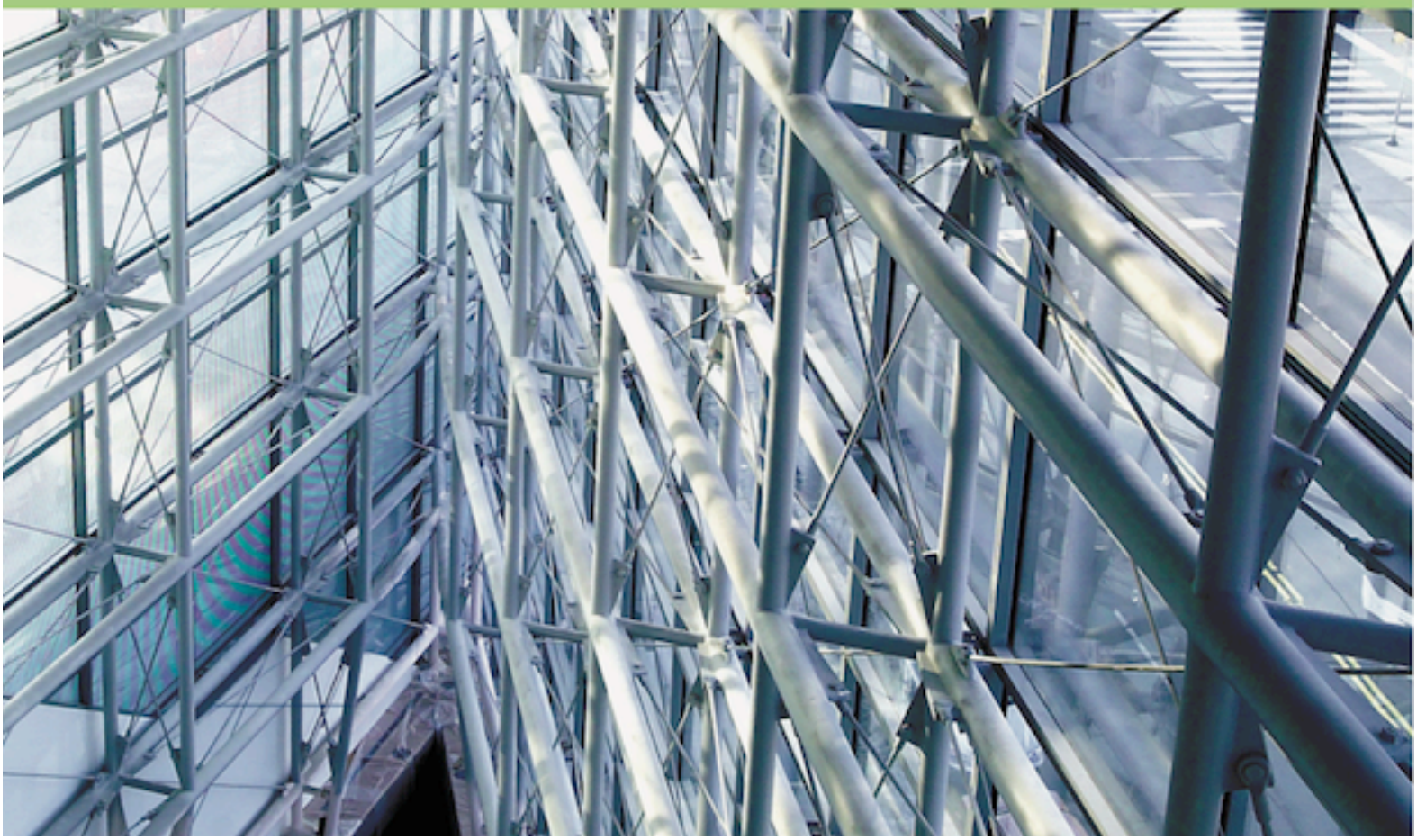
DREXEL UNIVERSITY COLLEGE OF ENGINEERING

Senior Design Projects 2015



SENIOR DESIGN

The Senior Design three-course sequence is intended to simulate a professional work environment, to provide experience working in a group on an open-ended problem and to develop information gathering and communication skills. Substantial interaction between students, faculty and industrial and governmental institutions is an integral part of this experience.

Engineering students make up the majority of the senior design teams but the sequence is open to seniors in any discipline. During the fall the students form their teams, select an area of interest, then extract and explicitly state their design problems and methods of solution in formal proposals to the Design Faculty. The teams develop their own solutions during the Winter and Spring, the culmination of which is a formal report of the results. The faculty encourages the students to place as much emphasis upon the process of defining the problems and developing the solutions as is placed upon the actual end products. To reflect that concern, proposals, progress reports and final reports are required in both written and oral formats.

The Senior Design Final Presentations are our way of providing a forum in which the project engineers (the students) can communicate their results to the community.

Adam Fontecchio
Associate Dean
Associate Dean for Academic Affairs
College of Engineering

CAEE-01	RESILIENCE STUDY OF PHILADELPHIA: RISKS OF DERAILING CRUDE OIL CARRYING TRAINS
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CBE-04	POLYBUTADIENE PLANT
CBE-05	PRODUCTION OF SYNDIOTACTIC POLYSTYRENE
CBE-06	PRODUCTION OF LACTIC ACID VIA ENGINEERED CYANOBACTERIA, SYNECHOCOCCUS PCC7942
CBE-07	BIOCHAR PRODUCTION FOR CO_2 SEQUESTERING
CBE-08	DOMESTIC HYDROGEN FUEL PRODUCTION VIA SOLAR THERMOCHEMICAL WATER SPLITTING
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CBE-16	EXTRACTION OF LITHIUM CARBONATE FROM SPODUMENE ORE
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ECE-07	UNMANNED GROUND VEHICLE COMMAND AND CONTROL CENTER
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ECE-09	WIRELESS INFANT RESPIRATION MONITORING SYSTEM
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ECE-18	WIRELESS USB STORAGE PLATFORM
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ECE-21	SYSTEM IDENTIFICATION OF MOTOR PARAMETERS
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ECE-23	THE ATLAS PROJECT
ECE-24	MULTI-ATLASES SEGMENTATION OF ORGANS AT RISK
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ET-02	THE ELECTRONIC FORTEPIANO
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ET-07	REMOTE ENVIRONMENTAL MONITOR
ET-08	SENSOR FOR IMPACTS CAUSING HEAD TRAUMA
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MSE-02	SYNTHESIS OF BIORESPONSIVE HYDROGEL FOR ON-DEMAND DELIVERY OF THERAPEUTICS
MSE-03	RANDOM NON-WOVEN FIBER COMPOSITES FOR SPINAL CORD INJURY REPAIR: MECHANICAL, CHEMICAL STABILITY, AND REACTIVE PROPERTIES
MSE-04	POLYMER STRUCTURE CONTROL IN 3-D PRINTING
MSE-05	FRACTURE TOUGHNESS & DUCTILITY OF PRESSED PHARMACEUTICALS
MSE-06	CORRELATING GAMMA PRIME MISMATCH OF MODIFIED ALLOY 925 COMPOSITIONS TO MECHANICAL STRENGTH
MSE-07	BREATHALYZER CARD: TAKING CURRENT BREATHALYZER TECHNOLOGY AND APPLYING IT TO A WALLET-SIZED DEVICE
MSE-08	DEVELOPMENT OF AN ENVIRONMENTALLY SAFE WAY TO REMOVE SILVER PLATE FROM LOW ALLOY STEEL WITHOUT HARMING THE BASE MATERIAL
MEM-01	SUSTAINABLE DEVELOPMENT FOR RURAL THAILAND: IMPROVED RICE PLANTER

MEM-04	MINIATURE PONTOON BOAT FOR BASS FISHING
MEM-05A	LEADER/FOLLOWER CONTROL OF A ROBOTIC TRANSPORT SKID
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MEM-06A	JERSEY SHORE LIGHT HOUSE-STRUCTURE TEAM
MEM-06B	JERSEY SHORE LIGHTHOUSE - POWER TEAM
MEM-07	THERMAL CONTROLLED GARMENT FOR FIRE SERVICE
MEM-08	UNMANNED AERIAL SYSTEM FOR STRUCTURAL ENGINEERING APPLICATIONS
MEM-09	COMBUSTION ENGINE TORSIONAL VIBRATION ISOLATION
MEM-10A	MOMENT ARM PROPULSION SYSTEM (MAPS)
MEM-10B	ORIGAMI SOLAR ARRAY FOR CUBESATS
MEM-11A	NON-INVASIVE DEVICE TO DETECT PERIPHERAL EDEMA IN HEART FAILURE PATIENTS
MEM-11B	NON-INVASIVE DEVICE TO DETECT PERIPHERAL EDEMA IN HEART FAILURE PATIENTS
MEM-13	ADDITIVE MANUFACTURING OF THE SMART SKELETAL FRACTURE SLEEVE
MEM-14	SOCIETY OF AUTOMOTIVE ENGINEERS: AERO DESIGN, BUILD, FLY COMPETITION
MEM-15	AUTONOMOUS ATHLETIC FIELD-MARKING ROBOT (HARDWARE)
MEM-16	ATHLETIC FIELD MARKING ROBOT (SOFTWARE)
MEM-17	GIMBAL-ACTUATED VTOL NACELLE (GAVN)
MEM-20	AUTOMATED, SMART COFFEE MAKER
MEM-23	EVALUATION FOR ALTERNATE MATERIALS FOR MOST RUGGEDIZED COMMERCIAL MOVING CAMERA SYSTEM
MEM-24	FLYING DRAGON - 100CC MOTORCYCLE LAND SPEED RECORD
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MEM-27	FLOW CHARACTERIZATION FOR NEXT GENERATION POWER PLANT DRY COOLING TOWER
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MEM-31	PLASMA TREATMENT OF PRODUCED WATER
MEM-33	AUTOMATED COUETTE VISCOMETER
MEM-35	IMPACT HELMET PERFORMANCE BY TEAM VIPER
MEM-36	BAJA SAE: FRAME AND POWERTRAIN FABRICATION AND ANALYSIS
MEM-37	SELF-FOLDING BIOPOLYMER MICROSTRUCTURE: DESIGN, FABRICATION & APPLICATIONS
MEM-39	QUADCOPTER AND SENSORY SYSTEM FOR RESCUE OPERATIONS
MEM-40	QUADCOPTER FLIGHT CONTROLS AND AUTONOMOUS NAVIGATION
MEM-41	PARTIAL WEIGHT-BEARING GAIT TRAINING DEVICE
MEM-43	AUTOMATED WELDING SYSTEM FOR PVC ROOFING MEMBRANE
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MEM-45	FLAGELLAR FOREST FABRICATION
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MEM-47	3D PRINTING MACHINE FOR HETEROGENEOUS MATERIAL PRINTING APPLICATIONS
MEM-48	IRON GRANNY
MEM-49	AUTOMATED DRINK DISPENSER
MEM-51	IFM TRAINING STAND
MEM-52	LOW PRESSURE FLOW CONTROLLER CALIBRATION SYSTEM
MEM-53	PROGRAMMABLE LAWN MOWER
MEM-54	DESIGN, FABRICATION, AND VALIDATION OF FAA BEAM STRUCTURE TEST FIXTURE

MEM-55	DESIGN, FABRICATE, AND VALIDATE AN AIRCRAFT WING STRUCTURE FOR BONDED REPAIR STUDY
MEM-57	AUTONOMOUS BIODIESEL CONVERSION SYSTEM
MEM-58	AUTOMATED HOME INDUCTION BREWING SYSTEM [AHIBS]
MEM-59	MULTI-DISCIPLINARY ROCK CLIMBING PACK
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MEM-61	DESIGN, FABRICATION, AND VALIDATION OF FOOT-WEIGHT MONITORING DEVICE
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BMES-01	ENABLING WHEELCHAIR MOBILITY FOR INDIVIDUALS WITH IMPAIRED DEXTERITY: A 3D PRINTING MANUFACTURING PROCESS TO PRODUCE CUSTOMIZED JOYSTICKS
BMES-02	ADJUSTABLE ORTHOPEDIC MECHANISM FOR CONGENITAL CLUBFOOT
BMES-03	ONLINE PRE-PROCESSING AND FEATURE EXTRACTION MODULE FOR LOW COST, PORTABLE SENSORIMOTOR RHYTHM BRAIN COMPUTER INTERFACE
BMES-04	PELTIER THERMAL FLOW METER FOR FOLEY CATHETER URINE OUTPUT QUANTIFICATION APPLICATIONS IN BEDRIDDEN HOSPITAL PATIENTS
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BMES-06	AMPLIO RETRACTOR SYSTEM
BMES-07	BRAIN SIGNAL FALL DETECTION RESEARCH TOOL USING EEG- ACCELEROMETER COUPLED SIGNALS
BMES-08	DEVELOPMENT OF A VALIDATION APPARATUS FOR ADVANCED COMPUTER MODELS OF PEDIATRIC TRAUMATIC BRAIN INJURY
BMES-09	POWERED ASSISTIVE DEVICE FOR EXTENSION OF SECOND AND THIRD PHALANGES
BMES-10	PORTABLE NEAR-INFRARED CRANIAL PROBE FOR HEMATOMA AND TISSUE OXYGENATON DETECTION
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BMES-14	LOW PRESSURE LYMPHATIC PUMP AS NOVEL TREATMENT FOR CONGESTIVE HEART FAILURE
BMES-15	DEVICE FOR MEASURING STIFFNESS OF THE GLENOHUMERAL JOINT
BMES-16	NON TRADITIONAL POWER SOURCE FOR LOW POWERED BIOMEDICAL DEVICES
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BMES-18	SEQUENTIAL RELEASE OF PROTEINS FROM HYDROGEL MICROSPHERES
BMES-19	CONTINUOUS MONITORING OF PATIENT AIRWAY FOR LARYNGOSPASM
BMES-20	SMARTPHONE APPLICATION ALGORITHM FOR GINGIVAL RECESSION CLASSIFICATION
BMES-21	METHOD TO MEASURE THE ROTATIONAL STIFFNESS OF THE TORSO

CAEE-01
RESILIENCE STUDY OF PHILADELPHIA: RISKS OF DERAILING CRUDE OIL CARRYING TRAINS

Advisor: Dr. Emin Aktan

Team:

Richard Gaibler	Civil Engineering
Michael Setaro	Civil Engineering
Christopher Smitelli	Civil Engineering
Michael Zinno	Civil Engineering

Our team has performed a risk assessment of the crude oil transport by rail through the city of Philadelphia. The goal was to allow for the continued transport of oil into our city in a manner which is safe for those who are exposed to the risks involved. This assessment was done due to the risks involved with the 4,000% increase of crude by rail transport this country has been experiencing since 2005. Our aim was to determine and highlight the areas which are at the highest risk in Philadelphia. Using the results from our analysis, safety methods are suggested to be implemented at the focus point of the Schuylkill Arsenal Railroad Bridge and 30 Street Station rail yard. With the proposed design solutions, our team believes it has produced an effect method to bolster the safety of the Philadelphia area, and crude by rail transport as a whole.

CAEE-02
SEPTA BROAD STREET LINE EXTENSION PROJECT

Advisor: Dr. Joseph Martin

Team:

Mark Kaspin	Civil Engineering
Robert Lubinski	Civil Engineering
Mayank Patel	Civil Engineering
Sebastian Soria	Civil Engineering

Philadelphia's economy has been steadily recovering since the end of the 2008 recession. The recovery has resulted in a construction and land development boom in and around the city, particularly in the Navy Yard. In fact, the projected number of workers in the Navy Yard is expected to hit 20,000 by 2022. To accommodate the increase in activity, we drafted plans to extend SEPTA's Broad Street Line from AT&T Station from the sports complex to the intersection of Broad Street and Flagship Drive. This 1.3-mile extension contained three stops: one near the I-95 on and off ramps, another in the center of the Navy Yard, and a final one where the line terminates. The project deliverables included a tunnel boring machine analysis and specification, plans for a slurry wall, structural design plans for the CSX railway crossing and trestle supports, elevation profile of the tracks, environmental assessments, life cycle analysis, and a soil stress analysis.

CAEE-03
DESIGN OF A MULTIPURPOSE HIGH-RISE

Advisor: ***Prof. Robert Brehm***

Team:

Chris Magruder	Civil Engineering
Jihan Shraibati	Architectural Engineering
Santiago Uribe	Civil and Architectural Engineering
Tyler Woyshner	Architectural, M.S. Civil Engineering

Located next to 30th Street Station in Philadelphia, PA, the design team was tasked by our client to develop a newly acquired space into a greater revenue generating structure. A multipurpose high-rise, constructed of reinforced concrete, was chosen for the site which included hotel rooms, event spaces, restaurants, and retail stores. These amenities in addition to its proximity to 30th street station and University City should generate revenue from the location. Stakeholders included the client, Amtrak, SEPTA, and PennDOT which played a large role in the final design parameters. Deliverables included the architectural layouts and elevations as well as the structural framing design and construction cost analysis.

CAEE-04
ADA CURB RAMP COMPLIANCE STUDY: SAMPLING, ANALYSIS AND DESIGN

Advisor: ***Dr. Emin Aktan***

Team:

Michael Holzworth	Civil and Architectural Engineering
Igor Lavrov	Civil and Architectural Engineering
Andrew Sivertsen	Civil and Architectural Engineering
Mani Vairapandi	Civil Engineering

There are approximately 60,000 curb ramps within Philadelphia that are incompliant due to ADA specifications altered in 2010. Current ADA specifications require 18 ramp parameters to be recorded and meet compliancy within 3 significant figures. In conjunction with the Philadelphia Streets Department (PSD), our group collected data from nearly 250 ramps around the city. The data was collected using ArcGIS that accurately stored all of the ramps pertinent information. We performed studies with handicapped individuals to determine which ramp parameters needed to be assessed with appropriate tolerances while still being considered acceptable. With this, the group created a ranking system to prioritize the curbs ramps and assisted the PSD in creating a ramp bid set. Alternative concrete solutions like self-consolidated concrete and alternative materials such as resin injection molding and thermoformed plastics were investigated. In addition to alternative materials, methods to easily renovate /repair incompliant ramps over reconstruction were explored.

CAEE-05
RIDLEY CREEK STATE PARK REVITALIZATION

Advisor: ***Dr. Patricia Gallagher***

Team:

Nick Christman	Civil Engineering
Brianne Frawley	Civil Engineering
Michael Johnescu	Civil Engineering
Tyler Krechmer	Civil Engineering

Ridley Creek State Park, only 16 miles from Philadelphia, encompasses over 2,606 acres of public use area in Delaware County, PA. Offering fishing, hunting, horseback riding, biking, walking, hiking, picnicking and event space, Ridley Creek State Park attracts approximately 1 million visitors a year. Despite the success of the park, the park is in dire need of a restoration to prepare for the future direction of the park. The group has identified the most crucial issues based on constraints, cost, scheduling and efficiency and organized a plan to revitalize Ridley Creek State Park. Proposed projects at Ridley Creek State Park include an office building, mansion transformation, multi-use trail parking lot, pole barn, road and multi-use trail improvements, bank rehabilitation and park signage.

CAEE-06
PROPOSAL FOR DEMOLITION OF MYERS HALL AND CONSTRUCTION OF MARIO HALL HIGH RISE

Advisor: ***Prof. James E. Mitchell***

Team:

Stephen Bartal	Architectural, MS Civil Engineering
Philip Brubaker	Architectural, MS Civil Engineering
Andrew Paladino	Architectural, MS Civil Engineering
Alex Petroske	Civil and Architectural Engineering
Madison Wambold	Architectural Engineering

This project was designed to address the need for freshman housing on Drexel's campus. It was determined that approximately 1400 more beds would be needed for incoming freshman by the year 2021. In order to address this problem, it was proposed that Myers Hall be demolished and replaced with a new dormitory. The new dormitory was designed to be constructed using modular design in order to save time. Faster construction time was desirable because the demolition of Myers Hall and the subsequent construction of the new dorm would cause a period where there are no usable beds on the site, forcing Drexel to house students elsewhere and causing a loss of income for the university. The faster, modular construction was used to reduce this downtime. A new dormitory was fully designed and presented, covering architectural, structural, site, plumbing, electrical, mechanical, and transportation concerns.

CAEE-07
NEW COLLEGE OF ENGINEERING BUILDING

Advisor: ***Dr. Franklin Moon***

Team:

Bader Al Moulah	Architectural Engineering
Angelina Castro	Architectural Engineering
Husain Ibrahaim	Civil and Architectural Engineering
Ahmad Jamal	Architectural Engineering
Gurjit Kaur	Civil and Architectural Engineering

There is a known concern among students and faculty regarding the tight engineering classes and overfilled halls of the Main and CAT Buildings. A new engineering building has been designed to comfortably house the MEM and CAEE departments including ample space for gathering, collaboration, presentation and lab work, as well as classrooms and offices. Located at F-lot parking lot, it is in keeping with the philosophy and vision that Drexel University is working towards; bringing the campus to the streets. The architecture is sleek and reflects the aesthetic of the newest Drexel buildings. The main entrance greets the occupants with a mirror-like glass façade leaving them in awe as they enter the indoor garden with natural trees and greenery. The structural design was detailed and focused on providing a stable, large 10-story high atrium. The building features LEED Gold Certification with an advanced HVAC system and sustainability designs.

