appearance. While many skin therapy devices are currently on the market, an all-in-one device has yet to be developed. Our goal was to redesign the current MSB device to include detachable components (microcurrent, nano needle, and facial scrubber), improvements to LED strength, upgraded battery capacity, waterproof design, and a sanitation container that also doubles as a portable charging station. Through our research, we were able to verify that the current model's LED range of 460 nm to 630 nm is ideal.

Application for Improvement of Sepsis Treatment and SEP-1 Compliance

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SPONSORS

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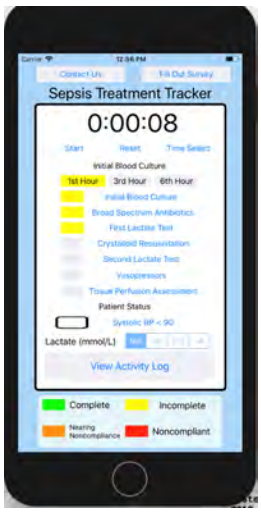

Each year, 1.7 million adults in America develop Sepsis and nearly 270,000 of these people die due to Sepsis. One in three patients who die in a hospital have Sepsis. Sepsis is a debilitating immune response that results in severe hypoxia and multiple organ dysfunction syndrome in response to an infection. Sepsis treatment in the United States is regulated by the Center for Medicaid and Medicare Services Core Measures, SEP-1. The SEP-1 Core Measures are time based and encourage quick and reactive treatment in order to improve patient outcomes through financial reimbursement. Cost of Sepsis treatment ranges based on severity from $16,324 to $38,298, which only gets reimbursed if the patient is properly treated compliant to the SEP-1 Core Measures. The overall treatment plan for sepsis can become complicated in a high workload environment, specifically the emergency ward. As a result treatments required by the SEP-1 procedures sometimes fail to be performed in the proper time frames. This results in low hospital compliance rates to SEP-1 and large financial losses for hospitals. In order to improve SEP-1 a mobile iOS software has been proposed to assist in tracking treatment and provide a clear indication as to the urgency of treatment when compared to the SEP-1 required time frames. A prototype software, named SepTick, has been built for an iPhone 8 plus in preparation for testing in the hands of healthcare providers at Lourdes Medical Center. This application is also undergoing

Drug Delivery Systems for the Local Treatment of Metastatic Spinal Tumors

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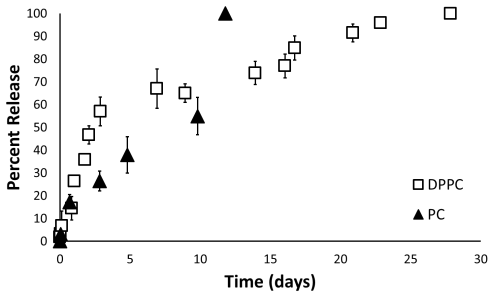

Among the 1.4 million new cases of cancer diagnosed annually, 5-14% of all patients will suffer from metastases to the spine, meaning that their cancer will spread to the bones of the vertebral column. Although many of these patients have succeeded in their first fight against cancer, they may present to their doctors years later with metastatic disease. Metastatic spine disease can severely affect a patient's quality of life, with those afflicted commonly experiencing intractable pain and neurological deficits. Surgery to address these tumors aims to remove as much tumor as possible, reduce pain and stabilize the spinal column. Although surgeons aim for gross total resection of the tumor of interest, in the spinal column the proximity of neural elements (nerve roots, the spinal cord) make "en bloc" procedures, i.e. procedures to remove the entire tumor and surrounding healthy tissue to ensure a clear margin, too dangerous for metastatic cancer patients. For this reason, a small amount of tumor is often left behind. Further, as most chemotherapy treatments limit the healing process, systemic chemotherapy is often held in the perioperative period. Regardless of the approach, surgery for removal of metastatic tumors are often painful for patients, as manipulation of the vertebral column can lead to large incisions and extensive bone removal. The purpose of this project is to develop a hydrogel polymer that can be implanted within a titanium cage at the time of surgery to deliver local chemotherapy to remaining tumor, as well as to deliver pain medication in the immediate post-operative period. The goal of this project is to provide chemotherapy to residual tumor

Hyaluronic Acid-Based Hydrogels for Negative Pressure Wound Therapy

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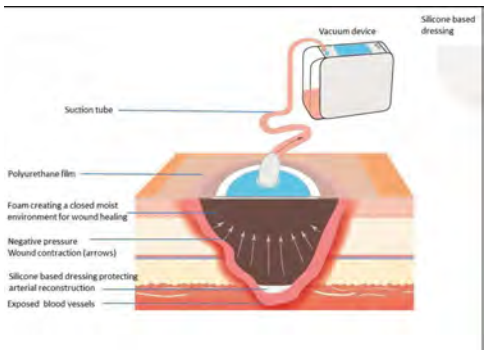

Negative Pressure Wound Therapy (NPWT) treats ulcers, acute and traumatic wounds, surgical wounds, and skin grafts, as well as other chronic wounds. This therapy enhances granulation formation, promotes angiogenesis, and manages fluid output. The current material used for this is Polyurethane foams. Unfortunately, the foams' residue remains in the wound after replacement and requires frequent changes of the sponge, presenting a risk due to the exposure of pathogens. Therefore, the goal of this project is to investigate a smart polymer suitable for interacting with this wound healing process.

To fulfill this goal, Hyaluronic acid, a substance found in connective tissue, is chosen to be crosslinked with synthetic polymers, Poly ethylene glycol diglycidyl ether (PEGDE) and Ethylene glycol diglycidyl ether (EGDE). Hyaluronic acid can be seen in many soft tissue engineering applications due to its biocompatible properties. Based on previous applications, PEGDE has been shown to have a high elastic deformation. EGDE consists of one ether group, while PEGDE has 2000. EGDE is being used as a baseline to investigate how amounts of ether groups affects the formation of gels. The data gathered should prove the hypothesis, an HA-PEGDE hydrogel will display the mechanical design characteristics needed for this wound therapy.

Rowan University

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