CAEE-08
GAIA'S VERTICAL FARM

Advisor: ***Prof. James E. Mitchell***

Team:

Matthew Morimoto	Architectural, MS Civil Engineering
Nissan Ching	Architectural, MS Civil Engineering
Tyler Devilbiss	Architectural Engineering
Anamika Ghosh	Civil and Architectural Engineering
Jonathan Plotkin	Civil Engineering BS/MS
Shafi Sattar	Electrical Engineering
Sean Soboloski	Mechanical Engineering

For the 2015 ASCE Charles Pankow Foundation Engineering Design Competition, college students from around the country were asked to design a 5 story vertical farm. A vertical farm takes the entire supply chain - farm, packaging/processing, storefront - and centralizes it into one location. The competition requested that the students' take a 2 acre site located at 5500 Silver Spring Drive in Milwaukee and design a new building implementing sustainable principles, adaptability to multiple locations, and community interaction. The client, Growing Power, requested a comprehensive design for a Milwaukee and Florida location while maximizing profits and minimizing operating cost. Utilizing hydroponics, trigeneration, and innovative materials, a more efficient building was produced providing lower embodied energy and operating cost while optimizing revenue.

CAEE-09
THE DIRT FACTORY

Advisor: Dr. Christopher Sales

Team:

Achira Amur	Environmental Engineering
Rebecca Barnes	Environmental Engineering
Frank Kivuyo	Environmental Engineering
Yujie Su	Environmental Engineering
Bai Xue	Environmental Engineering

The Dirt Factory, a community composting facility at 4308 Market Street, is seeking to expand its operation. The facility has been in operation for two years under the management of University City District employee Seth Budick. The project is sponsored by Drexel's Engineering Projects in Community Service (EPICS) group, as it holds a crucial community outreach component. The purpose of the project is twofold; the first goal is to redesign the current site to facilitate leachate management, ensure efficient functioning of the site and adding essential components, such as storage and lighting facilities. The project also focuses on analyzing possible sites for a new facility that would comply with the client's requirements and be designed to have higher productivity than the current one. Project completion is expected to divert Philadelphia's food waste from landfills in order to increase community involvement, reduce greenhouse gas emissions and minimize costs for the city.
Sponsor: Engineering Projects in Community Service (EPICS)

CAEE-10
SCHUYLKILL RIVER HUB AT BRATRAM'S GARDEN

Advisor: Dr. Eugenia Ellis

Team:

Samantha Forgas	Civil and Architectural Engineering
Antonia Iaconelli	Civil and Architectural Engineering
Ashley Johnson	Civil and Architectural Engineering
Kevin Mayes	Mechanical Engineering
Ashley Willis	Environmental Engineering

Bartram's Garden is the oldest surviving botanical garden in North America spanning over 45 acres in Southwest Philadelphia. In the coming year the city will soon begin to expand the Schuylkill River Trail south through Bartram's Garden creating a segment known as the Bartram's Mile. With a new influx of visitors the team was tasked with creating a Hub for visitors to access the riverfront. The team designed several alternatives of each component and the client chose the final designs to be installed in phases as funds become available. The components that were designed and constructed prior to June were a floating dock, the shipping container boathouse with roof structure and the shade structure. Other components designed to be installed later were a walk into the existing wetlands, living shorelines, a green roof with stormwater storage system for the boathouse, pier and promenade, an off the grid solar power system for the boathouse, and a container café.
Sponsors: Atlantic Trailer Leasing, The Workshop School

CAEE-11
THE OCEAN CITY, NEW JERSEY RECREATIONAL CENTER

Advisor: ***Dr. Abieyuwa Aghayere***

Team:

Ajin Fatima	Civil Engineering
Michael Hubbard	Architectural Engineering
William Kocher	Civil Engineering

The Ocean City Recreation Center in Ocean City, New Jersey was designed as a multiple use structure. There is a need within the city for a large gym and spa. The recreational center provides both of these services for the residents of the city, while also increasing available parking at the site. The need for hurricane shelters along the Jersey shore was exposed by Hurricane Sandy in 2012. For this reason, the LEED certified steel structure of the recreational center was designed to withstand hurricane force winds and acts as a disaster relief shelter in times of need.

CAEE-12
DESIGN OF COMMUNITIY DEVELOPMENT CENTER IN ZAMBIA

Advisor: ***Professor Robert H. Swan***

Team:

Eliya Hurd	Civil and Environmental Engineering
Jessica Reedy	Civil and Architectural Engineering
Mathieu Savarit	Civil Engineering
Michael Schickling	Civil and Architectural Engineering

African Education Program (AEP) is a non-profit organization committed to improving the community of Kafue, Zambia through education and development programs. AEP rents its current facility, but the organization has outgrown the building. Frenchie and Sons, Inc. was contracted to design a new community development center for the program's operations. The majority of AEP's budget is dedicated to funding its community programs, so only a small portion of the organization's funds was allocated to the center. The company was responsible for all aspects of the design and construction means and methods. Frenchie and Sons, Inc. recommended that the primary building material for the center be plastic bottles filled with local soil. The company developed design plans for the AEP community development center: site layout and grading, architectural and structural design of the building, building foundation, and a rainwater catchment system. Frenchie and Sons, Inc. also developed a manual for the future design and construction of "bottle-wall" buildings.

CAEE-13
HOTEL RESORT IN HAITI

Advisor: ***Dr. Patrick Gurian***

Team:

Ivi Kusta	Civil Engineering
Sean Donnelly	Civil Engineering
Daielle Lebert	Environmental Engineering
David Lemons	Architectural Engineering
Melissa Winship	Civil Engineering

Episcopal Relief Services requested the engineering design for a luxury hotel in Haiti in a parcel of land on their ownership. Located between the United States and emerging economies in South America, Haiti is well-positioned to attract tourists that look for quality and uncrowded beach resorts which provide services at low cost. This construction, is predicted to bring a considerable amount of monetary benefits to the surrounding area. Several complexities were associated with this project such as designing a self-sufficiency electrical supply to support the building and the HVAC system, a water treatment and storm water management system, installation of a green roof for cooling load reduction and also several structural design complexities (designing a reinforced concrete building to withstand the high seismic applied loading as well as foundation design on a sandy-silt soil). The structure is located on a 126,000 SF (about 3 acres) oceanfront lot. Roughly 60,000 SF is dedicated to the hotel footprint and required facility operational systems. The remaining land is landscaped with the intention of preserving most of the natural habitat since the trees in this region are a natural barrier for storms.

CAEE-14
NEW 5-STORY LIBRARY FOR DREXEL UNIVERSITY

Advisor: ***Dr. Kurt Sjoblom***

Team:

Jinhao Liang	Civil Engineering
Yanzhao Nong	Civil Engineering
Xiaoxiao Tan	Civil Engineering
Yuanbo Wang	Civil Engineering
Jiaao Wu	Civil Engineering

After conducting a survey on students' satisfaction about the Hagerty Library, an investigation on the growth rate of incoming students, and the observation of the CO_2 concentration in the library, we found that the Hagerty Library could not provide adequate functions for students. Therefore, we designed a new library on Drexel campus. Comparing to the alternative plans of replacing Nesbitt Hall or 7-Eleven and Tennis Courts with a new library, replacing Korman Center was the best plan, as it is closed to the academic zone and not fully functional. The Math Department in Korman Center would move to the new building at 33rd Street and Chestnut Street, which is under construction. This report included the design of structure, foundation, ventilation system, green roof, bio-retention, along with 3-D model and cost estimates.

CAEE-15
CENTENNIAL DISTRICT TROLLEY LINE

Advisor: ***Dr. Joseph Martin***

Team:

Kirsten Brown	Civil and Architectural Engineering
Michael Kilgallon	Civil Engineering
Devon McKee	Architectural Engineering

With tourism being a large industry in Philadelphia, there is a need for public transit options for tourists. The new transit line that was conceptualized was one that would go from Center City Philadelphia to the Mann Center in West Fairmount Park. Using existing infrastructure and abandoned rail lines, a direct route along the Parkway in the city to West Philadelphia was created. To be economical, different alternatives were looked at to see what one yielded the best results for both function and budget. Some issues that arose were buildings in the right-of-way, grade changes, and separation from industrial heavy rail. These problems were solved by reinforcing the building for a tunnel, use existing land to change grade, and create a barrier next to the CSX line. In the end, this line is feasible in terms of functionality and in terms of budget.

CAEE-16
DRAGONS INN – MIXED USE APARTMENT BUILDING

Advisor: ***Dr. Joseph. V. Mullin***

Team:

Abdulghani Albaloushi	Civil and Architectural Engineering
Steven Cruz	Architectural Engineering
Hang Wang	Architectural Engineering

Drexel University's student population has increased considerably over the years; each incoming class is larger than the previous. By working with Drexel University, this project sought to design a multipurpose apartment complex located on Drexel Park (32nd and Powelton Avenue). The goals of this project were to provide the following (1) increase housing options for the growing Drexel student population that is within campus boundary, (2) create a social space for students, and (3) attract retail business to promote complex activity. By conducting research, the team was able to develop a nine-story building plan to meet the goals. During the design phase, the team developed the detailed architectural, structural and mechanical systems. In addition, the team designed preliminary systems including electrical, plumbing and fire protection.

CAEE-17
JADEN'S VOICE ASD COMMUNITY CENTER

Advisor: ***Dr. Eugenia Ellis***

Team:

Justin Hileman	Architectural Engineering
Soichiro Minami	Civil and Architectural Engineering
Raeli Savitt	Electrical Engineering
Dmitriy Voznyak	Architectural Engineering
Anthony Yau	Architectural Engineering

In 2014, 3000-5000 people were diagnosed with Autism Spectrum Disorder (ASD), a neurological disorder which causes symptoms such as difficulty with social interaction and heightened sensory input. This number is predicted to grow by 10-18% annually. In response to this rising number, Terri Matthews, CEO of Jaden's Voice, requested the design of an environmentally and Autism friendly community center that would provide occupational, sensory, and behavioral therapy, recreational activities, diagnostic testing, and temporary housing for families with children who have or show signs of Autism Spectrum Disorder. The building's spaces and systems were designed in order to accommodate Autism friendly goals such as reduced noise transmission and optimization of natural light entering the spaces. The design of these systems included precast hollow concrete slab for the structure, rain and roof garden for storm water management, variable air volume and ductless mini-split systems for HVAC, and ASD friendly lighting.

CAEE-18
GREEN STORMWATER MANAGEMENT AT IKEA SOUTH PHILADELPHIA

Advisor: ***Prof. Robert H Swan Jr.***

Team:

Michael Biamah	Civil Engineering
Romeet Patel	Civil Engineering
Amedeo Petrongolo	Civil Engineering

The objective of this project is to propose a green stormwater infrastructure at the IKEA South Philadelphia Store to reduce their total stormwater bill, which increased after the Philadelphia Water Department (PWD) switched to a new parcel-based billing method which considers a property's gross and impervious areas. The IKEA store, located alongside South Christopher Columbus Boulevard, consists of a large impervious parking lot covering roughly 600,000 ft^2 that contributes significant amounts of stormwater runoff to the City of Philadelphia's combined sewer system. The design team proposes a semi-intensive green roof at the IKEA South Philadelphia, which will be used to increase the total amount of impervious area at the location. The design team also proposes a parking lot stormwater runoff collection, treatment, and irrigation system that will provide treated water to irrigate the green roof. Structural, geotechnical and environmental engineering aspects were taken into consideration to ensure a cost and time effective solution.

CAEE-19
STACKABLE MODULAR HOUSING PROTOTYPE

Advisor: ***Prof. James E. Mitchell***

Team:

Tom Ben-David	Architectural Engineering
Elizabeth Daugherty	Architectural Engineering
Brad DiBenedetto	Architectural Engineering
Audrey Ryan	Architectural Engineering
Jeremy Sulak	Architectural Engineering

We performed integrated design of an 8-story, 64,800 square foot, modular prototype for affordable urban housing. The system is composed of stackable, repeatable units and is intended to be adapted for implementation in urban areas throughout the northeastern United States. Prefabricated modules were utilized to minimize waste and maximize constructability. The prototype building was designed for a representative site at 1200-6 Washington Avenue in Philadelphia, PA, to house and provide amenities to 160 residents. Sustainability and affordability were key project objectives; the prototype satisfies LEED Platinum standards, achieving a high-performance, high-efficiency design with reduced long-term operating costs.

CAEE-20
HISTORICAL RENOVATION OF THE HOTEL SYRACUSE

Advisor: ***Dr. Sabrina Spatari***

Team:

Alyssa Kelly	Environmental Engineering
Carolyn Quackenbush	Architectural Engineering
Alexa Smith	Architectural Engineering

The objective of work was to rehabilitate the Hotel Syracuse, built in 1942 in Syracuse, New York, and protected by the National Registry of Historic Buildings. The scope of work included a mechanical, electrical, and plumbing retrofit in addition to expansion of guestroom floor plans to ensure compliance with new demand loads and modern safety codes while preserving the historical integrity of the structure. Correcting deterioration of the hotel's envelope and roof and replacing outdated equipment to allow a higher performance level of operation improved the overall building efficiency. Solar panels and fitness room equipment were used to supply a portion of the electrical demand and a green roof was implemented to reduce on-site stormwater runoff. Mechanical, structural and cost analyses were done to ensure the cost of the project is affordable, and rooms can be competitively priced to maintain an optimal occupancy, as Syracuse rebuilds its economy.

CAEE-21
THE REVITALIZATION OF THE DELAWARE GENERATING STATION

Advisor: ***Dr. Joseph Martin***

Team:

Michelle Burnworth	Civil Engineering
Brian LaCerra	Civil Engineering
Al Pastor	Civil Engineering

The Delaware Generating station in Fishtown was decommissioned in 2004 and the site has been unused for the past ten years. Fishtown has gone through a period of gentrification, consequently real estate prices have increased and the cultural landscape has changed. Buildings in the area that have once been abandoned factories have been repurposed as condominiums, studio spaces, designer workshops, incubators for small businesses, as well as other purposes. This design plan in this proposal adheres to the "Master Plan for the Central Delaware". The design plan includes a combination of commercial and residential characteristics including condominiums, a restaurant, art galleries, and a performance space. A public marina will be available for the residents of the condominiums. Public amenities that are assessable by visitors of adjacent Penn Treaty Park will also be available. Overall, the design will aim to improve ecological function, prevent flooding, and create spaces for recreation.

CAEE-22
SUSTAINABLE PARKING FACILITY AND RECREATIONAL PARK

Advisor: ***Prof. Robert H. Swan, Jr.***

Team:

Ryan Anstotz	Civil Engineering
Ryan Hetzko	Civil Engineering
Christian Noriega	Civil Engineering
Peyton Wells	Civil Engineering

The scope of this project includes the structural, geotechnical, and drainage design of a multistory parking garage utilizing green storm water infrastructure with ground floor retail space to be located at the intersection of Broad Street and Washington Street. Also included in this project was the design of an adjacent recreational park as an exhibition of green stormwater best management practices with input from the Philadelphia Water Department (PWD). The objective of the project was to satisfy off-street parking demand in south Philadelphia, and alleviate the volume of runoff contributing to combined sewer overflows. The project location of south Philadelphia was selected due to notorious parking issues in the area and was inspired the by green streets program of the PWD.

CAEE-23
PALUMBO RECREATION CENTER BUILDING ENERGY RETROFIT

Advisor: Dr. Jin Wen

Team:

Matthew DiDomenico	Electrical Engineering
Sophia Gaines	Civil Engineering
Mikaela Price	Architectural Engineering
Kevin Saldivar	Architectural Engineering
Karyn Warthen	Civil and Architectural Engineering

The City of Philadelphia's Energy Sector has a main objective to promote conservation of energy by increasing energy efficiency on city properties. This group performs a total building and site analysis of the Palumbo Recreation Center in Philadelphia. The goal is to propose a whole building upgrade including the HVAC, building envelope, structural, electrical, and land development systems to increase the overall building energy efficiency, and sustainability, and to decrease the utility costs, and thus to provide an overall higher value of the building. The group formulates an encompassing total building and site submittal that justifies the retrofit of Palumbo Recreation Center. A cost analysis is performed for the proposed designs and the alternatives in order to evaluate their cost-effectiveness and to ensure government funding of the project. It is believed that our proposed designs will promote sustainability of Philadelphia's public works, and will also benefit the welfare of the community.
Sponsor: City Department of Philadelphia Parks and Recreation Sector (PPR)

CAEE-24
THE LOFTS AT GLASSWORKS

Advisor: Dr. Joseph Martin

Team:

Bora Beqiri	Civil Engineering
Madelyn Spinner	Civil and Environmental Engineering
John Theisen	Civil Engineering
Delia Votsch	Civil Engineering

The vacation of previous industrial areas along the Delaware River has resulted in the abandonment of numerous sites. These areas provide an opportunity for both redevelopment and innovation. This project focuses on the re-use of a roughly 47-acre site on the waterfront near the intersection of North Beach Street and Montgomery Avenue. The planned development for this site is a mixed use, primarily residential area. This will feature mid-rise, apartment style buildings, mixed-use green space, a multi-use trail, parking accommodations, and about 13,000 square feet of retail space. The project includes several site improvements such as a redesigned waterfront to create the open space desired by this community, stormwater management practices which ensure the river is undisturbed by the reuse of the site, and an innovative heating and cooling design which uses the Delaware River as a heat sink.

CAEE-25
REMEDIATION OF BAGHURST DRIVE HARLEYSVILLE, PA

Advisors: Dr. Charles Haas, Dr. Christopher Sales

Team:

Melika Riley	Environmental Engineering
Nicole Stilwell	Environmental Engineering
Maria Tortorelli	Environmental Engineering
Amy Wetherby	Civil and Environmental Engineering

Baghurst Drive, a new addition to the Superfund National Priorities List (NPL), is located in Harleysville, PA. A historical disposal of contaminants resulted in groundwater contamination affecting 42 residential drinking wells. The contaminants of concern include trichloroethene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), vinyl chloride (VC), and 1,4-dioxane. The remedial goal was to decontaminate the polluted area below the maximum contaminant level (MCL) to provide potable water to the affected residents. The five best alternatives for contaminant removal were determined using a scoring matrix based on a specific criteria used to rate cost, contaminant removal, efficiency, and sustainability for each remedial technology. Each alternative was designed and assessed for site feasibility. The final project deliverable was a remedial action plan for the best remediation alternative.

CAEE-26
SEWAGE GEOTHERMAL TECHNOLOGY FEASIBILITY STUDY FOR MOUNT LAUREL TOWNSHIP MUNICIPAL UTILITIES AUTHORITY

Advisor: Dr. Roger Marino

Team:

Bryan Geissel	Environmental Engineering
Brandon James	Environmental Engineering
Pangyan Zhang	Architectural Engineering

Our group looked at the feasibility of a Sewage Geothermal installation at Mount Laurel Municipal Utilities Authority Wastewater Treatment Plant. Sewage water lines are a consistent source of energy that can be used to regulate the temperature within a building to lower heating and cooling costs. Our group used NovaThermal Energy's pilot study at the Southeast Wastewater Treatment Plant to design the size and capacity of the system that would be installed at Mount Laurel's facility. We also worked with the Mount Laurel Municipal Utilities Authority to acquire data describing their sewer system. Our group determined the amount of energy and money that could be saved by air conditioning the administration building using Sewage Geothermal technology. Our group developed two alternatives for the placement of the installation, one utilizes the plant influent and one utilizes the plant effluent.

CAEE-27
BIOGAS GENERATION IN ANAEROBIC DIGESTION

Advisor: ***Dr. Christopher Sales***

Team:

James Cirelli	Environmental Engineering
Leonard Lui	Civil and Environmental Engineering
Alex Newhart	Environmental Engineering
Sean-Erik O'Donnell	Environmental Engineering, BS/MS

Drexel City Water is home to two major Waste Pollution Control Plants (WPCP) that handle residential, commercial, and industrial wastewater streams of Drexel County. The Drexel City WPCP (DCWPCP) handles about 90 tons per day of primary sludge and 50 tons per day of waste activated sludge (WAS) from the county through an anaerobic digestion process. From these sludge streams, about 1.1 million ft^3 of biogas is produced per day after anaerobic digestion, which contains about 64% methane. The goal of this senior design team is to research methods and technologies to improve biogas production rate in the digesters, and to find alternative uses for the excess biogas that is output. Currently, the methods being looked at include multi-phase anaerobic digestion and co-digestion for enhanced biogas increase, while the alternative uses for the biogas include cogeneration and fueling a natural gas fleet. Multi-phase anaerobic digestion can increase overall biogas output by about 4% while co-digestion can increase overall biogas output by about 33%. Cogeneration has the potential to take DCWPCP off the grid while the natural gas fleet would greatly reduce fueling costs and vehicle emissions.

CAEE-28
30th STREET STATION NETWORK MODERNIZATION

Advisor: ***Dr. Emin Aktan***

Team:

Hamad Al-Sulaiti	Civil Engineering
Scott Colbert	Civil Engineering
Tomor Gashi	Civil Engineering
Leo Riley	Architectural Engineering

The network surrounding 30th Street Station has reached an unsustainable level of congestion in several key areas. Those key areas in need of improvement are identified in this report along with possible solutions concerning the network that would facilitate a more efficient overall flow during peak times. The evening and morning rush hours have shown that the system is not properly managed at present, with severe congestion causing paralyzed conditions for lengthy periods of time. The current design layout was engineered for a different era and a much smaller traffic demand. The sudden increase in population to the area over the last ten years has overburdened the system beyond any measure of efficiency. In order to tackle such a complex network of roadways, pedestrian facilities, and public transit access, the entire system has been evaluated which has allowed the targeting of specific locations in need of improvement. Traffic simulation models have been developed to understand the current conditions of the network, as well as evaluate potential improvements that may be implemented.

CBE-01
FLUID CATALYTIC CRACKER

Advisor: Edward Luckiewicz

Team:

Sacha Borrero	Chemical Engineering
Natalie Leonardi	Chemical Engineering
Christopher Nartey	Chemical Engineering
Martin Ofosu-Amaah	Chemical Engineering

This project investigates the possibility of revamping the Fluidized Catalytic Cracking Unit (FCCU) of an existing refinery. This revamp involves modifying the operating conditions of the existing FCC unit to increase the overall yield of propylene in the plant. The refinery is expected to process 150,000 barrels per day of gas oil from West Texas Intermediate Crude, with the FCCU expected to process 48,000 barrels per day. The process is flexible as it involves many factors that were altered to maximize the propylene yield. The process involves two critical units, the reactor and the regenerator, where the cracking reactions take place and a fractionator, which separates the reactor products into the appropriate fractions. Currently, the average propylene yield in refineries is 4 wt. %. This project increases the propylene yield to 20%.
The results from the economic analysis show that the project is very profitable. The initial fixed capital investment required over a two year construction period is $1,607MM. This results in a Net Present Value of $9,165 MM with a payback period of 1.2 years.

CBE-02
SCUM GREASE-TO-BIODIESEL PRODUCTION FACILITY

Advisor: Dr. Richard A. Cairncross

Team:

Nino Bonanno	Chemical Engineering
Dylan Gallagher	Chemical Engineering
Brian Rummel	Chemical Engineering
Tristan Volpi	Chemical Engineering

Political focus on global warming and green energy over the past decade has led to a substantial increase in growth of the alternative fuels industry, specifically biodiesel, which can reduce greenhouse gas emissions up to 86% compared to hydrocarbon-based fuels. The proposed facility uses a supercritical reactor, and supercritical methanol as a main reactant, to convert the Free Fatty Acids (FFA) of scum grease and brown grease feedstock to high-energy Fatty Acid Methyl Esters (FAME). The FAME in the product stream is the key component in commercial biodiesel. The proposed facility is located approximately 25 miles outside of Camden, NJ, where it is in a location of maximum “reach” for obtaining feedstock from a multitude of major US cities. The facility uses a continuous process to maximize production, with an annual throughput of 12,305,518 gal/yr. The IRR for the facility is 3%, which falls well below the 15% MARR set for the project. The NPV (15%) and payback period for the facility are -$6.51 million and 8.89 years, respectively. The initial capital investment for the facility is $13 million. The negative NPV and low IRR for the feasibility study show that the facility is unfeasible under current market conditions.

CBE-03
COAL TO METHANOL

Advisor: ***Edward Andjeski***

Team:

Danielle Boccelli	Chemical Engineering
Jacklyn Briguglio	Chemical Engineering
Laura Ferguson	Chemical Engineering
Kyle Mattson	Chemical Engineering
Olivia Mustaro	Chemical Engineering

The coal-to-methanol process creates 99.99% pure methanol using coal as the raw material. Methanol is typically produced from natural gas; in this case, coal is used because it is an abundant and dirty fuel source. Producing methanol from coal creates a cleaner fuel product. 1,000 lb/hr of pulverized coal is fed into a gasification reactor, which breaks the coal down into gaseous CO and H_2, called syngas. The resulting syngas contain sulfur compounds, which are stripped from the mixture using an amine solution in an absorption column. The CO and H_2 are then fed to a reactor, which uses a catalyst to produce methanol. The methanol is separated from the unreacted gas, and the gas is further separated into pure hydrogen and waste gases. The plant is located in Pittsburgh, Pennsylvania because the feed coal is a Pittsburgh-based bituminous coal with a high carbon and low sulfur content.

CBE-04
POLYBUTADIENE PLANT

Advisor: ***Dr. Michael Grady***

Team:

Kaitlin Bonk	Chemical Engineering
Sruthi Janakiraman	Chemical Engineering
Meredith Snyder	Chemical Engineering
Teena Thomas	Chemical Engineering
Kipp Wolff	Chemical Engineering

The polybutadiene plant produces 98% technical grade 1,3-butadiene and polybutadiene acrylic acid acrylonitrile (PBAN), a binder for solid rocket fuel. The 1,3-butadiene is produced through extractive distillation with N-methyl-pyrrolidone (NMP) as the solvent and oxidative dehydrogenation of butenes in a catalytic plug flow reactor. A slipstream of the extracted butadiene is further purified to 99.5% 1,3-butadiene using a conventional distillation column to be polymerized into PBAN in a semi batch reactor. The plant annually produces 219 MM lb of 98% technical grade 1,3-butadiene, out of which 17 MM lb is purified into 99.5% polymer grade and converted to 20 MM lb of PBAN.
The discounted payback period for the polybutadiene plant is 4 years and the net present value is $60.9 million. For an annual interest rate of 10%, the discounted cash flow rate of return (DCFROR) for this project is 20.4%.

CBE-05
PRODUCTION OF SYNDIOTACTIC POLYSTYRENE

Advisor: ***Dr. Gennaro Maffia***

Team:

Xhuljano Dhima	Chemical Engineering
Matthew P. Geheran	Chemical Engineering
Katya Hristova	Chemical Engineering
Alice Hu	Chemical Engineering
Danielle MacKinnon	Chemical Engineering

Syndiotactic polystyrene is a high-performance semicrystalline thermoplastic with a high melting point, low dielectric constant, and good chemical and moisture resistance. Its unique properties make SPS ideally suited for applications in the automotive, electronics, appliance, and medical industries. This project explores the feasibility of economically producing syndiotactic polystyrene on a commercial scale. The process utilizes a homogeneous metallocene catalyst system to produce the syndiotactic form of the polymer that exhibits the desired properties. The plant produces 1,667 pounds per hour of a 98.9% syndiotactic pelleted product. The annual cost of manufacturing is approximately $96 million and the projected discounted cash flow rate of return for the plant is 18.49%.

CBE-06
PRODUCTION OF LACTIC ACID VIA ENGINEERED CYANOBACTERIA, SYNECHOCOCCUS PCC7942

Advisor: ***Dr. Gennaro Maffia***

Team:

Danielle Bush	Chemical Engineering
Armando Pineda	Chemical Engineering
Ursula Shannon	Chemical Engineering
Carina Watson	Chemical Engineering
Yousef Yousef	Chemical Engineering

This project focuses on the feasibility of lactic acid production via engineered cyanobacteria synechococcus elongatus PCC7942. Demand for lactic acid is expected to reach about 1,960 kilo tons per year by 2020. Lactic acid has several uses, most of which are industrial applications, yet other common uses include food and beverage additives, pharmaceuticals, and personal care. The lactic acid is produced and accumulated in several fermentation batch photo-bioreactors as bacteria grow and consumes nutrients in the BG-11 medium, CO2 from a feed, sugars it produces, and light. Lactic acid is collected by a separation process, which involves microfiltration, ultrafiltration, and a liquid-liquid extraction. The total bare module for the industrial plant was found to be $7.72 million. The expected revenue from sales is about $66.2 million. The proposed project is feasible with a payback period of 4 years and a $6.16 million Net Present Value.

CBE-07
BIOCHAR PRODUCTION FOR CO_2 SEQUESTERING

Advisor: ***David Kolesar***

Team:

Nathan Chesmar	Chemical Engineering
Rebecca Peltzman	Chemical Engineering
Derek Rahe	Chemical Engineering
Karl Weiss	Chemical Engineering

The 007 Biochar Company has set forth to design a facility to produce biochar. Biochar can be used to sequester carbon and improve the quality of soil. A facility for the production of biochar from forest residues will be located in the state of New York due to its high potential output for raw material and New York's involvement in a Cap and Trade Program. The plant produces approximately 9 tons of biochar per day, which is on par with other companies within the industry and allows room for growth. After researching the other methods of biochar production that are used in both lab scale and industrial scale productions, two auger reactor trains with heating jackets will be used for the reactor section of the plant. Initial estimates on the cost of the first year investment for the plant is $1,580,000 and the ATROR is 17%. The 007 Biochar Company believes it is best to move forward with this plant.

CBE-08
DOMESTIC HYDROGEN FUEL PRODUCTION VIA SOLAR THERMOCHEMICAL WATER SPLITTING

Advisor: ***Steven Schon***

Andrew Iacoviello	Chemical Engineering
Tariq Mahmood	Chemical Engineering
Thomas Neff	Chemical Engineering
Jaguar Singh	Chemical Engineering

The proposed household hydrogen production unit uses solar concentrators to run a thermochemical water splitting cycle. The cyclic redox reaction involving nickel ferrite as a catalyst splits water at temperatures above 1,830 degrees F to produce 2.5 pound per day of hydrogen. The cycle is powered by solar concentrators, which focus solar radiation through fiber optic cables which are directed at different points on a silicon carbide monolithic reactor. Two monolithic reactors, similar to plug flow reactors, are run cyclically; while one is performing the oxidation (water splitting step), the other is reducing in preparation for the next cycle. When sunlight is not needed to power either reactor, the fiber optic cables are diverted to PV cells to generate electricity for the consumer. The unreacted water is then condensed out of the effluent and the hydrogen is stored using a metal hydride prior to delivery to the customer's vehicle.

CBE-09
SEPARATION AND TRANSMUTATION OF SPENT NUCLEAR FUEL

Advisors: Dr. Christopher Peters, Prof. John Speidel

Team:

Jena Dorrin	Chemical Engineering
Devin Kownurko	Chemical Engineering
Amanda Norcini	Chemical Engineering

Nuclear power plants are a major source of energy and produced more than 800 billion kilowatt-hours in 2013. The main disadvantage of nuclear power plants are the large amounts of radioactive waste it produces. A reprocessing facility has been developed that separates and transmutes spent nuclear fuel using an accelerator driven system to decrease the radioactivity of the fuel. The spent nuclear fuel is processed by separating the waste fission products and actinides from the uranium and plutonium using a series of mixers and settlers in the PUREX process. The waste fission products and actinides that are separated are sent to the transmutation section whereby a proton beam from an accelerator transmutes the elements in the waste and splits long lived nuclei to reduce the half-lives. The economic analysis indicates that the cost of the accelerator is $2.5 billion alone and the silver oxide catalyst is $800/kg.

CBE-10
OLEFINS FROM SHALE GAS CONDENSATES

Advisor: Michael Kain, Dow Chemical Company

Team:

Rishon Benjamin	Chemical Engineering
Harrison Bradley	Chemical Engineering
Samuel Hardy	Chemical Engineering
Sean Layton	Chemical Engineering
Daniel McPherson	Chemical Engineering

Olefins, typically produced by cracking feeds such as naphthas, are commodity chemicals used in the production of polymers. However, a recent shift from the use of naphtha has opened up opportunities for the use of other feeds, such as shale gas condensates, for the production of high purity olefins.

This plant has six processing sections consisting of feed preparation and cracking, cool down to terminate the reaction, pre-separations compression, acid gas elimination, hydrogenation of acetylene and methylacetylene to improve product purity, and final separations/purification.

The plant is designed to produce 1.2 MM tons of ethylene and 0.7 MM tons of propylene per year. The revenue of the plant is approximated to be $3.4 billion/year with a total cost of manufacturing of $2.8 billion/year. The capital cost for this plant is $615 MM and the expected payback period is 4.8 years after construction has begun.

CBE-12
OXIDATIVE COUPLING OF METHANE TO ETHYLENE

Advisor: ***David Kolesar, The Dow Chemical Company***

Team:

Vishnu Anand	Chemical Engineering
Patrick McKercher	Chemical Engineering
Jordan Alexandria M. Shepard	Chemical Engineering

Team Trifecta is designing a methane coupling oxidation plant. The current design of the plant is producing 2.3 billion pounds per year of ethylene at a cost of $50 million in capital cost, with a manufacturing cost of $235 million. The revenue of the plant is $360 million, with a profit after taxes and depreciation of $88 million per year, resulting in a payback period of 2 years. The reactors will contain a catalyst that is not yet on the market and has only been used in small scale research. It is recommended that the plant be built in the Delaware Valley area due to the proximity to the Marcellus Shale production facilities and the pipeline to provide the plant with a natural gas source.

CBE-13
BIO-PROCESSING NATURAL FURANS FOR COATINGS AND COMPOSITES

Advisors: ***Dr. Giuseppe Palmese, Dr. Michael Grady***

Team:

Ivan Ding	Chemical Engineering
Xiangxi Meng	Chemical Engineering
Hongchu Shen	Chemical Engineering

The project focuses upon the reaction of 5-hydroxymethylfurfural(HMF) into the epoxy resin 2,5-bis[(2- oxiranylmethoxy)methyl]-furan, also known as BOF. HMF is a platform chemical derived from biomass which can be converted into environmentally friendly alternatives to many petroleum based products. The goal is to compete directly with common petroleum based epoxy resins, such as DGEBA, which controls the majority share of the epoxy market. The process involves hydrogenation the HMF feed before completing the conversion into an epoxy resin in a semi-batch reactor over the course of 6 hours. The final product is purified using a series of liquid-liquid extractors and distilled in two separation columns, resulting in a 99.5% pure product. As epoxy resins are produced on a relatively small scale, the plant is set to produce 78 million pounds per year, capturing approximately 1.3% of the global market.

CBE-14
BIODIESEL FROM INEDIBLE FEEDSTOCKS

Advisor: ***Dr. Richard Cairncross***

Team:

Jason Cotton	Chemical Engineering
Anthony Scala	Chemical Engineering
Yunze Tian	Chemical Engineering
Matthew Wilson	Chemical Engineering

As the reserves of petroleum based fuels are continually decreasing, the need for alternative fuel sources has become ever more apparent. Biodiesel created from renewable materials has been identified as a promising alternative. The ideal biodiesel feedstock would be inedible, inexpensive, readily available in large quantities, and have high oil content. Spent coffee grounds were identified as the most suitable feedstock.
This study explored the feasibility of constructing a plant in Brazil which would convert the triglycerides in spent coffee grounds into biodiesel. 184,500 metric tons of spent coffee grounds are used annually to produce 8 million gallons of biodiesel. While technically feasible, the plant is not economically viable. Tax rate was set at 42%, and a 20 year plant life was utilized. Fixed capital cost is $31.9 million, yearly manufacturing costs are $24.1 million, yearly revenue is $26.3 million; resulting in a DCFROR of 1.79%.

CBE-16
EXTRACTION OF LITHIUM CARBONATE FROM SPODUMENE ORE

Advisor: ***Mike Keane, DuPont***

Team:

Jesse Austin	Chemical Engineering
Madeleine Dahms	Chemical Engineering
Devin Peck	Chemical Engineering
Alexander Wartenberg	Chemical Engineering

Project is a continuous process to produce 8,800 short tons of 99.5 wt% lithium carbonate from 50,700 short tons of spodumene ore annually. Spodumene ore is a lithium aluminum inosilicate, $LiAl(SiO_3)_2$, and Australia accounts for ~70% of the total production of lithium ores. Through leaching reactions and further processing, lithium is extracted from the ore as lithium carbonate. Two processes were investigated: a solid-gas process and a liquid phase process. The solid-gas phase process was chosen based on raw material requirements, capital costs, and first pass lithium carbonate production rate. Sulfur trioxide is the reacting gas and beta-spodumene is the solid. The main process units include a rotary kiln, a fluidized bed reactor, a leaching tank, and a precipitator.
The total utility cost per year is $1.89 million, working capital costs are $9.08 million, raw material costs are $85.8 million per year, and the operating costs are $650,000 per year. The total revenue from sales totals to $111 million per year. The internal rate of return (IRR) for this process is 19.64%. Within four years of start-up, this plant will begin to earn a profit and will continue to grow as the demand for lithium carbonate increases.

CBE-17
PRODUCTION OF VINYL ACETATE MONOMER FROM NATURAL GAS

Advisor: ***Michael Keane Jr***.

Team:

Dillon Brennan	Chemical Engineering
Yang Hong	Chemical Engineering
Drew Lentz	Chemical Engineering
Xiao Lin	Chemical Engineering

The objective of this project was to develop a study to determine the feasibility of creating an industrial facility dedicated to converting natural gas into vinyl acetate monomer. Vinyl acetate is produced in large quantities in the United States and is mainly used for the production of polyvinyl acetate, which is used in water-based emulsions for paints and glues. To accomplish this project's goal, a production process utilizing four main reaction steps and four raw materials was developed. First, natural gas and steam are converted to carbon monoxide and hydrogen with some carbon dioxide (a mixture known as syngas). Second, carbon monoxide is reacted with hydrogen to form methanol. Third, the methanol is reacted with carbon monoxide to form acetic acid. Finally, the acetic acid is reacted with ethylene and oxygen to form vinyl acetate monomer (VAM). The total annual production of VAM is 106,680 tons, which satisfies 5% of the U.S.VAM market.

CBE-18
GASOLINE VIA C4 OLEFIN ALKYLATION

Advisor: ***Mr. Michael Kain, The Dow Chemical Company***

Team:

Nicola Ciccone	Chemical Engineering
Mrinalini Sharma	Chemical Engineering
Sharanya Subramony	Chemical Engineering
Mohamed Yattsaye	Chemical Engineering

This project studies the feasibility of producing a gasoline additive, 2,2,2-Trimethylpentane (TMP), via alkylation of C4 olefins. TMP is used to increase the knock resistance in fuel, preventing self-ignition in internal combustion engines. For this process, a continuous stirred tank reactor is used, with a short residence time. The olefin feed contains C_2-C_4 olefins and the isobutane feed contains 20% of n-butane. The fixed cost investment of the project is estimated to be $76,700,000 and the projected discounted cash flow rate of return is 37.7%. With a high efficiency process producing 99.99% product purity, the plant produces 3,310 lb/hr of TMP. The developed process uses multiple reactors in parallel at 50 F and 60.3 psig. The unreacted components are recycled back to the reactor to improve the yield of the process.

CBE-19
THE C_4 ROUTE TO METHYL METHACRYLATE

Advisor: ***Steven Schon, Arkema Inc.***

Team:

Nnaemeka Egede	Chemical Engineering
Thang Nguyen	Chemical Engineering
Michael Reilly	Chemical Engineering
Sol Seo	Chemical Engineering

The objective of this project is to design a methyl methacrylate plant in Garyville, Louisiana. The plant is sited on an existing industrial site next to the Marathon Garyville Refinery as a joint venture between Asahi Kasei and Marathon Petroleum Corporation. This business plan allows the unrestricted use of Asahi Kasei's oxidative esterification reactor technology while also providing utilities and raw materials from the Marathon Garyville Refinery. The plant uses a C_4-based process with isobutylene as the primary raw material. The process consists of two main reaction steps: (1) isobutylene is reacted with oxygen to form methacrolein in a tubular oxidation reactor and (2) the produced methacrolein effluent is oxidized and esterified with methanol simultaneously in a continuous stirred-tank reactor to form methyl methacrylate. The plant operates with a capacity of 100 MMlb/yr producing 99.9 weight% methyl methacrylate.

ECE-01
LOW COST PORTABLE HEADPHONE AMPLIFIER

Advisor: ***Dr. Prawat Nagvajara***

Team:

John August	Electrical Engineering
Sung Hei Hui	Electrical Engineering
Marko Kopij	Electrical Engineering
Soni Lamkaj	Electrical Engineering

The objective of this project is to construct a battery powered audio amplifier designed for high impedance headphones that require more power than a phone or music player can provide for optimal listening experience. Additional features such as Bluetooth connectivity, a Lithium Ion rechargeable battery, and an LCD screen are explored. The device will include a human machine interface in the form of buttons to allow the user to change parameters such as volume level. Bluetooth implementation is desired as it would eliminated the need for external wiring into the device, letting the user stream their music via Bluetooth to the amplifier. A small form factor 3D printed housing will be created as an enclosure for the unit, small enough to fit into ones pocket.

ECE-02
AGRICULTURAL WILDLIFE DETERRENT

Advisor: ***Dr. Paul Kalata***

Team:

Brandon Carns	Mechanical Engineering
Jonathan Chan	Electrical Engineering
Khaula Rashid	Electrical Engineering

The purpose of this project is to construct a quadcopter for Vynecrest's vineyard that will operate to deter avian wildlife on the crop. This new system is to automate and reduce the cost of existing bird deterrent method. This will also be less time consuming to operate. The goal is to achieve a flight time of at least 15 minutes with a maximum charging time of 30 minutes. The system will run effectively during the peak summer season which is approximately 3 months. The whole system will include a programmed quadcopter, and a charging station using conduction charging. The charging station will serve as a landing and charging platform for the copter to meet the overall deterrent functionality and its challenges. The copter batteries would be used to 20% remaining battery life and charging up to 80% capacity between flights so that the LiPo battery can charge up to 1000 cycles.

ECE-04
DUAL HEAD INSPECTION CAMERA FOR PIPING SYSTEM

Advisor: Dr. Christopher Peters

Team:

Jordan Dantas	Electrical and Computer Engineering
Reid Flasinski	Electrical and Mechanical Engineering
Christopher Reynolds	Electrical Engineering

Wastewater management systems are critical components on-board naval vessels. All waste that is generated needs to be handled properly for the ship to continue functioning in an environmentally friendly manner. The integrity of these systems is difficult to maintain due to the composition of the chemicals and solids that are inherent to waste systems. Although some inspection methods exist for large and medium sized pipes, pipes with small diameters (as small as 1-½") are harder to examine because the lack of space prohibits using the larger solutions. The goal of this project is to develop a tool that can be used easily to provide a means for visual inspection of the inside of small diameter pipes. The final product will ideally be used for early identification of potential problems in naval piping systems, and will contribute to the overall health and safety of the ship.

Sponsor: Mr. Brett Huhman, Naval Research Laboratory (NRL)

ECE-06
PROGRAMMABLE AUDIO EFFECT PROCESSOR

Advisor: Dr. Thomas Chmielewski

Team:

Zachary Geesey	Electrical Engineering
Nicholas Gunia	Computer Engineering
Jacob Iseminger	Electrical and Computer Engineering
David Senos	Electrical Engineering

The main goal of this project was to design an affordable Digital, Programmable Audio Effects Processor (DPAEP) kit for construction by a do-it-yourself (DIY) enthusiast with minimal soldering, and some C programming experience. A DPAEP allows musicians playing electronic instruments to develop their own digital audio effects for live performances. To make the developed DPAEP kit easily accessible for the hobbyist, the budget for components for a single kit was constrained to be under $250. It was also ensured that all components selected were easily attainable. Once a microcontroller was selected, a template audio effect project was created to configure all of the necessary hardware peripherals in the microcontroller and allow the programmer to focus on effects development. Circuits for a DC power supply and two versions of an anti-aliasing filter were designed before two stacked printed circuit board and the mechanical drawings for a case were developed.

ECE-07
UNMANNED GROUND VEHICLE COMMAND AND CONTROL CENTER

Advisor: ***Dr. Christopher Peters***

Team:

Jake Ailor	Computer Engineering
DM Enakshi Dissanayake	Electrical Engineering
Maria Enokian	Computer Engineering
Minh Vu	Computer Engineering

Technology in the Nuclear power plant industry has not been updated to the latest technological trends. Current radiation detection mechanisms use stationary sensors to detect radiation activity. The problem with stationary sensors is that they are susceptible to gaps in data collection. It causes the need to dispatch a response team for additional data collection, but creates the risk having them being exposed to high amounts of radiation. The proposed solution is a Command and Control Center (CCC). The CCC consists of a SMART Board™ and Unmanned Ground Vehicle (UGV). The UGV takes advantage of its navigational capabilities. The UGV houses sensors such as a video camera, a Geiger counter, and a GPS sensor. Using pre-determined routes, the UGV will traverse through the Nuclear power plant and relay sensor data back to a SMART Board™ for analysis.

ECE-08
AERIAL INSPECTION AND DETERMINATION OF POWER LINE INTEGRITY

Advisor: ***Dr. Christopher Peters***

Team:

Jonathon Affleck	Mechanical Engineering
David Hocky	Computer Engineering
Jamie Howard	Electrical Engineering
Shauna Walters	Electrical Engineering

Current distribution power line inspection methods can be dangerous to linemen because reliability engineers have limited visibility into the current state of the infrastructure. Unmanned Aerial Systems (UASs) can provide a safer and more cost effective solution to the current manual process of gathering system data. The implemented UAS uses quadcopter technology to collect critical power line data such as infrared (IR) images, GPS coordinates, and aerial video feed of circuit sections. The quadcopter gives utility companies the ability to proactively identify damage to circuits and prepare crews for work. Data is quickly organized and uploaded into a Geographic Information System (GIS) and basic image processing is used to identify system poles and their locations. Future projects can expand to include autonomous flights with advanced image processing.

Sponsor: PECO Energy

ECE-09
WIRELESS INFANT RESPIRATION MONITORING SYSTEM

Advisors: ***Dr. Kapil Dandekar, Dr. Timothy Kurzweg, Dr. Adam Fontecchio, Prof. Geneviève Dion, CoMAD, William Mongan, CS, Dr. Endla Anday, DUCoM***

Team:

David Lee	Electrical Engineering
Van Le Nguyen	Electrical Engineering
Ilhaan Rasheed	Electrical Engineering
Bryce Walburn	Electrical Engineering

The project consists of a wireless respiration monitoring system designed to detect Sudden Infant Death Syndrome (SIDS). This syndrome, which often affects otherwise healthy infants and cannot be explained with post-mortem examinations, is the leading cause of deaths in infants aged 1-12 months. Through the use of conductive fabric and an RFID interrogation system, breathing information is transmitted from a passive wearable garment worn by infants when sleeping or unattended. This technology has been leveraged to provide a solution for monitoring infant breathing and alerting guardians of abnormal breathing events. Various garment fabrics, antenna configurations and garment designs have been explored to determine the optimal respiration monitoring band design. Signal processing algorithms interpret data streams coming from the garment and determine whether the infant is breathing or not. An RFID system, consisting of a reader, interrogator, data processing hardware, and communications hardware have been designed and optimized.

ECE-10
INTERACTIVE EDUCATIONAL DISPLAYS FOR THE PLEASE TOUCH MUSEUM

Advisor: ***Dr. Eli Fromm***

Team:

Darren Krewson	Electrical Engineering
Chang Liu	Electrical Engineering
Steven Loher	Electrical Engineering
Pavel Seuruk	Electrical Engineering

The Please Touch Museum of Philadelphia has a need to create exhibits and displays in support of the STEM (Science, Technology, Engineering, and Mathematics) program. This team has developed two carts to be used as mobile displays that will introduce, educate, and entertain young children with the concepts and principles of electricity and engineering. The first cart features several self-contained experiments such as moving a hand over a photo cell to light up a series of LEDs, a touch sensitive circuit made with conductive paint, a hand operated crank generator, and a wire-loop game. Accompanying each activity is a storyboard explaining the demonstrated phenomena in a "cause and effect" manner. The second cart supports a Van de Graaff generator that will be used for conducting electrical demonstrations. Both carts include train-the-trainer information for educators to be able to utilize the carts in a classroom environment.

Sponsor: Philadelphia Please Touch Museum

ECE-11
SECURITY ANALYSIS VISUALIZATION TOOL

Advisors: Dr. Chikaodinaka Nwankpa, Richard Brenton, PJM Interconnection

Team:

Matthew Brady	Electrical Engineering
Zehra Bilge Derin	Electrical Engineering

PJM Interconnection is a Regional Transmission Organization (RTO), with over 875 member companies that provide electricity to 61 million customers in 13 states and the DC area. Dispatchers at PJM Interconnection have requested a tool that will help visualize the RTO's Security Analysis (SA) and State Estimator (SE) data. Such a tool would improve dispatcher situational awareness, and help operators respond more efficiently to ever changing grid conditions. Failing to respond appropriately to a system impact can potentially lead to situations such as damaged equipment, load shed, black-outs or brown-outs, and financial losses.
This project delivered a production-ready web application before the beginning of summer operations. The application UI has trending functionality with equipment selection filters to help find constraint data. The UI also provides a rolling alarm window, and equipment outage information to help operators identify grid impacts. The project scope included the UI, and all necessary queries, calculations, data aggregation and data storage.
Sponsor: PJM Interconnection, LLC

ECE-12
PNEUMATIC AIR MUSCLE ROBOTIC ARM CONTROL

Advisor: Prof. Richard Primerano

Team:

Chia Chen	Mechanical Engineering
Ren Jianxin	Electrical Engineering
Stephen Lewis	Computer Engineering
Kartikeya Tayal	Electrical Engineering

Pneumatic air muscles open new avenues for a controllable robotic arm. They can be used in place of traditional motors and actuators to complete linear functions. They have the additional benefit lightweight and versatile and can be used in various industries such as the medical field. This project explored the use of a pneumatic air muscle in the simulation of a human arm. A fully functional elbow joint was constructed and various properties of the air muscles including lifting capabilities, speed of contraction/extension, and smoothness of motion were also investigated. The motion of the elbow joint was simulated by having two air muscles that work in an antagonistic way. These air muscles expand and contract depending on the air pressure supplied. The control of this system is done using an arduino. A current controlled circuit was used to control the airflow in and out of the muscle using air valves.

ECE-14
JET CAR TEST TRACK CLOSED-LOOP CONTROL ALGORITHM FOR SPEED ACCURACY

Advisor: Dr. Leonid Hrebien

Team:

Latham Harris	Electrical Engineering
David Pavelco	Mechanical Engineering
Karl Schemmer	Electrical Engineering

NAVAIR currently tests the shipboard aircraft cable arresting system by using a Jet car equipped with four J57 engines to push a dead load representative of an aircraft. The Jet car is fueled and controlled by a predetermined equation for a certain thrust value. The car was originally controlled by electric relays with no dynamic control. There was recently an upgrade to the system with an Allen Bradly PLC Controller and a GPS unit. However, the original open loop control system is still being used to control the thrust. Since the system is now capable, a closed loop control algorithm will be developed to control the dynamic system. A requirement of the control system is to be overdamped to prevent damages to the existing physical system. The final system will be simulated and proven to work within the requested accuracy for varying loads and target arresting velocities.

ECE-15
TENNIS TRAINER
Advisor: Dr. Bruce Eisenstein

Team:

Khaled Alfatta	Computer Engineering
Kent Clark	Mechanical Engineering
Shashank Ganesan	Computer Engineering
Matt Kline	Computer Engineering

Tennis is an expensive sport to learn and practice because of the costs related, but not limited, to the practice space required, a coach's guidance, and equipment needed to play. The Tennis Trainer aims to provide the user with an inexpensive and effective way to practice tennis in the comfort of his/her home. Unlike other products currently in the market which tracks the swings of professionals, this product is specifically meant for beginners who want to give tennis a try without the extra costs. The Tennis Trainer consists of 4 main components: a tennis racket, a fan, a microcontroller, and a smart phone application. As the user swings the racket, the blades of the fan will rotate and calculate a specific velocity. This data is recorded by the microcontroller and then relayed to the smart phone application for the user to view.

ECE-16
SOLAR CANOPY

Advisor: ***Dr. Kevin Scoles***

Team:

Sophia Frelke	Mechanical Engineering
Reginald Pharaud	Electrical Engineering
Joshua Stoner	Mechanical Engineering
Katherine Walker	Electrical Engineering

The project includes the design of a solar canopy system and a roof mounted solar array to be integrated with a new schoolyard for the McMichael Elementary and Middle School in Mantua, Philadelphia. The canopy system will improve the environment of the neighborhood while integrating a science, technology, engineering, arts, and mathematics (STEAM) curriculum. Both systems were designed according to NEC and ASCE standards and produce 24 kW of peak DC power. Power generated from each system is fed into the grid, allowing for federal and state incentives. Additionally, the canopy system provides a shaded space for students and faculty as well as integrating student artwork using digitally fabricated perforated panels. Electrical modeling and analysis was performed using Solmetric iSV application software and System Advisor Model (SAM). Structural modeling and analysis was performed using Bentley RAM Elements and PTC Creo.

ECE-17
DESIGN/SIMULATION OF A WIRELESS MULTI-USER CHARGING SYSTEM FOR LAPTOPS

Advisor: ***Dr. Gennady Friedman***

Team:

Dustin Ho	Electrical and Computer Engineering
Yu Lin	Electrical Engineering
Anup Upasani	Electrical Engineering

The demand for accessible power is constantly increasing with the growing number of mobile devices e.g. cellphones, tablets. Charging multiple devices with a limited amount of power outlets becomes awkward. Wireless Power Transfer has proven to be a viable method of transferring energy to multiple devices over short to mid-range distances in areas such as a library or cafe. A wireless power system was designed and simulated to distribute power to multiple laptops via a single power source and multiple wireless receivers. The transmitter sends power to receivers attached to the individual laptops using inductive coupling. The system uses a power distribution algorithm similar to frequency division multiplexing to share power between the receiving devices.

ECE-18
WIRELESS USB STORAGE PLATFORM

Advisor: Dr. Mark Hempstead

Team:

Tyler Jung	Computer Engineering
Patrick LaFata	Computer Engineering
Chris Ousey	Computer Engineering

In today's digital world, constant access to data is important to many people. Free Wi-Fi access or low cost data plans to access this data are not always available. Storing data remotely can add additional costs. The proposed project hopes to satisfy the need for reliable access to data. The project provides a reliable, low cost and portable method of accessing data in area with limited Internet availability. Such a solution is comprised of a Raspberry Pi with a USB port that can broadcast a Wi-Fi signal, making the contents of a USB drive available. Users will be able to stream, download or upload files to and from the device using a smartphone application or web browser. This solution, called the Wireless USB Storage Platform (WUSP), allows users to have reliable access to their data anywhere at any time, while avoiding the costs of expensive alternatives.

ECE-19
WIRELESS POWER HARVESTING

Advisors: Dr. Kapil Dandekar, Prof. Genevieve Dion, CoMAD

Team:

Julia Marchese	Electrical Engineering
AJ Matsanka	Electrical Engineering
John Straguzzi	Electrical Engineering

The objective of this project was to provide a means for reusing ambient RF energy through the convenience of a wearable application. This was achieved by developing of a wearable wireless power harvesting system using a combination of knit and traditional electronics. In the design of wearable electronics there two competing considerations: comfort of the user and efficiency of the electronic system. This system was designed to capture ambient energy from electromagnetic radiation given off from devices, which use GSM and Wi-Fi protocol for communication to power a low energy Bluetooth device. The goal was to maximize system efficiency without compromising wearability. This system design was approached through two solutions. The first utilized a commercial IC and the second was a custom multiband design. Prototypes were made for each design in PCB. Knit electronics were implemented in the better of the two solutions to be used as the final deliverable.

Sponsor: National Science Foundation under Grant No. IIP-1430212, titled "Wearable Smart Textiles Based on Programmable and Automated Knitting Technology for Biomedical and Sensor Actuation Applications"

ECE-20
LEAD ACID BATTERY MANAGEMENT SYSTEM

Advisor: ***Dr. Chika Nwankpa***

Team:

Eliseo Carrasco	Electrical Engineering
Christian Guzman	Computer Engineering
Jerote Ragsdale	Electrical Engineering
Josue Vazquez	Computer Engineering

Batteries are an essential part in nearly all energy systems and their corresponding battery management systems (BMS) are crucial for electric utilities. A BMS is meant to regulate a battery bank so that each battery in the system will have similar voltages, thus expanding the lifespan of the battery bank as a whole.
Our group will design a lead acid battery management system that calculates the lifespan of the battery bank using the voltage, current, and other important parameters retrieved from the lead acid battery bank already set up in the Drexel Power Lab. The finished system will include regulators to balance the battery, a microcontroller to process data, and a GUI to display the cell balancing properties and a calculated lifespan of the battery bank.

ECE-21
SYSTEM IDENTIFICATION OF MOTOR PARAMETERS

Advisor: ***Dr. Thomas Chmielewski***

Team:

Sandeep Kaur	Computer Engineering
Fallon Kider	Electrical Engineering
Taha Shafa	Electrical Engineering

The fields of robotics and other control systems are growing in popularity. In order to make any given system work accurately, the motor parameters need to be known in order to predict the functionality of the system. This can be done by finding the motor's transfer function, of which the terms relate to specific motor parameters. The ultimate goal of this project was to create a proof-of-concept system that finds the transfer function of a closer loop motor system (servo, simple DC motor, and brushless motor). For the proof-of-concept system, the motors were attached to two single board computers; one for moving the system and one for reading data. The sampled data of the inputs and outputs was transferred into MATLAB. A proprietary algorithm based on the batch least squares method took the discrete time input and output signals and created a discrete time transfer function, from which the motor parameters were extracted.

ECE-22
SOLAR POWER DISTRIBUTION MANAGEMENT SYSTEM

Advisor: ***Dr. Karen Miu***

Team:

Ryan Mallgrave	Electrical Engineering
Yichen Qian	Electrical Engineering
Ruben Sandoval	Electrical Engineering
Lixin Zhu	Electrical Engineering

Collecting energy from renewable sources is a rapidly growing industry, especially as traditional fuel sources are becoming scarce and expensive. Due to this interest, Solar Photovoltaic Distributed Generation (PV-DG) has become popular in North America. PV-DG differs from more traditional generation systems in that PV-DG systems are highly variable because of the unpredictable nature of weather and sunlight. One way to encourage PV-DG utilization is to provide methods for analyzing the influence distribution level solar power generation has on the overall distribution network.
The objective for this project is to provide a software simulation and a hardware experiment that recreates an isolated solar power distribution system. This project will be using the solar panels on top of the main building of Drexel University as the energy source. LabVIEW will be used to collect power flow data during the hardware experiment, while Simulink will be used for the software simulation.

ECE-23
THE ATLAS PROJECT

Advisor: ***Dr. Yon Visell***

Team:

Rod Aluise	Computer Engineering
Brandon Fernandes	Electrical Engineering
Qandeel Khan	Computer Engineering
Sean Maclean	Computer Engineering
Ian Wynyard	Computer Engineering

ATLAS is a wearable device, which models the hand of the user in a virtual environment in real time. This functionality is enabled by the use of custom fabricated silicone liquid-medium strain gauges. This device has many potential uses including teleoperation of robotic limbs or as an interface with a computer operating system.

ECE-24
MULTI-ATLASES SEGMENTATION OF ORGANS AT RISK

Advisor: ***Dr. James Shackleford***

Team:

Hieu Bui	Electrical and Computer Engineering
Tajik Choudhury	Computer Engineering
Thang Dao	Computer Engineering

Intensity-modulated radiation therapy (IMRT) is an advanced high-precision radiotherapy that uses linear accelerators to deliver accurate doses of radiation to tumors. In order to maximize radiation dosage to a cancerous region while also minimizing the radiation dosage to adjacent normal tissues, or organs at risk (OARs), a segmentation of a pretreatment 3-D computed tomography (CT) scan is required. Physicians must then manually perform OAR segmentation and determine a suitable treatment plan. However, it is estimated that medical experts take approximately 2.7 hours to manually perform the segmentation of OARs in the head-neck region of a single patient. This project focuses on providing accurate automatic OAR segmentation of the head-neck region that is less time-consuming than manual segmentation. This automated procedure will allow medical experts to focus on other aspects of the treatment process that are less inclined to automation.

ECE-27
AUTOMATIC LICENSE PLATE READER

Advisor: ***Dr. Prawat Nagvajara***

Team:

Abdullah Al-Rasheed	Computer Engineering
Mark Chua	Computer Engineering
David Hwang	Computer Engineering
Matthew Johnson	Computer Engineering

The team has designed a prototype for a low-cost implementation of an automatic license plate reading system (ALPR) that utilizes open-sourced libraries. The ALPR system consists of a Linux virtual machine, an Internet Protocol (IP) camera, an Ethernet network switch, and a power over Ethernet (POE) adapter. The end user has a choice of hardware platforms, including desktop hardware, server hardware, and the cloud. The Optical Character Recognition software and Image processing library were selected as Tesseract and OpenCV respectively. The deliverables upon completing the software/hardware integration were: the physical ALPR system, source code, and API library.

The OpenCV library contains functions that allow for the implementation and use of a variety of image processing algorithms. Some of the image processing algorithms that were implemented includes: grayscale conversion, adaptive thresholding and binarization, dilation, erosion, canny edge detection, contour detection, and rectangle detection. The use of these image processing algorithms enable the ALPR system to process, filter, and detect the license plate region which is then passed through the Tesseract OCR for character recognition. These numbers can then be stored in a database and used as a client sees fit.

ECE-28
BARTRAM'S GARDEN APP

Advisor: Dr. Pramod Abichandani

Team:

Timoteo Meson	Computer Engineering
Minh Nguyen	Computer Engineering
Paul Palladino	Electrical Engineering

Bartram's Garden, located in West Philadelphia, is North America's oldest surviving botanical garden. Their attendance is expected to double in the next year due to the expansion of Schuylkill river trail. Bartram's Garden has contacted Drexel University and asked us to engineer a technology that will aid their staff in managing this additional load. Our solution is a self-guided tour application. This smart phone app will enable visitors to explore the gardens on their own while allowing staff to focus on interacting with the public where it is most effective. To ensure it's lasting effectiveness, the self-guided tour application is built upon a platform that will allow administrators to easily manage content and grow with the facility.

ECE-30
THE DREXEL RIDE

Advisors: Dr. Paul Diefenbach, Dr. Yon Visel

Team:

Jason Dichter	Mechanical Engineering
Lingke Li	Electrical Engineering
Kavan Smith	Electrical Engineering
Fuyin Tu	Electrical Engineering

The Drexel Ride was a former amusement park 3 degree of freedom (DOF) hydraulically powered motion ride and has been transformed into a research platform housed on Drexel's campus. The original set-up offered operators no formal way to control the individual hydraulic actuators. This group used advances from previous groups such as utilizing a LabVIEW interface connected to a CompactRIO motion controller, which allowed operators to have direct control over each degree of freedom on the ride. In addition, we added the safety protocols that the original gaming platform had prior to being donated, and reducing jitter on both open and closed loop systems. The machine will now stop moving if it detects that the actuators have moved past preset limits, or if any of the safety protocols (such as seatbelt and door sensors) have been tripped. The machine has been tested to ensure that it meets all of the previous benchmarks in terms of ride dynamics and safety.

ET-01
HYBRID WIND AND SOLAR POWERED OUTDOOR LIGHTING KIT

Advisors: ***Dr. Irina Ciobanescu Husanu, Dr. Michael Mauk***

Team:

David Clark	Engineering Technology
Adrian Kretschmer	Engineering Technology
Ryan Martin	Engineering Technology
Jose Batista	Engineering Technology

On a global scale in this day and age, a new movement has come about focusing on green technologies. By observing this movement and its intentions, we saw the opportunity to produce a hybrid wind and solar kit that attaches to a light post for off the grid power. The build focused on five key areas: the turbine, the generator, the battery, the photovoltaic (PV) panel, and the control units. The main objective is to design and develop a combined Darrius and Savonius turbines combined with PV unit that would power a street light. We used a Bach style blade design would for the Savonius turbine due to its high efficiency amongst other Savonius turbines by creating a small nozzle as the air that passes through its open center and using its dispersion as a counter force of the drag on the blades. As for the Darrius, it was determined that the most optimum design for the needs of the project was the NACA 0012 style blades. These blades offer a power of 21.64 Watts to be used for the rotation of the turbine setup.

ET-02
THE ELECTRONIC FORTEPIANO

Advisors: ***Dr. Warren Rosen, Dr. Yalcin Ertekin, Dr. Luke Abruzzo***

Team:

Brett Davis	Engineering Technology
Michael Cassidy	Engineering Technology
Bruno Diallo	Engineering Technology

The fortepiano was the instrument on which the great classical piano works of the late 18th century were composed. The instrument delivered a tone distinctive from its modern counterparts. The keyboard would feel incorrect to a modern pianist due to its short key travel, smaller keys, and fewer octaves. Modern reproductions of the fortepiano do exist, but at substantial cost to the customer (~$60,000). Our project is aimed at building an electronic version of the instrument that will reduce cost as well as be more maintainable. The challenges of building such an instrument include accurately recreating the feel of the keyboard and the sound of the instrument. We designed an electronics system that connects the physical keyboard to the sound production stage and develop a sound system that will accurately reproduce the sound of the original instrument. To reproduce the proper feel for the keyboard we recreated most of the actual physical mechanics of the keys. Our electronics system utilize individual microcontrollers per key to measure the velocity and send the resulting signal to the sound production stage.

ET-03
FORCE DATA COLLECTION ORTHOPEDIC INSERT

Advisors: ***Dr. Michael Mauk, Dr. Jay Zemel, University of Pennsylvania***

Team:

Travis Elwood	Engineering Technology
Earl Gripton	Engineering Technology
Gregory King	Engineering Technology
Carena Pineda	Engineering Technology

The objective of this project was to design an affordable foot analysis unit that is capable of measuring the forces subjected on the feet. There are numerous running related injuries that affect each area of the lower body. This unit would be used to assist in the study of the correlation between the adolescent physical activity and bone growth. As well as give sports medicine doctors a cheap, but reliable alternative to analyzing running patterns for adults. The outcome of this project is a fully operational, and cost effective, force analysis unit that show the forces developed by a child at play or of an adult. The force is measured using Tekscan flexforce force sensitive resistors. The main focus of using this device is for pediatric research and to assist sports medicine doctors with adults and their injuries.

ET-04
PORTABLE POWER SOURCE USING MICRO DIRECT METHANOL FUEL CELL

Advisors: ***Dr. Irina Ciobanescu Husanu, Dr. Michael Mauk***

Team:

Matthew Clark	Engineering Technology
Kreshnik Furxhiu	Engineering Technology
Joseph Neily	Engineering Technology

With current portable battery technology, we can go longer than ever before without having to "plug in." This allows us to work longer and increases productivity. In spite of all advances made, the current state-of-the-art lithium ion battery packs on the market lack the capacity we as a society demand. The main objective of our project was to work on a micro direct methanol fuel cell proof-of-concept and develop a working prototype of a novel portable power unit. The proof-of-concept was adapted and modified to achieve a 30% higher energy when compared to competitive designs. We developed an assembly of 20 micro-fluidic fuel cell system incorporating an "evacuated system". Such a system will allow for easier transportation of the assembly while reducing the number of electronic components within. Additionally, a pump for the fuel and catalyst would not be needed being substituted with a vacuum waste tank to induce fluid flow within the system.

ET-05
AUTONOMOUS SOLAR POWERED VEHICLE

Advisors: ***Dr. Richard Choiu, Dr. Yalcin Ertekin***

Team:

Kingston Lee	Engineering Technology
Aurel Mathews	Engineering Technology

This project aims to design, build, and test an autonomous solar powered ground vehicle. The vehicle was developed based on a customized remote control car whose steering and acceleration was controlled autonomously using an Arduino microcontroller. The vehicle is capable to drive to preset destinations using a GPS receiver module and a compass to navigate to waypoints until the destination is reached. The vehicle is powered using a lithium polymer (LiPo) battery that is recharged using solar panels. A maximum power point tracking (MPPT) solar charger was be used in between the panels and the battery in order to provide the maximum charging current to the battery that it is able to safely handle. A Bluetooth module was used to allow for wireless communication between the vehicle and an Android smartphone.

ET-06
AUTOMATED GREEN ENERGY SOLAR HEATING

Advisors: ***Dr. Richard Chiou, Dr. Irina Ciobanescu Husanu***

Team:

Zachary Heino	Engineering Technology
Keith Hess	Engineering Technology
Mohammed Said	Engineering Technology

The overall objective of this design project is to modify a previously constructed heat exchanging solar collector system for implementation in the effective heating of a farming greenhouse. This system is comprised of an evacuated tube and a flat panel solar collector both attached to a hot water tank heat exchanger for maximum efficiency. Having two different solar collectors present with varying ideal operating conditions enables the unit to operate effectively under changing environmental conditions in the North Eastern Region of the United States. A control system is designed to actively monitor the thermal energy transferred to the fluid from both solar collectors and allows the fluid to flow through the most effective heat exchanger using electronically activated pumps. The second stage is the solar collector system connection to the greenhouse for ideal effective heating. The control system is specifically designed to actively monitor soil temperatures with the use of a thermocouple sensor all the while maintaining ideal greenhouse conditions by pumping heated fluid through coils underneath the soil surface. The addition of this active feedback control system is to maximize the energy transfer from each panel with minimal energy loses. The purpose of this project is to replace an expensive energy existing systems for heating a greenhouse with an alternative sustainable solar heating design. The outcome of this undertaking is the successfully incorporation of the heat exchanging solar collectors as the exclusive energy input required to heat the greenhouse system in order to decrease farming costs, expand the profitability of fruit and vegetable harvests, and decrease the environmental impact of greenhouse heating.

ET-07
REMOTE ENVIRONMENTAL MONITOR

Advisor: ***Dr. Michael Mauk***

Team:

Tremayne Baylor	Engineering Technology
Algeron Johnson	Engineering Technology
David Marguglio	Engineering Technology

Weather stations are placed in remote locations around the world to gather weather data and they are battery powered. This may be a problem if the station is placed in a remote area. This is why there is a need for a weather station, which uses renewable energy as a back-up power source. Another issue is related to the ability to send data via a wireless network at large distances. Our rain gauge is an atmospheric testing station: is a stand-alone, portable, self–charging, weather-resistant measurement system, powered by a 12V maintenance-free battery that will be recharged by solar and wind power generation through a photovoltaic module and an anemometer wind speed generator. The weather station uses an Arduino microcontroller along with sensors to detect and log: PH of rain water, local temperature, rainfall precipitation, humidity, wind speed, and a GPS locator. It also has potential to be upgraded with additional sensors if required. It has onboard Flash memory for storing received and calculated past and current data. The weather station does contain an RF transmitter to send compiled data to a central location. The Rain-gauge should be practical and economical for most budgets.

ET-08
SENSOR FOR IMPACTS CAUSING HEAD TRAUMA

Advisor: ***Dr. Michael Mauk***

Team:

Tamra Duke	Engineering Technology
Maxx Kehoe	Engineering Technology
Qayum Malik	Engineering Technology

Many people sustain traumatic brain injury (TBI) at some point, and to some degree, within their lifetime, but some people might not even be aware that they have. Our objective is to manufacture our design for the microfluidic chip that will be capable of signaling that rotational acceleration of large magnitudes has occurred in the human head. A microfluidic chip was designed to sense and identify traumatic head injuries through the use of rotational accelerations in the head during traumatic events. The microfluidic chip includes an indication system that will identify when a particular threshold for rotational acceleration is exceeded. This device will allow appropriate officials to respond in the event of an injury and help that person seek medical attention if needed. The device will be easily mountable to any user by means of adhesives or headbands to secure it in place. The design is based on microfluidics using dyed fluid as the indicator and acrylic as the structure of the chip. This will be a one-time use chip that will be easily disposable after the threshold is surpassed. A testing method, through the use of a stepper motor system, is being designed and built to easily and quickly test the rotational acceleration, which will accurately represent a diffuse axonal injury.

MSE-01
DEVELOPMENT AND CHARACTERIZATION OF CURRENT AND NEXT-GENERATION CORROSION-RESISTANT, MECHANICALLY STABLE ALUMINUM ALLOYS FOR LIGHTWEIGHT NAVAL SHIPS

Advisor: ***Dr. Mitra Taheri***
Mentor: ***Daniel Scotto D'Antuono***

Team:
Yan-Chun Liu Materials Science and Engineering

Due to its good formability, weldability, and inherent corrosion resistance, the US Navy uses 5000-series aluminum alloys extensively in its lightweight combat ships. Aluminum-magnesium alloys are, however, susceptible to sensitization at low temperatures, which ultimately leads to stress-corrosion-cracking, costing the Navy $millions to resolve. Remediation heat treatments have been developed to obtain improved corrosion resistance. AA 5456-H116 samples were remediated and subjected to Nitric Acid Mass Loss Testing (NAMLT). Microstructural analysis was performed using an FEI XL30 ESEM together with Orientation Imaging Microscopy (OIM). Fatigue testing, in conjunction with OIM, was also used to characterize the crack propagation behavior within the microstructure. Finally, microhardness testing was performed to confirm whether the remediation treatments were successful. NAMLT confirmed that more frequent remediation cycles lowered the corrosion resistance while microstructural analysis indicated that crack propagation generally preferred more strained grains with a {111} orientation.
Sponsor: Naval Surface Warfare Center (NSWC), Carderock Division

MSE-02
SYNTHESIS OF BIORESPONSIVE HYDROGEL FOR ON-DEMAND DELIVERY OF THERAPEUTICS

Advisor: ***Dr. Hao Cheng***
Mentor: ***Dr. Junjie Deng***

Team:
Christopher Eble Materials Science and Engineering
Nrupen Zaver Materials Science and Engineering

Chronic wounds affect millions of patients each year. With rising chronic illnesses, wounds, and cost of healthcare a smarter drug delivery system needs to be synthesized to better control the biological cascades associated with wound care. By releasing therapeutics as needed, triggered by enzymes released during the natural healing cascade, wound care patients can receive improved care by helping maintain biologically necessary levels of key biological factors while additionally reducing the probability of overdoses. To achieve this goal, a bulk hydrogel consisting of dextran-glycidyl methacrylate and polyethylene glycol was synthesized at varying ratios to control the size of the hydrogel mesh and ultimately the diffusion of enzymes and therapeutics. The rheological properties and protein release of the hydrogel have been measured. Using this delivery platform, bio-responsive nanoparticles were encapsulated to regulate different biological cascades, with release only occurring when specific stimuli were present.

MSE-03
RANDOM NON-WOVEN FIBER COMPOSITES FOR SPINAL CORD INJURY REPAIR: MECHANICAL, CHEMICAL STABILITY, AND REACTIVE PROPERTIES

Advisor: ***Dr. Caroline Schauer***
Mentors: ***Reva Street, Chelsea Knittel***

Team:

Derek Chaleun-Aloun	Materials Science and Engineering
Tiffany Liao	Materials Science and Engineering

The spinal cord is a complex part of the human body that plays a vital role in the transmission of impulses between brain and body. Damage to the area can be detrimental to sensory and motor skills. Current treatments aim to halt further damage to cells in the spinal cord and promote regrowth. Promoting cell regeneration involves implanting scaffolds (combined with other treatments) that provide the cells with a substrate to grow on. Over time, the scaffold will degrade *in vitro* allowing new cells to take its place. Electrospun composites of gelatin and hyaluronic acid have the potential to be used to create these scaffolds. Before the composite can be used, the mechanical and chemical properties need to be studied to verify its ability to support the applied loads and ensure biocompatibility. Crosslinking the nanofibrous mats has resulted in an improvement in the mechanical properties as well the chemical stability.

MSE-04
POLYMER STRUCTURE CONTROL IN 3-D PRINTING

Advisors: ***Dr. Christopher Li, Dr. Antonios Zavaliangos***
Mentor: ***Dr. Shijun Wang***

Team:

Janette Danella	Materials Science and Engineering
Jared Ely	Materials Science and Engineering
Emma Foley	Materials Science and Engineering
Emily Krantz	Materials Science and Engineering

Over the last few years, 3-D printing and Fused Deposition Modeling (FDM) have gained considerable press and an expanded user base as printers have become smaller and more affordable. FDM allows for controlled printing of complex polymer-based structures that can be used in many applications including scaffolds for semi-conductors and biomedical applications. The high strength and low density of these structures are ideal for many applications, but the relationship between printing conditions and mechanical properties has yet to be identified or controlled. This project aims to better understand the capabilities of the *Makerbot Replicator 2* 3-D printer and to determine the mechanical and morphological properties of bulk samples. Tensile testing of filament-filament adhesion and along the fibers showed variations due to the tolerances of the machine. Bulk samples showed possible sintering within 3-D printed PLA.

MSE-05
FRACTURE TOUGHNESS & DUCTILITY OF PRESSED PHARMACEUTICALS

Advisor: ***Dr. Antonios Zavaliangos***
Mentors: ***Sean Garner, Jovana Radojevic***

Team:

Nick Fabritiis	Materials Science and Engineering
Xuefei Li	Materials Science and Engineering
Pete Palena III	Materials Science and Engineering
Rob Walls	Materials Science and Engineering

Pressed powder compacts are important in the pharmaceutical industry, accounting for 80% of oral pharmaceuticals. The fracture toughness (K_{1c}) of materials used in pressed pharmaceuticals needs to be determined to improve tablet survivability. Tablets typically comprise weak, brittle materials, not easily formed into standard specimens for K_{1c} testing. The goal was to evaluate methods of determining K_{1c} - 3-point bending, chevron notch testing, compression of disks with a through slit, and annular ring compression - for accuracy, reliability and usability.
Results showed that chevron notch testing was unsuitable, and compression of a slotted disk was impractical due to the difficulty of machining a center slit. Three-point bending could be used, but the samples were too large for industrial use and would need to be miniaturized. Smaller beams have been used to determine K_{1c}, so 3-point bending is a viable option. Annular ring compression can also be used with few sample preparation concerns. Rate and geometry dependencies for annular ring compression are still being evaluated.
Sponsor: Merck

MSE-06
CORRELATING GAMMA PRIME MISMATCH OF MODIFIED ALLOY 925 COMPOSITIONS TO MECHANICAL STRENGTH

Advisor: ***Dr. Mitra Taheri***
Mentor: ***Matt Hartshorne***

Team:

Emily Holcombe	Materials Science and Engineering
Jacob Horejs	Materials Science and Engineering

Development of new alloys may take years owing to the vast number of possible compositions, heat treatments, and need for validation of mechanical properties. Nickel-based superalloys often have a strengthening mechanism such as γ' $Ni_3(Ti,Al)$ for Alloy 925, an alloy widely used in the oil and gas industry. Through the use of electrolytic extraction and X-Ray Diffraction the γ' phase was isolated and the lattice mismatch parameter between the gamma prime phase and matrix was calculated. The process varied the Al/Ti content and heat treatments of Alloy 925 to observe how these changes affected the lattice parameter. The mismatches were then compared to results from mechanical testing performed by Carpenter Technology to observe any correlation between mismatch and mechanical strength. Results indicated that the sample with an Al/Ti ratio of 0.5 had the smallest mismatch and the greatest strength.
Through such understanding of the role of the γ' strengthening mechanism, future work by Carpenter's R&D team can be expedited by narrowing the scope of potential new alloys to focus on.
Sponsor: Carpenter Technology Corporation

MSE-07
BREATHALYZER CARD: TAKING CURRENT BREATHALYZER TECHNOLOGY AND APPLYING IT TO A WALLET-SIZED DEVICE

Advisor: ***Dr. Wei-Heng Shih***
Mentor: ***Cheng-Hsin Lu***

Team:

Eric Angell	Materials Science and Engineering
Evan Shillington	Materials Science and Engineering

According to Mothers Against Drunk Driving (MADD), 28 people die every day and someone is injured roughly every 2 minutes due to drunk driving related incidents. The economic impact equates to nearly $200 billion a year. In order to deter intoxicated people from driving a new dynamic solution has been developed: the Breathalyzer Card. This new device will not just provide a level intoxication, but instead exhibit a dramatic color change when the user is over the legal driving limit of 0.08 blood alcohol content (BAC). The card uses a unique combination of materials that are absorbed by a specially developed paper cell. If the user is over 0.08 BAC the card will change color from orange to green within a few minutes and inform the potential driver that he/she should not get behind the wheel. The larger amount of alcohol present in the user's breath the faster the color change occurs.

MSE-08
DEVELOPMENT OF AN ENVIRONMENTALLY SAFE WAY TO REMOVE SILVER PLATE FROM LOW ALLOY STEEL WITHOUT HARMING THE BASE MATERIAL

Advisor: ***Dr. Ekaterina Pomerantseva***
Mentor: ***Bryan Byles***

Team:

Kelly Leonard	Materials Science and Engineering
Adolfo Urrutia	Materials Science and Engineering
Qimin Zhang	Materials Science and Engineering

The objective was to develop an environmentally friendly technique for the removal of silver-plating from low alloy steel without harming the base material. Three different types of stripping were investigated. Chemical candidates included non-toxic solutions of sodium thiosulfate and iodine. Electrochemical methods included techniques with sodium thiosulfate and dimethylformamide (DMF) as the solution electrolytes. Mechanical methods were also employed in which the stripping media was varied to compare glass beads and angular acrylic media.
Samples of two types of silver plated low alloy steel (AISI 4130 and AISI 4340) were subjected to each stripping method; their effectiveness was evaluated based on the effects on the material. Surface topography and chemical composition were determined using optical profilometry, scanning electron microscopy, and electron dispersive spectroscopy to determine the most desirable technique. The samples exhibiting the least change in surface roughness and chemical composition of the base material will be considered the most suitable technique.
Sponsor: The Boeing Company

MEM-01
SUSTAINABLE DEVELOPMENT FOR RURAL THAILAND: IMPROVED RICE PLANTER

Advisor: Dr. Alexander Moseson

Team:

Michael Crouse	Mechanical Engineering
Christopher Holzer	Mechanical Engineering
Justin Petronglo	Mechanical Engineering
Jacob Schottman	Mechanical Engineering
John Van Zelst	Mechanical Engineering

The subsistence farmers of Bo Klua, Thailand cultivate rice on steep, rocky slopes with strict time constraints, using primitive tools. In response, since 2009, the SEED Lab (Sustainable Engineering & Entrepreneurship for Development) has co-developed sustainable planting and weeding methods with a local field partner, the SDRF (Sustainable Development Research Foundation). The key problems with current farming approaches are musculoskeletal pain, low efficiency, and low crop yields. Work has been accomplished to advance previous teams' designs for two devices, which address all three problems and can be manufactured locally and affordably: a rice planter (4th iteration) and a weeding tool (2nd iteration). Areas of improvement included manufacturability, durability, actuation speed, and many more. The new design iterations were field-tested in Thailand in Spring 2015, with the final deliverables being two tools that the SDRF can adapt, produce locally, and sell to the farmers of Bo Klua.
Sponsor: Bill and Melinda Gates Foundation

MEM-04
MINIATURE PONTOON BOAT FOR BASS FISHING

Advisor: Dr. John Lacontora

Team:

Joe Estel	Mechanical Engineering
Lulu Huang	Mechanical Engineering
Nick Manigrassi	Mechanical Engineering
James Tolan	Electrical Engineering
Kevin Walker	Electrical Engineering

As the economy and technology develops, human's awareness of protecting the environment has been increased accordingly. With respect to the aquatic environments management, state regulators have replaced new regulations about watercraft building and operating. Fishing on the freshwater rivers and lakes has become extremely difficult for amateur fishermen who fish from a boat. Using Pennsylvania and New Jersey as examples, most lakes and ponds are now restricting the use of fuel powered boats and require large registration fees for boats over 10 feet in length. The goal of this project is to conceptualize, design, and fabricate a pontoon bass boat that meets the 10 feet regulation and runs off a battery rather than a gas motor. CAD and FEA analysis of our design will allow us to find the best way of designing the compartment of the boat and balancing the boat with the weight of the motor, batteries, and passengers so that at no point will the boat flip over. The final outcome of the project would be an environmentally friendly well-designed bass fishing boat that meets all the state regulations and runs freely on the freshwater in PA and NJ.

MEM-05A
LEADER/FOLLOWER CONTROL OF A ROBOTIC TRANSPORT SKID

Advisor: ***Dr. John Lacontora***

Team:

Daniel Bonner	Mechanical Engineering
Thomas Quinn	Biomedical Engineering
Joseph Rivera	Mechanical Engineering
John Trefz	Mechanical Engineering
Stephen Yost	Mechanical Engineering

The goal of this senior design project is to design and prototype the control system for a robotic-assisted weapons transport skid capable of moving through tight passageways and having the ability to avoid obstacles. The current weapons skid requires four sailors to operate moving the necessary ammunition from its original storage point to final destination. The projects intension aims to increase the efficiency and reduce the manpower necessary to move the weapon transport skid aboard an aircraft carrier. The primary stakeholder (NAVAIR) has allocated $2,500.00 to assist in the development of a prototype that would meet these requirements and be constrained to the dimensions and kinematics of the MHU-191. The secondary stakeholder (Doctor John Lacontora) has allocated an additional $500.00 to assist with the development. Based off the decision matrix, a Pixy CMUcam5 will work with a RPLIDAR Laser Scanner on a RC vehicle to carry out the objectives.
Sponsor: Naval Air Systems Command

MEM-05B
LEADER/FOLLOWER CONTROL OF A ROBOTIC TRANSPORT SKID

Advisor: ***Dr. John Lacontora***
Co-Advisors: Dr. Thomas Chmielewski, Dr. Harry Kwatny

Team:

Timothy Banks	Mechanical Engineering
Benjamin Campbell	Mechanical Engineering
Simone Osuji	Electrical Engineering
David Redington	Electrical Engineering
Michael Squillace	Electrical Engineering

On aircraft carriers, weapons and ammunition are delivered to aircraft using a crew of 4-6 sailors who load a MHU-191 weapon skid. The skid is manually pushed from the weapons bay to the aircraft. This project entails the design of a control system capable of providing the weapon skid with autonomous control that allows it to follow a human through the passageways of an aircraft carrier to the aircraft, detect and avoid obstacles, and deal with loss of line of sight of the leader. This system will provide the Navy with a control methodology that could help them limit the manpower required to operate the weapon skid and hopefully streamline their current weapons transport process. To prove the effectiveness of the control system designed, it has been modeled on a scaled version of the skid with a Raspberri Pi and Arduino working in conjunction with video and ultrasonic sensors.
Sponsor: Naval Air System Command, Lakehurst

MEM-06A
JERSEY SHORE LIGHT HOUSE-STRUCTURE TEAM

Advisor: ***Dr. John Lacontora***

Team:

Derek Lavigne	Architectural Engineering
Aakash Modi	Architectural Engineering
Darshan Patel	Mechanical Engineering
Chris Stokes	Mechanical Engineering

After a decade of economic decline and recent hurricane damage, the small bayside town of Fortescue, NJ was in need of a tourist destination. This completed project will provide the town with a landmark to increase tourism and provide an additional revenue stream to the local economy. The stakeholders include the site owner, the residents of Fortescue, Drexel University College of Engineering, and the general public. The 45 foot tall lighthouse dominates the landscape with architecture that calls upon design elements common to other Northeast lighthouses. The use of sustainable design elements was implemented to minimize environmental impact while lowering annual operating costs. The structure is designed to withstand 150 Mph winds and the mechanical systems have been designed to maintain equilibrium with less consumption. The finished space functions as recreational space for guests of the Heritage Bay Front Camping Resort including a small observation deck at the top.

MEM-06B
JERSEY SHORE LIGHTHOUSE - POWER TEAM

Advisor: ***Dr. John Lacontora***

Team:

Ubani Anthony Balogun	Computer Engineering
Stephen Forrest	Electrical Engineering
Stephen Heidengren	Mechanical Engineering
Joseph Musembi	Electrical Engineering
Ankit Patel	Mechanical Engineering

The Jersey Shore Lighthouse Power Team is oriented towards making an implementable and functional prototype design of a solar powered lighthouse-like structure. The proposed design incorporates a semi-mobile solar panel array that supplements the existing external campsite power supply to reduce operating costs. A rooftop frame will actuate to track the sun as it moves throughout the season. The mechanical design utilized 3D modeling software's to draft the mechanical parts and conduct stress analysis distribution considering various parameters affecting the structure. The electrical design integrates the solar power generated with the utility power service while taking into account various codes and standards. A control algorithm is implemented to actuate the solar panel arrays in order optimize solar input and power output. The project is prototyped in order to demonstrate certain features of the proposed design.

MEM-07
THERMAL CONTROLLED GARMENT FOR FIRE SERVICE

Advisor: ***Dr. E. Caglan Kumbur***

Team:

Mario Cefalo	Mechanical Engineering
Harrison Fox	Mechanical Engineering
Adam Nassani	Mechanical Engineering
Sandeep Patel	Mechanical Engineering
Timothy Ruch	Mechanical Engineering

Firefighters risk death on a daily basis. Despite all the protective equipment they wear, firefighters lack solutions to help them mitigate heat stroke and oxygen consumption as their core temperatures rise while fighting a fire. This project sought to create a garment that will regulate the temperature inside a firefighter's suit. The concept chosen to achieve this goal is roughly based on the NASA liquid cooling and ventilation garment used by astronauts. The design utilizes tubing sewn into a cotton shirt to circulate a mixture of water and propylene glycol around the firefighter's core. The liquid is cooled by a heat exchanger as the fluid draws heat away from the person's body. A Raspberry Pi controller was created to turn the heat exchange system on and off depending on thermal suit internal temperature. The garment designed addresses the necessary mobility, durability, and cooling capability concerns for firefighters.
Sponsor: The Boeing Company

MEM-08
UNMANNED AERIAL SYSTEM FOR STRUCTURAL ENGINEERING APPLICATIONS

Advisors: ***Dr. Antonios Kontsos, Dr. Ivan Bartoli***

Team:

Jason Allen	Mechanical Engineering
Luis Castro	Mechanical Engineering
JR Donovan	Mechanical Engineering
John Swearer	Electrical Engineering
Maria Tabbut	Mechanical Engineering

The rapidly declining infrastructure in the United States poses many problems for the general public and governmental organizations; such as the Federal Highway Administration, and local Departments of Transportation. Inspections needed to maintain this vital infrastructure can be a dangerous process and infrequent, typically only preformed every two years. The solution developed was a redundant autonomous UAV system to perform automatic infrastructure inspection. An autonomous vehicle can efficiently and safely perform these time-consuming inspections multiple times a year, with little manpower and training. The system was designed as a turn-key system, allowing for interchangeable modular payload components for different mission parameters. This project was specifically focused on the physical design the aircraft and integrated systems and has been coupled with on-going work done in computer based analysis and machine learning systems. This amalgamation of UAV and analysis systems created a fully integrated system capable of fully autonomous infrastructure inspections.
Sponsor: Piasecki Aircraft Corporation

MEM-09
COMBUSTION ENGINE TORSIONAL VIBRATION ISOLATION

Advisor: Dr. Bor-Chin Chang

Team:

Mitchell Barish	Mechanical Engineering
Tok Lau	Mechanical Engineering
Sean Rodeheaver	Mechanical Engineering
Brian Silvestri	Mechanical Engineering
Jose Uzcategui	Mechanical Engineering

Damping torsional vibrations generated by internal combustion engines is important in order to aid in reducing vehicle drivetrain fatigue, as well as reduce noise, vibration, and harshness (NVH). The outcome of this project was a mathematical model in MATLAB/Simulink that allows the end user to more quickly and effectively design a torsional vibration isolator/damper for various common engine layouts. A physical testing apparatus was developed with a single-cylinder, 4-stroke DuroMax XP4400E generator in order to validate the model. A vibration isolator/damper was designed that adds a degree-of-freedom to the system and allows for modifications to test different damper inertias and spring rates. Testing of the engine with several inertias and spring rates allowed the model to be validated across a range of values for input parameters. Our sponsor Pratt & Miller Engineering is planning to use this model within multiple industries, including the Defense, Automotive, and Motorsports industries.
Sponsor: Pratt & Miller Engineering

MEM-10A
MOMENT ARM PROPULSION SYSTEM (MAPS)

Advisors: Dr. Ajmal Yousuff, Joe Kujawski

Team:

Nicholas Amanatides	Mechanical Engineering
James Kominick	Mechanical Engineering
Edmond Mak	Mechanical Engineering
Christopher Rugbeer	Mechanical Engineering
Kyle Santos	Mechanical Engineering

Current CubeSat missions that require precise pointing scenarios, such as Earth imaging, often require reaction wheel assemblies (RWA) for active attitude control. Consequently, the RWAs become saturated with angular momentum and require a desaturation process in which a secondary system is required to compensate for the dispensed momentum. Magnetorquers offer the most compact and lasting solution for low-Earth orbit missions, however their requirement of a surrounding consistent magnetic field deems them unusable during extraterrestrial CubeSat missions. The goal for the proposed Moment Arm Propulsion System (MAPS) was to expand the capabilities of attitude control systems for a 3U Mars-imaging CubeSat mission. The vision behind MAPS is that it performs momentum dumping and recharging of RWAs using deployable micro-pulsed plasma thrusters on a 3U CubeSat. A prototype for MAPS was designed and built to show momentum dumping and recharging by using compressed air to represent the secondary desaturation system.
Sponsor: The Boeing Company

MEM-10B
ORIGAMI SOLAR ARRAY FOR CUBESATS

Advisor: ***Dr. Ajmal Yousuff***

Team:

Alex Crain	Mechanical Engineering
Dean Ripley	Mechanical Engineering
Tirthak Saha	Electrical & Computer Engineering
Zach Wilson	Mechanical Engineering

The intention of the Origami Solar Array project, hereafter known as "Sunbird," was to develop a small scale, modular array capable of launching with and operating on a cubesat of standard dimensions. Project Sunbird's goal was to develop this array as a superior alternative to the existing power solution for cubesats (body-mounted panels or telescoping arms). Superiority is achieved via the optimization of size and volume used vs. power generated.

The Sunbird array is attached to cubesats via a small, external space known colloquially as the "hockey puck." Within this small space, a compact deployment system and solar array is stored with minimal usage of available surface area on the craft.

Sponsor: The Boeing Company

MEM-11A
NON-INVASIVE DEVICE TO DETECT PERIPHERAL EDEMA IN HEART FAILURE PATIENTS

Advisor: ***Dr. Alisa Morss Clyne***

Team:

Brian Chau	Mechanical Engineering
Anoop Daniel	Mechanical Engineering
Yousuf Khaled	Mechanical Engineering
Norman Tieu	Mechanical Engineering

Over 1 million hospitalizations occur each year in the United States due to heart failure. The average cost of a heart failure related hospitalization is $23,077, making the cost over $37 billion annually. The primary objective of this project was to design a device to reduce heart failure related hospital admissions through early detection of heart failure exacerbation. The concentration of N-terminal prohormone B-type natriuretic peptides (NT-proBNP) in urine was chosen as the method of measuring the severity of heart failure because studies show that higher concentrations are indicative of more severe heart failure. NT-proBNP is a protein secreted by damaged heart tissue. A lateral flow assay was designed to quantitatively measure the levels of NT-proBNP in a patient's urine. The lateral flow assay was designed to be a cheap disposable device that patients could use in their homes. This design will allow patients to proactively monitor their condition.

MEM-11B
NON-INVASIVE DEVICE TO DETECT PERIPHERAL EDEMA IN HEART FAILURE PATIENTS

Advisor: ***Dr. Alisa Morss Clyne***

Team:

Alexander Davie	Mechanical Engineering
Michael Elmer	Mechanical Engineering
Laurene Milan	Biomedical Engineering
Jamie Schairer	Biomedical Engineering

More than 5.8 million people in the United States suffer from heart failure, with a projected cost of $70 billion by 2030. Heart failure exacerbations often go unnoticed, resulting in patient hospitalization. An early symptom of worsening heart failure is peripheral edema, which is swelling of the ankles and feet. The project objective is to design a device that notifies the patient of a change in ankle circumference. The design process involved testing four major ideas: bioimpedance, conductive fabric, strain gage ankle band, and a knit sock. Bioimpedance and conductive fabric were ruled out in early experiments due to high measurement variability. We then tested the ankle band and sock using a mock ankle fabricated from ballistic gel and pediatric blood pressure cuffs to mimic swelling. We plan to test the device in human patients to determine if it improves heart failure patient health and reduces hospital admissions.
Sponsor: The Boeing Company

MEM-13
ADDITIVE MANUFACTURING OF THE SMART SKELETAL FRACTURE SLEEVE

Advisor: ***Dr. Jack G. Zhou***

Team:

Yujie Chen	Mechanical Engineering
Yifan Fei	Mechanical Engineering
Hongxin Xu	Mechanical Engineering
Xiaohang Zhou	Mechanical Engineering

The objective of this year's senior design project is to provide a new way of supporting fracture bone structure that can fulfill the requirements. During last term, background research, materials searching, basic cast design and different scanner methods the discovery has been done and achieved the schedule. This term, the project is moving forward which should focus on those several topics. The first objective is reevaluating the current project based on collected feedback. Then make the final decision on the materials that are going to use on the cast. The comparison of different materials and more information such as materials' availability around local companies and printing cost will be made. Second, further improvement on the cast design will continue, and the goal is to fit the goal that is to save more materials and a better appearance. Once the cast design is done, mechanical testing will start during the term. Also, another main objective is the 3D scanning design. More comparison based on testing should be done, and the 3D scanning method should be made by the end of this term.

MEM-14
SOCIETY OF AUTOMOTIVE ENGINEERS: AERO DESIGN, BUILD, FLY COMPETITION

Advisor: ***Dr. Ajmal Yousuff***

Team:

David Gatter	Electrical Engineering
Christian Heydt	Mechanical Engineering
Dylan Jervis	Electrical Engineering
Joseph Procida	Mechanical Engineering

The Society of Automotive Engineers holds an annual competition asking participants to design build and fly (DBF) planes using principles and theories learned throughout their educational career. Requirements set by the DBF competition included design constraints, performance necessities, as well as detailed reports and analyses. Stakeholders in the competition were the Drexel chapter of the American Institute of Aeronautics (AIAA), Drexel Space Systems Laboratory, SAE, Drexel SAE Aero Club, external technical design **Advisor**s. The aircraft was designed through a tedious analysis process that proved via calculations that the lift and thrust overcame weight and drag. The group developed and built this fully functional plane capable of performing within DBF criterion and carrying the maximum additional payload of approximately 20 pounds in an internal payload bay.

MEM-15
AUTONOMOUS ATHLETIC FIELD-MARKING ROBOT (HARDWARE)

Advisor: ***Dr. Ani Hsieh***

Team:

Alex Benjamin	Mechanical Engineering
Mike Fink	Mechanical Engineering
Elizabeth Hallman	Mechanical Engineering
Stephanie Teleski	Mechanical Engineering

The process of lining athletic fields is one that has been untouched by the development of autonomous robots. Even today, athletic fields are lined manually and the overall process is inefficient, cumbersome, and prone to human error. In an attempt to solve this problem, a scaled-down (2:1) prototype of an autonomous robot, capable of lining athletic fields, was developed. The prototype consisted of a mobile base, four independently powered wheels (with encoders), an electronically controlled paint sprayer, paint reservoirs, and the requisite control and power systems. This project was completed in conjunction with MEM-16 whose primary role was to develop the overarching navigation algorithms for the robot. The prototype was then used to demonstrate the feasibility of the design and the possibility of using autonomous robots to line athletic fields; this was accomplished by painting arcs, lines, and other fundamental curves that form the basis of athletic fields.

Sponsor: Eaton Aerospace and Mr. Charles Gamble

MEM-16
ATHLETIC FIELD MARKING ROBOT (SOFTWARE)

Advisor: ***Dr. Ani Hsieh***

Team:

Zach Brong	Electrical Engineering
Dreddrick Brown	Electrical Engineering
Daniel Mox	Mechanical Engineering

Advances in technology in recent years have enabled robots to accomplish many tedious tasks that once required manual human labor. Take, for example, the lining of athletic fields, a responsibility of athletic departments and maintenance staff worldwide. To solve this problem a robotic sensing and control framework was developed to handle the localization and path planning necessary to paint a desired stencil. The Asus Xtion Pro Live camera sensor was used along with the PTAM monocular SLAM algorithm to determine the robots position. From this information, a differential drive control algorithm along with a way point manager was created to navigate the robot along the desired trajectory by discretizing the path and regulating the yaw of the robot to a desired value at each point. Using a physical prototype created by MEM-15 and an Optitrack motion capture system, the accuracy of the algorithm was determined to be less than 0.25".
Sponsors: Eaton Aerospace Inc. & Charles Gamble

MEM-17
GIMBAL-ACTUATED VTOL NACELLE (GAVN)

Advisor: ***Dr. Ajmal Yousuff***

Team:

Michael Daily	Mechanical Engineering
Paul Lachaud	Mechanical Engineering
Lauren Nutt	Mechanical Engineering
Andrew Quinn	Mechanical Engineering
Michael Simeoni	Mechanical Engineering

Current small-scale UAVs use RPM controlled steering systems, and have shown a high level of precision in maneuverability. This method of control only functions optimally with fast-response propulsion sources, such as electric motors. Larger propulsion sources, such as turbines, do not have high-speed response times, and thus this cannot be feasibly scaled to large aircraft. Consequently, a new method of flight actuation and control is needed that can achieve comparable maneuverability to existing small-scale UAVs while providing an interchangeable and robust platform for other propulsion sources. A prototype tri-rotor UAV was developed that uses thrust vectoring, eliminating the need for frequent RPM changes. This UAV works independently of the response time of the propulsion source. Thrust is provided by ducted fans housed inside gimbal-actuated vertical-takeoff-and-landing nacelles (GAVNs). This UAV served as a proof of concept that thrust vectoring could produce a stable, controllable aircraft.

MEM-20
AUTOMATED, SMART COFFEE MAKER

Advisor: ***Dr. Nicholas Cernansky***

Team:

Meridith Bienvenue	Mechanical Engineering
Craig Gordan	Mechanical Engineering
Ross Morris	Mechanical Engineering
Dan Noone	Mechanical Engineering

Making coffee every morning is time consuming, laborious, and wasteful using either traditional coffee machines or personal "pod" brewers. This project focused on the design of a coffee maker that, using whole beans, could brew personal cups of coffee with minimal weekly interaction. This smart coffee maker recognizes a user's cup using RFID technology, provides modular storage for varying bean blends, stores enough water to last multiple brews, and only requires weekly manual cleaning. The machine can be programmed using a smartphone so the user could set up an entire week of coffee without touching the machine but to grab the ready to drink cup. Using fine controls to ensure a proper grind of the beans before brewing, a proper temperature of water for brewing, and a self-cleaning mechanism, this machine offers a quality, personal brew that is greener than and similarly priced to leading market competitors.

MEM-23
EVALUATION FOR ALTERNATE MATERIALS FOR MOST RUGGEDIZED COMMERCIAL MOVING CAMERA SYSTEM

Advisors: ***Dr. John Lacantora, Dr. Timothy Kurzweg, ECE***

Team:

Brian DiPaolo	Mechanical Engineering
Pat Garvey	Mechanical Engineering
Ken Hamson	Mechanical Engineering
Junke Tan	Mechanical Engineering
Hao Zhu	Electrical Engineering

Bosch Security Systems MIC 7000 features a cast aluminum frame that is capable of operation in extreme temperature ranges while performing through strong impacts. This team was tasked with redesigning the current model for further expansion into the marketplace. One model made of plastics was less expensive and slightly less robust, reaching customers with requirements that were not as demanding. The second, made of stainless steel, was more applicable to the oceanic environment and focused on solving needs for military stakeholders. Through comprehensive research the team chose the most optimized materials for both versions and redesigned the body of the camera using utilizing Creo Simulate. Design iterations underwent finite element analysis to inspect the behavior with regards to applied stress and thermal energy. The most optimized designs with regards to manufacturing cost were chosen to be prototyped. These prototypes were then tested and evaluated compared to the original.

Sponsor: Bosch Security System Inc.

MEM-24
FLYING DRAGON - 100CC MOTORCYCLE LAND SPEED RECORD

Advisor: ***Dr. John Lacontora***

Team:

Kyle Collins	Mechanical Engineering
Joseph Fornara	Mechanical Engineering
Matthew Klinke	Mechanical Engineering
Michael Smith	Mechanical Engineering

The fourth year of the Flying Dragon Land Speed team has designed and built a motorcycle frame with high aerodynamic qualities in an attempt to break the land speed world record for class A/G-100/2. The team has worked in conjunction with a Drexel alumni, Ryan Miller, to attain this goal. The team has made no changes to the engine or tires, which were both modified in previous years. A pressed aluminum frame was built as well as a new front suspension and rear axle to decrease weight and decrease drag to break the 100MPH record that currently exists.

MEM-25
BINARY REFRIGERANT REFRIGERATOR

Advisor: ***Dr. Bakhtier Farouk***

Team:

Samuel Beccaria	Mechanical Engineering
Abhinav Duggal	Mechanical Engineering
Mathew Smith	Mechanical Engineering
Xiaoyi Zhu	Mechanical Engineering

The project is to design, build, and test a domestic refrigerator using a binary mixture of refrigerants. This concept is motivated by energy savings potential from non-azeotropic refrigerant mixtures. Alternative refrigerants are crucial due to restrictions on the sale/production of substances with ozone depletion potential (ODP), and lower future limits on global warming potential (GWP). While a single fluid remains at constant temperature during constant pressure evaporation/condensation processes, a non-azeotropic mixture at constant pressure undergoes evaporation/condensation processes over a temperature range, called temperature glide. The first phase of this project was to select two refrigerants and optimize the mixture fractions for the refrigerant cycle. Refrigerants R-125/152a were selected based on thermophysical and environmental properties, like GWP and ODP. Constrained Lagrange multiplier methods determined optimized mixture fractions. The performance of the refrigerator charged with the optimized binary refrigerant mixture will be experimentally verified. Project stakeholders include consumers, appliance manufacturers, and government agencies.
Sponsor: The Boeing Company

MEM-26
SUPER-CRITICAL FLOW REACTOR (CO2) FOR CURRENCY NOTE RESTORATION

Advisor: Dr. Bakhtier Farouk

Team:

Calvin Chen	Mechanical Engineering
Jonathan Locco	Mechanical Engineering
Michael Lucidi	Mechanical Engineering
Armando Salome	Mechanical Engineering
Danielle Soghoian	Mechanical Engineering

In 2013, the U.S. Federal Reserve spent approximately $705 million for destroying, reprinting and redistributing banknotes. Supercritical fluid extraction (SFE), commonly used to extract chemicals from organic substances, can be developed as a restoration system for cleaning banknotes to increase the working lifespan. In this senior design project, a supercritical carbon dioxide flow reactor has been designed and manufactured for cleaning soiled bank notes for possible recirculation. A system to obtain supercritical carbon dioxide was created utilizing gas liquid mixture tank, a cold heat exchanger using peltier coolers, liquid pump, and hot heat exchanger using heat tape. Supercritical carbon dioxide (P_{cr}=7.38 MPa; T_{cr}=30.97 °C) was then supplied to a reaction chamber at 10 MPa and 40 °C. The system developed was designed to clean each banknote while maintaining the integrity of security features and all excess CO_2, was vented through an exhaust muffler to the atmosphere.
Sponsor: The Boeing Company

MEM-27
FLOW CHARACTERIZATION FOR NEXT GENERATION POWER PLANT DRY COOLING TOWER

Advisors: Dr. Ying Sun, Dr. Philip Boettcher

Team:

Zachary Busch	Mechanical Engineering
Travis Gehman	Mechanical Engineering
James Raciti	Mechanical Engineering
Christopher Whitney	Mechanical Engineering
Zachary Williamson	Mechanical Engineering

Thermo-electric power plants utilize a working fluid, typically steam, to rotate a turbine which produces power. In order to avoid damaging some components of the plant the steam temperature needs to be reduced, which is done by extracting water from rivers and lakes. The extracted water is then pumped back into the environment which increases the temperature of the lake or river the water was taken from. To avoid this, the project utilizes the latent heat of fusion of a phase change material to cool the working fluid. The specific purpose of this subsection of the project is to model the flow of phase change particles across tube banks of various sizes and spacing to measure the velocities, turbulence, and pressure drop that occur during flow. This base data provides information for a broader scale project that could eliminate external water from being used to cool the working fluid.
Sponsors: Electric Power Research Institute (EPRI), National Science Foundation (NSF)

MEM-28
STATIC ELECTRICITY HARVESTING GENERATOR FOR MEMS DEVICES

Advisor: ***Dr. Moses Noh***

Team:

Ben Nissim	Mechanical Engineering
Mike Annucci	Mechanical Engineering
Kelsey Hannigan	Mechanical Engineering
Brittany Killen	Mechanical Engineering
Roussab Rashid	Electrical Engineering

Portable electronics have become an integral part of everyday life. Many sensors, lab-on-a-chip, and other MEMS devices have been introduced for industrial and research applications. These devices require electrical power, which generally comes from expensive and nonrenewable energy sources. In order to create a new power source for various MEMS devices, a power source harvesting static electricity from human motion was developed. A compact device was developed that uses a free and renewable source of energy, human motion, to power itself. The device also uses inexpensive materials commonly found in MEMS devices to ease fabrication and integration with MEMS devices. This project has successfully produced a new power source that powers micro devices without the use of a battery or external power.

MEM-31
PLASMA TREATMENT OF PRODUCED WATER

Advisors: ***Dr. Young Cho, Dr. Alexander Fridman***

Team:

Myles Buffalo	Mechanical Engineering
Robert Hall	Mechanical Engineering
Eddie Hopper	Mechanical Engineering
Markus Kapfhammer	Mechanical Engineering
Zihao Li	Mechanical Engineering
Tariq Packer	Mechanical Engineering

Hydraulic fracking is a method used by the energy industry to fracture large rocks, allowing for acquisition of shale oil and gas. Along with the recovery of oil and gas is a large reservoir of produced water; a mixture of oil, hydrocarbons, dissolved and suspended solids and inorganic ions. Produced water can be treated and recycled for uses such as enhanced oil recovery techniques or released into freshwater streams. This project explores the treatment of produced water using a gliding plasma arc discharge (GAD). The underlying purpose is to design a plasma reactor that facilitates de-oiling, kills bacteria, softens water, removes suspended solids and inorganic ions (Ca2+ and Na+) to the standard of the EPA in Philadelphia. Deliverables for this project involve analyzing the current design, developing and implementing a new design; this design will provide better product safety and more drastic reduction rates in properties of interest.

MEM-33
AUTOMATED COUETTE VISCOMETER

Advisor: Dr. Young Cho

Team:

Austin Farber	Mechanical Engineering
Richard Hanna	Mechanical Engineering
Matthew Lorenz	Mechanical Engineering
Dan Nguyen	Mechanical Engineering
Michael Sinisi	Mechanical Engineering

Blood viscosity can be correlated with cardiovascular disease (CVD) and other microvascular disorders. In the field of preventative medicine, such a metric can help monitor patient health and detect cardiovascular risk factors. We propose a Couette flow viscometer specifically designed to accommodate non-Newtonian fluids such as blood. Rotation of the inner of two coaxial cylinders, induced via eddy current, is used to measure the torque applied to the shear stress of a fluid trapped between the cylinders' surfaces. By control of a DC motor, a rotating magnetic field will induce the rotation and allow for data collection over a range of low shear rates. This device assists physicians and researchers alike with the option to output specific values or full viscosity profiles. It also enriches the quantitative blood viscosity data currently available, improving the potential to predict the onset of CVD.

MEM-35
IMPACT HELMET PERFORMANCE BY TEAM VIPER

Advisor: Dr. Leslie Lamberson

Team:

Benjamin Banks	Mechanical Engineering
Zorbey Canturk	Mechanical Engineering
Robert Grundy	Mechanical Engineering
Robert Mele	Mechanical Engineering

The objective of this Senior Design project is to fabricate an impact fatigue device for the groups sponsor, Storelli. The purpose of this device will be to test the impact performance of materials used in soccer headgear. The device will be used to help allocate the best materials for Storelli's headgear in order to help prevent head injuries in soccer. It is important to build a cost-effective device that can measure peak forces accurately and consistently. The device will have an air operated piston actuator and a die spring that will project a rod into the material. There will be force sensors reading the impact force on each side of the material. The difference in force readings will show the impact performance of the material. The system will be operated through an Arduino board with Python software and the data acquisition will be collected by Loadstar sensors and software.
Sponsor: Storelli Sports

MEM-36
BAJA SAE: FRAME AND POWERTRAIN FABRICATION AND ANALYSIS

Advisor: ***Dr. Hisham Abdel-Aal***

Team:

Mateusz Dziuba	Mechanical Engineering
Shawn Nichlos	Mechanical Engineering
Joseph Stitt	Mechanical Engineering
Zachary Taylor	Mechanical Engineering

Baja SAE is an annual completion hosted by the Society of Automotive Engineers (SAE), which challenges students from universities around the world to produce performance leading single-seat, all terrain, sporting vehicles. The team developed a complete design for a Drexel competition vehicle, with a proposed two year build cycle. As part of the first year, the team fabricated and tested both the frame and powertrain systems of the vehicle. PTC Creo Parametric was used to model a safe frame which effectively used the frame space. It was manufactured from 4310 steel, TIG welded for maximum strength, and analyzed for potential impact during competition. The powertrain system, consisting of the engine, continuously variable transmission, and differential was assembled and tested for efficiency and performance. During the testing phase, analysis was also performed on the complete design's suspension, using Lotus Cars' Suspension Analysis software, to provide data for future Drexel design teams.

MEM-37
SELF-FOLDING BIOPOLYMER MICROSTRUCTURE: DESIGN, FABRICATION & APPLICATIONS

Advisor: ***Dr. Li-Hsin Han***

Team:

Yiwei Cai	Mechanical Engineering
Matt Crowley	Mechanical Engineering
Aninda Hossain	Mechanical Engineering
Phat Nguyen	Mechanical Engineering
Phuong Nguyen	Mechanical Engineering

Tissue engineering industry grows continually over the past decade, as more than 52 percent of companies profited in the past three years [1]. However, the future development of this field is facing major obstacles. One main challenge is to replicate the micro-topography that cells sense from the native tissues. Current technology, such as hydrogels, porous biopolymers and 3D printing are ineffective at creating such cell-laden constructs; more advanced technology is urgently needed. Here we attempt to achieve such goal by creating self-foldable, cross-linkable structures from biopolymers. These structures would support cell encapsulation while 3D self-folding to mimic the topography of native microenvironments. The self-folding structures will be fabricated by using an inkjet printer customized for patterning biopolymer with cell-sized resolution. Multi-layer biopolymer printing will be used to induce self-folding via the internal stress among layers. Through the project, the team will practice product design, dynamics control and organic synthesis.

[1]http://www.genengnews.com/gen-articles/b-tissue-engineering-b-revenues-rise/4155

MEM-39
QUADCOPTER AND SENSORY SYSTEM FOR RESCUE OPERATIONS

Advisors: Dr. Harry Kwatny, Dr. Bor-Chin Chang

Team:

Matthew Butts	Mechanical Engineering
Erica Fernandez	Mechanical Engineering
Brian Fisher	Electrical Engineering
Cathryn Lankert	Mechanical Engineering
Kevin Rabuck	Mechanical Engineering
Julia Saunders	Mechanical Engineering

The highest priority after a building collapse is locating and rescuing survivors. However, collapsed structures pose many dangers to rescuers and survivors. In order to increase efficiency in locating survivors and rescuers safety, a system was developed to allow rescuers to determine the approximate locations of survivors before approaching the collapse. This system is incorporated with a UAV for mobility, allowing for video and audio surveillance. Unlike other UAVs for this application, this observes the scene from the ground and aerial levels. Ground level observation is achieved by dropping audio recording and transmitting pods known as Data Collection Units (DCUs). DCUs are dropped from the UAV with electro-permanent magnets throughout the site. They capture surrounding noise, namely survivors' voices, and transmit data back to the command post. By recording the location of each DCU, the approximate locations of survivors is determined and results in a more efficient rescue plan.

MEM-40
QUADCOPTER FLIGHT CONTROLS AND AUTONOMOUS NAVIGATION

Advisors: Dr. Bor-Chin Chang, Dr. Prawat Nagvajara, ECE

Team:

Ernest Gregori	Mechanical Engineering
Fengqiao "Ben" Sang	Electrical Engineering
Nicholas Smargisso	Mechanical Engineering
Xuhao "Elbert" Wang	Electrical Engineering

There has recently been an increase in demand for Unmanned Aerial Vehicles (UAV's). Applications of UAV's seem limitless, so that is why our team has decided to design and construct an autonomous flying quadcoptor. The first goal of achieving autonomous flight is attitude control, which allows the quadcoptor to hover. Our team has constructed a mathematical model of the quadcopter which was then used to design a Linear Quadratic Regulator Controller (LQR). To implement the LQR control algorithm our team utilized a nine axis accelerometer, gyro, and magnetometer to collect data about the quadcoptor's position and velocity. The sensor data was then processed by a PSOC5 microprocessor, which applied the LQR control algorithm and adjusted the angular velocity of the motors. One of the benefits of using the LQR control algorithm is its ability to handle unexpected disturbances and still maintain stable and level flight.

MEM-41
PARTIAL WEIGHT-BEARING GAIT TRAINING DEVICE

Advisor: ***Dr. Rahamin Seliktar***

Team:

Melissa Bloecker	Mechanical Engineering
Joseph Capriotti	Mechanical Engineering
Shaneen Dewendre	Mechanical Engineering
Brittany McCray	Mechanical Engineering
David Torres Jr.	Mechanical Engineering

Acquired brain injury often results in impairments to an individual's mobility and ability to support their own bodyweight. Devices that can support a portion of a patient's weight are highly useful in physical therapy with these types of injuries. With funding from Pate Rehabilitation in Texas, the team was tasked with building a working prototype designed to facilitate proper gait motion in order to assist in patient recovery. Market leading weight bearing models cost in excess of $10,000, the group constructed a similar system at a fraction of the cost. After brainstorming many designs, the group developed a mechanical lever pulled by a winch to lift a patient into the upright position. The new design allowed for the patient to be accessed from all sides so physical therapists could more easily assist with the proper gait motion.
Sponsor: PATE Rehabilitation

MEM-43
AUTOMATED WELDING SYSTEM FOR PVC ROOFING MEMBRANE

Advisor: ***Dr. Bor-Chin Chang***

Team:

Tyler Darrah	Mechanical Engineering
Justin Dempsey	Electrical Engineering
Elliot Farquhar	Mechanical Engineering
Joseph O'Brien	Mechanical Engineering
Robert Stricek	Mechanical Engineering

The installation of a flat roof employs fastening together a layer of corrugated steel, rigid foam insulation, and a weatherproof thermoplastic membrane. Initially, adhesive-coated metal plates are placed atop the insulation and fasteners are driven through them to secure the insulation. The membrane is then placed down and secured through a non-destructive bonding process utilizing induction heating to fuse together the metal plates and membrane. Issues arise with bond strength inconsistencies and excess job duration due to the tedious manual nature of existing tools. The senior design team had set out to eliminate these inconsistencies by automating the plate locating and welding processes, thus improving both job quality and customer satisfaction. The senior design team developed a strong, ergonomic, efficient, and cost effective prototype which centered on the non-destructive induction heating system. As critical functions were automated, secondary systems were then integrated to further improve the tools performance and capabilities.
Sponsor: SFS intec

MEM-44
HIGH HEAT FLUX THERMAL MANAGEMENT DEVICE FOR ELECTRONICS COOLING

Advisor: ***Dr. Matthew McCarthy***

Team:

Siri Feinberg	Mechanical Engineering
Ernest Jordan	Mechanical Engineering
Joe Rugama	Mechanical Engineering
Robert Schwalbenberg	Mechanical Engineering
Andrew Staudt	Mechanical Engineering

Processor integrated circuit chips are used in electronics, computer hardware, and military applications. As they become smaller and more powerful, current methods of cooling are no longer sufficient. The objective of this project was to develop and optimize a compact and robust phase-change, closed-loop cooling system to meet the growing demand for heat removal in high heat flux electronic applications. The primary stakeholder, L-3 Communications, required such a system to remove a total of 400W from four integrated circuit chips utilizing two-phase flow with a power consumption limited to 20W. A manifold micro-channel heat exchanger (MMHE) was found to best suit stakeholder needs. Several MMHE systems were designed, built, and tested in order to determine and verify optimal dimensions that removed sufficient heat from the system in a rugged test environment. A final, proof-of-concept prototype was then constructed using analysis and experimental data. The prototype successfully removed the required heat.
Sponsor: L-3 Communications

MEM-45
FLAGELLAR FOREST FABRICATION

Advisor: ***Dr. MinJun Kim***

Team:

Taoufik Daadi	Mechanical Engineering
Narayan El	Mechanical Engineering
Emily Mirizio	Biomedical Engineering
Jennifer Muller	Biomedical Engineering
Nay Shah	Mechanical Engineering

Flagellar filaments from a number of bacterial species undergo polymorphic transformations when subjected to external stresses or changes in environmental stimuli, such as temperature, pH, and ionic strength. This project aimed to fabricate a substrate of arrayed flagella, termed a flagellar forest, for the purpose of investigating the material's bio-enabled sensing and actuation properties. The biomaterial was constructed through the extraction of flagellum from cultured *Salmonella Typhimurium* bacteria, which were then bound to a substrate, in high concentrations, to harness their stimuli responsive properties. The group designed a mircofluidic device to test out this biomaterial under different pH levels and different temperatures to study collective autonomic response of flagella. Results were obtained using microscopy methods that enabled detection of the changes in polymorphic form, as environmental conditions were altered. The group developed a fully functional flagellar forest that was able to sense and react to changes in its environment. This prototype will help advance the field of biomechanics and microfluidic sensors.

MEM-46
DESIGN OF A MICRO-AUTONOMOUS UNDERWATER VEHICLE

Advisor: ***Dr. M. Ani Hsieh***

Team:

Gregory Gorman	Mechanical Engineering
Anthony Scholl	Mechanical Engineering
Mark Walush	Mechanical Engineering
Joseph Wayne	Mechanical Engineering
Robert Zielinski	Mechanical Engineering

With help from the Drexel Scalable Autonomous Systems Laboratory, we are designing an underwater, autonomous vehicle that distinguishes itself by holding a centimeter scale and being entirely tetherless. The vehicle will be used to validate underwater monitoring and sampling strategies in a laboratory environment through the use of on-board sensors. This vehicle provides a cheaper solution for proof-of-concept assessment compared to expenses associated with full-scale vehicles.

A planetary vehicle design is proposed to achieve strict size constraints that drive the application of the project. The vehicle is composed of three concentric, hollow spheres. The first houses all electronics and essential peripheral sensors. Each subsequent shell is designed to provide motion control of the vehicle. This is achieved through the presence of a gear train along the equator of the inside of each shell. Through the use of a motor, these shells are able to rotate and position an external propeller.

Sponsor: Drexel Scalable Autonomous Systems Laboratory

MEM-47
3D PRINTING MACHINE FOR HETEROGENEOUS MATERIAL PRINTING APPLICATIONS

Advisor: ***Dr. Jack Zhou***

Team:

Larry Ding	Mechanical Engineering
Jian Li	Mechanical Engineering
Kayode Oluwu	Mechanical Engineering

In the past decades, engineers have had a great achievement in 3-D printer technology. Even some bio-medical structure 3-D printing technique has be developed to help those who are suffering from physical disability and organ function problem. This project focuses on designing a multiply nozzles heterogeneous 3-D printer. This 3-D printer should be able to print both heterogeneous and general filament material at the same time but with low cost, because of which, the usage of this printer is more wild and affordable compare to other bio-medical 3-D printer that already exist. The system has two main parts, the printer and PC. First, the structure is created as a SLT file via CAD software and coverts into G-code on PC. The controller on the printer controls two nozzles by three-axis motors and material extrusion base on the G-code to produce the structure. The challenges are nozzle design, G-code programming and system feasibility.

MEM-48
IRON GRANNY

Advisor: ***Dr. Rahamim Seliktar***

Team:

Mark Bovich	Mechanical Engineering
Sungwook Hwang	Mechanical Engineering
Oren Kanel	Mechanical Engineering
Paul Mehan	Mechanical Engineering

The walker that the team developed addresses the problem of creating a walker which increases the level of independence of senior citizens, disable veterans, and people who are handicapped. The main stakeholders for the project were University of the Sciences Physical Therapy Department, Drexel University, Caldwell Therapy Center, Maria Tadros, Mechanical Technologies, users addressed above and the team members. The problem was addressed by analyzing existing products and markets, and speaking with experts in the physical therapy field which resulted in a concept that would lead to a final product. The system that was used in the final design were the gas springs because they allowed for the greatest power combined with the lowest cost and great damping characteristics. This allowed for the final desired outcome of a system with minimal weight, minimal cost, and maximized maneuverability. The project was able to showcase the team's combined knowledge of statics, mechanics, dynamics, fabrications, 3D/2D design and project management.

Sponsors: Maria Tadros – Beneficiary, Caldwell Therapy Center – Supplier, Mechanical Technologies – Supplier
Boeing Grant, University of the Sciences Physical Therapy Department – Subject Matter Experts

MEM-49
AUTOMATED DRINK DISPENSER

Advisor: ***Dr. Bor-Chin Chang***

Team:

Nicholas Halas	Mechanical Engineering
Will Hardie	Electrical Engineering
TJ Markham	Computer Engineering
Nicholas Tannahill	Mechanical Engineering
Chris Weincek	Mechanical Engineering

The bar industry relies on fast, accurate service to maximize profits. The Automated Drink Dispenser (ADDi) was developed to reduce serve time and maximize the efficiency of bar staff. ADDi performs all steps in the cocktail service process excluding final delivery. The customer orders a drink via a smart phone app. The order is received by ADDi, then a cup is dispensed and the ordered drink is mixed and poured simultaneously. Finally, the customer pays for the drink with a credit card through the app and receives a unique order indicator. The bartender sees the unique indicator, matches it to the proper cup, and delivers the drink to the customer. By performing the aforementioned tasks ADDi allows bar staff to focus on more complicated drink orders and customer interaction. This leads to happier bar staff, more satisfied customers, and more accurate inventory management; maximizing profits and minimizing waste.

MEM-51
IFM TRAINING STAND

Advisor: ***Dr. Roger Marino***

Team:

Jeffrey Fuller	Mechanical Engineering
Dylan Groff	Mechanical Engineering
Nick Lacko	Mechanical Engineering
Devin Marlin	Mechanical Engineering
Malena Williams	Biomedical Engineering

The team will be partnering with ifm electronic gmbh, a company who specializes in industrial automation, to complete the project. ifm has a need for training stations to be designed and built to aid in the training of their employees. The company has asked the group to incorporate specific sensors in our design, including pressure, level, temperature and flow sensors, in addition to using an industrial networking system AS-i (Actuator Sensor Interface) to control the process. The team must design a complete miniaturized industrial process loop using the sensors; the group was given freedom in choosing the industrial process decided to recreate a system that would be used for brewing beer. The beer brewing process involves the need for controlled heating and cooling of the liquid, pressure monitoring, and liquid transfer from vessel to vessel, making this a perfect application to showcase the sensors ifm would like to be included in the design. A prototype of the stand was built using an actual 14-gallon fermenting tank along with a pump and the appropriate sensors. The controller and electrical box are easily accessible for demonstration and training purposes. The group aims to create the proper training documents and allow control over IP through a basic web interface. Then the training stand's effectiveness can be tested and validated.

MEM-52
LOW PRESSURE FLOW CONTROLLER CALIBRATION SYSTEM

Advisor: ***Dr. Nicholas Cernansky***

Team:

Jeffrey Briner	Mechanical Engineering
Kevin Curcio	Mechanical Engineering
Bela Kraut	Mechanical Engineering
Mark Noel	Mechanical Engineering
Kevin Schwegler	Mechanical Engineering

Mass flow controllers are used to accurately control the flow rate of fluids for precision applications in many industries (stakeholders) such as food and pharmaceutical. However, current testing and calibration of flow controllers at low flow rates (<10 sscm) has been found to be both inaccurate and imprecise due to system noise. To solve this, our group has developed a small scale testing manifold to effectively raise testing pressure by reducing testing volume; this allows the calibration to more accurately decipher the pressure changes due to gas flow from that of electrical noise. The existing system has been adapted to a smaller scale application, while taking into account gas dynamics that are more evident at lower flow rates and pressures. Customers can then use these newly calibrated flow controllers at lower flow rate applications in situations that require a high degree of precision and accuracy.
Sponsor: Brooks Instruments

MEM-53
PROGRAMMABLE LAWN MOWER

Advisor: Dr. Roger Marino

Team:

Cody Brewer	Mechanical Engineering
Brian Lynch	Mechanical Engineering
Arundeep Singh	Computer Engineering
Chris Warren	Electrical Engineering

Millions of Americans suffer from physical disabilities, allergies, or other ailments that prevent them from being able to properly maintain their own lawn. The goal of this project is to build a fully electric remote control lawn mower with an on board camera monitoring system. The fully electric design will lower operating and maintenance cost to the end user. The mower will also have an integrated weed whacker allowing our customers to have greater control over their lawn care. The camera system will live stream video to the handheld remote control providing the user the convenience of operating the mower from the comfort and security of their home. Current robotic mower products on the market today are not only inefficient but also expensive; our design will be able to utilize electricity more efficiently and be produced and sold at a cheaper price

MEM-54
DESIGN, FABRICATION, AND VALIDATION OF FAA BEAM STRUCTURE TEST FIXTURE

Advisors: Dr. Jonathan Awerbuch, Dr. Tein-Min Tan

Team:

Joseph Angelico	Mechanical Engineering
Aidan Jamison-Frank	Mechanical Engineering
Ryan Neel	Mechanical Engineering
Sean O'Connor	Mechanical Engineering
Joseph Yacono	Mechanical Engineering

The FAA William J. Hughes Technical Center is the research arm of the FAA and supports its core mission area of aircraft safety. Among the many capabilities at the Technical Center: the Full-Scale Aircraft Structural Test Evaluation and Research (FASTER) facility, a capability developed to perform structural testing of fuselage structures. The Technical Center is currently expanding the structural testing capabilities to include primary beam structures representative of an aircraft wing and stabilizer components. The objective is to design a test fixture capable of subjecting a test article representative of an aircraft wing to pure moment, shear, and torsional loading such that the top skin of the article experiences desired levels of stress and strain. With guidance from the FAA and Boeing, and in coordination with team MEM-55, a testing fixture has been designed and validated using Finite Element Analysis. Fabrication of the fixture is scheduled to begin mid-February.

Sponsors: Federal Aviation Administration, The Boeing Company

MEM-55
DESIGN, FABRICATE, AND VALIDATE AN AIRCRAFT WING STRUCTURE FOR BONDED REPAIR STUDY

Advisors: Dr. Jonathan Awerbuch, Dr. Tein-Min Tan

Team:

Daniel Ehala	Mechanical Engineering
Benjamin Kim	Mechanical Engineering
Nathan Knauss	Mechanical Engineering
Mark Santella	Mechanical Engineering
William Scaggs	Mechanical Engineering

The William J. Hughes Technical Center (FAA-TC) is one of the Federal Aviation Administration's (FAA) primary research facilities. The FAA-TC has sponsored two Drexel senior design teams to develop a prototype system for fatigue studies of generic beam structures representative of typical horizontal aircraft wing and/or stabilizer components. The objective of this team is to design, fabricate, and validate a system consisting of a reusable beam test article capable of attaching either metallic or composite panels comprised of skin and substructures. To accomplish this objective, the team has coordinated with FAA and Boeing engineers to design a test article capable of producing 1500 μstrain on a test specimen under fatigue loading conditions. A test fixture, developed by conjoined team MEM-54, will house the test article and exert a combination of shear, pure bending, and torsional loads to the test specimen. Once both are fabricated, validation of the design can begin.

Sponsors: Federal Aviation Administration, The Boeing Company

MEM-57
AUTONOMOUS BIODIESEL CONVERSION SYSTEM

Advisor: Dr. Roger Marino

Team:

Jared Barag	Mechanical Engineering
Brian Keller	Mechanical Engineering
Brandon Kozak	Mechanical Engineering
Michael Mangini	Mechanical Engineering

The goal was to construct a prototype biodiesel processor, which was easy to use and produces biodiesel that will pass ASTM D6751 standards at a low cost. The primary stakeholders for this system include all diesel fuel users, whom are interested in renewable diesel fuel alternatives. The projected goal was met by constructing a prototype and performing quality tests of the biodiesel produced. The constructed prototype converts 25 gallons of waste cooking oil into 25 gallons of biodiesel, followed by the purification process. The team performed general tests on the produced biodiesel, such as glycerin content, soap content, and water content. Results of the following tests were within the acceptable parameters. The biodiesel produced operated successfully in a diesel heater and diesel automobile. The performance of both applications was indistinguishable in comparison to traditional diesel. The fuel produced by the prototype costs $1.08/gallon.

MEM-58
AUTOMATED HOME INDUCTION BREWING SYSTEM [AHIBS]

Advisor: ***Dr. Tein-Mein Tan***

Team:

Ersen Boran	Mechanical Engineering
Daniel Gaffney	Electrical Engineering
Joseph Kendall	Electrical Engineering
Joseph Laschenski	Electrical Engineering
Nickolas Max	Mechanical Engineering

The Automated Home Induction Brewing System is the next level design combines ease of use kitchen appliance with advanced level heating and cooling techniques for a unique home brewing system. The primary market for such a devices is a novice- and intermediate-level home brewer that are interested in creating their own unique recipe beers without any effort with regards to temperature control from the user. A normal home brewing process involves constant user input and correction while the AHIBS system monitors and automatically controls temperature during the entire home brewing process with a PID controller through an array of custom circuitry. This allows for a better user experience for those who wish to enjoy the practical hobby of brewing without any equipment or tools beyond a 120V 20A outlet. By combining an induction and cooling coil, an Arduino controller, and an array of sensors is what constitutes the AHIBS system. With home brewing specific coding, this product can brew any style of ales and lagers that the user wishes.

MEM-59
MULTI-DISCIPLINARY ROCK CLIMBING PACK

Advisor: ***Dr. Andrei Jablokow***

Team:

Dylan Fairfield	Mechanical Engineering
Kristaps Kancans	Mechanical Engineering

There are currently three different disciplines in rock climbing. Each requires a substantial amount of specialized gear for the discipline. The current market does not sell any backpack that can hold all the gear required to accomplish a roped climb and a boulder climb in a single trip. A backpack was created to efficiently hold all of the gear for a roped climb within the pack along with an attachment mechanism to attach a bouldering crash pad to the outside of the backpack. To accomplish this, multiple backpack configurations where tested using a center of gravity calculator to gain the optimal packing configuration. Then, a universal bouldering pad attachment mechanism was designed. This involved statics calculations in order to minimize the size and maintain a discrete yet functional product. The project concluded with prototyping concluded with in-field durability testing.

MEM-60
CLOUD SEEDING VIA RC PLANE

Advisor: ***Dr. Andrei Jablokow***

Team:

Sean Cujdik	Mechanical Engineering
Casey de la Pena	Mechanical Engineering
Robert Durbano	Mechanical Engineering
Dominick Flacco	Mechanical Engineering
Kyle Hawkins	Mechanical Engineering

Cloud seeding via RC Model Plane, with the idea to market to smaller scale agricultural farming. Cloud seeding is an old idea we plan to put a new spin on by making it much less expensive and more accessible to non-professionals. With limited runways, non-licensed pilots, limited access to expensive weather equipment, and inexperienced personnel; a farming establishment will be able to produce much more rain on a steady basis with our project. To put it simply, when this final product is purchased, you will be able to pull it out of the box, load the agents and fuel and make it rain! Although we are primarily focusing on cloud seeding, our project lends itself to many different fields, search and destroy, search and rescue, weather mitigation, crop dusting, and many others. The main stakeholder needs we are looking at for this project are farmers, sports arenas, and insurance companies.

MEM-61
DESIGN, FABRICATION, AND VALIDATION OF FOOT-WEIGHT MONITORING DEVICE

Advisor: ***Dr. Jonathan Awerbuch***

Team:

Richard Eastburn	Mechanical Engineering
Ian Riley	Mechanical Engineering
Zaheen Rouf	Electrical Engineering

After undergoing lower extremity surgeries, patients must apply limited loads to the injured areas or risk damaging them further. Conversely, patients with cerebral damage or new prosthetic limbs often fail to put enough weight on the affected leg, leading to balance issues. Devices exist to monitor limb loading, but they are costly and targeted at high-performance athletes and cannot be purchased by physical therapists or researchers. A low-cost insole was created with embedded force sensors to measure the weight distribution in the foot as a patient goes about their daily life. The insole transmits force data to a smartphone or custom-designed watch, which allows the patient to monitor their gait and alerts them when they exceed the prescribed maximum weight. The patient is able to independently generate progress reports that are sent to the clinician to decrease the number of follow up visits needed.

MEM-62
AUTOMATED DELUGE GUN

Advisor: ***Dr. Harry Kwatny***

Team:

Jeremy Casey	Mechanical Engineering
Tim DiIorio	Mechanical Engineering
Corey Peterson	Mechanical Engineering
Allison Reeder	Electrical Engineering
Anthony Robalik	Mechanical Engineering

A deluge gun is generally used for fire containment purposes after a building has been overwhelmed by fire and is too dangerous to enter. These guns function by providing a high flow water stream to deliver large amounts of water onto flare-ups and hot-spots. Although the concept of a deluge gun plays a critical role in modern firefighting tactics, the currently accepted design possesses a major negative attribute. The operation requires the full attention of an on scene firefighter, preventing them from assisting fellow firefighters in other fire ground operations A potential solution to these problems would be to automate the deluge gun to direct a water stream towards the hot-spots and flare-ups without any human input. This design will only require that the automated deluge gun be placed and given a water supply (and potentially power too). This enhancement on current deluge gun designs will aid firefighters to more effectively and safely contain fires from spreading.
Sponsor: The Boeing Sponsorship Fund

BMES-01
ENABLING WHEELCHAIR MOBILITY FOR INDIVIDUALS WITH IMPAIRED DEXTERITY: A 3D PRINTING MANUFACTURING PROCESS TO PRODUCE CUSTOMIZED JOYSTICKS

Advisor: Dr. Fred Allen

Team:

Jacqueline Gerhart	Biomedical Engineering
Claudia Gutierrez	Biomedical Engineering
Meaghan Paulosky	Biomedical Engineering
Dan Resnic	Mechanical Engineering

In the United States, over one million patients suffer from neurological disorders, limiting muscle strength and compromising independence. These patients have difficulty maneuvering power wheelchair joysticks due to reduced hand dexterity. These joysticks must be frequently replaced, costing $40 or more. A manufacturing process was designed to 3D print customizable joysticks in-house. Our novel joystick design encourages the functional hand position, a clinically established safe position, and relieves the thenar muscles and median nerve. Manufacturing a customized joystick comprises a consultation phase to quantify hand dexterity, a CAD generation phase to enter anthropometric data into our GUI tool to calculate joystick dimensions that are customized to the patient's hand, and a delivery phase to 3D print and test the joystick via a clinical Wheelchair Skills Test. This manufacturing process, currently in testing at Inglis House, is completed in less than twelve hours with a production cost of $1 per joystick.
Sponsor: Inglis House

BMES-02
ADJUSTABLE ORTHOPEDIC MECHANISM FOR CONGENITAL CLUBFOOT

Advisor: Dr. Adrian Shieh

Team:

Amanda Margaret Busch	Biomedical Engineering
Alexander Valiga	Biomedical Engineering
Shane Zeshonski	Biomedical Engineering

Clubfoot affects one in 1,000 births worldwide and is most commonly treated via the Ponseti method, which consists of manipulation and serial plaster casting over a period of 5-8 weeks to reposition the foot into proper alignment. Treatment in middle- and low-income countries where 80% of cases occur, lack of access to appropriately trained personnel and the distance to appropriate clinics, along with the approximate $5,000 cost of care, are barriers to treatment, resulting in neglected cases. This motivates the development of a cost-effective, measurable, standardized mechanism that can actuate the affected feet, does not require weekly castings, and can be implemented by a non-healthcare professional. Our design targets these issues, and provides the groundwork for a wearable, articulating pediatric boot to correct the adduction, hindfoot varus, and hindfoot equinus deformities in mild to moderate cases of clubfoot (Pirani score from 0.5 – 4.0).

BMES-03
ONLINE PRE-PROCESSING AND FEATURE EXTRACTION MODULE FOR LOW COST, PORTABLE SENSORIMOTOR RHYTHM BRAIN COMPUTER INTERFACE

Advisor: ***Dr. John Kounios***

Team:

Colleen O'Malley	Biomedical Engineering
Amelia Solon	Biomedical Engineering
Aadarsh Viswanathan	Biomedical Engineering

Brain Computer Interfaces (BCIs) allow for direct brain-computer communication via brain signals such as electroencephalogram (EEG). Clinically, BCIs hold promise in restoring functionality to individuals living with severe motor disabilities. Challenges stalling the use of BCI as an assistive technology for these end-users include the cost of research-grade systems and the effectiveness of existing low cost, portable BCI technologies. To help bridge this translational gap a low cost, portable BCI system that addresses end-user needs should be created keeping in mind user-centered design principles standardized in ISO 9241–210. This project's contribution is a MATLAB prototype of a signal pre-processing, feature extraction, and classification module designed to effectively (accurately) discriminate sensorimotor rhythms (SMRs) associated with right and left hand motor imagery. The design is tested using real motor imagery EEG data from human subjects, and is intended for eventual integration with the portable and inexpensive OpenBCI board.

BMES-04
PELTIER THERMAL FLOW METER FOR FOLEY CATHETER URINE OUTPUT QUANTIFICATION APPLICATIONS IN BEDRIDDEN HOSPITAL PATIENTS

Advisor: ***Dr. Marek Swoboda***

Team:

Tim Bertone	Biomedical Engineering
Frank Chang	Biomedical Engineering
Nathaniel Maor	Biomedical Engineering
Patrick Murray	Biomedical Engineering

Patient urine output flow rate and volume are clinically significant parameters that require frequent measurement in bedridden hospital patients and current techniques for doing so are not ideal. Manual methods such as the clinical standard are time-consuming and do not optimize patient outcomes. Therefore, a device capable of automatically and continuously monitoring patient urine output would benefit nurses and patients by saving time and improving abilities to detect pathology. This project aimed to validate thermal flow measurements as a viable method of automatically monitoring patient urine output by developing a method of quantifying fluid flow through a Foley catheter tube using principles of thermodilution. A bench-top device was developed, which consisted of two thermosensors bestriding a Peltier cooling element, an Arduino microcontroller, and a Matlab algorithm. Fluid flow measurements within clinically significant ranges were achieved, which suggests potential for this method in the development of an automatic urine output-monitoring device.

BMES-05
AUTOMATIC DETECTION ALGORITHM OF FAST RIPPLES IN EPILEPSY PATIENTS

Advisor: ***Dr. Karen Moxon***

Team:

Natassia Aravind	Biomedical Engineering
Geoffrey Barrett	Biomedical Engineering
Rania Mina	Biomedical Engineering

Epilepsy is a medical disorder that affects more than 50 million people worldwide. Antiepileptic drug therapy can alleviate or mitigate epilepsy symptoms in most patients, however it is ineffective in about 20.0% of patients. Fast ripples, epileptogenic biomarkers found in electroencephalogram data, are theorized to occur in the seizure onset zone (SOZ) and its detection could lead to better surgical outcomes. Manual detection is the current gold-standard for detecting fast ripples, but is prohibitively time-consuming. Therefore, there is a need to automatically detect fast ripples. The proposed design is an algorithm that utilizes a pre-processing step and artificial neural network(ANN) to detect fast ripples with a 5.0% false discovery rate. Less than half of the pre-processing step candidates were fast ripples, hence the need for an ANN that will output only true fast ripples. Successful implementation of this design in the clinical setting will result in SOZ localization.
Sponsor: Thomas Jefferson Comprehensive Epilepsy Center at Thomas Jefferson Hospital

BMES-06
AMPLIO RETRACTOR SYSTEM

Advisor: ***Dr. Christopher Weinberger***

Team:

Rohan Agarwal	Biomedical Engineering
James Bullock	Mechanical Engineering
Anthony Fiorillo	Mechanical Engineering
Hannah Kollar	Biomedical Engineering
Neil Marfatia	Biomedical Engineering
Sagar Patel	Biomedical Engineering

There is an increasing demand for safety and efficiency improvements for instrumentation used in minimally invasive spine surgeries. Current lumbar spinal retractors cause a non-uniform force distribution upon retraction to the surrounding soft tissue due to multiple blade systems. The AMPLIO Retractor System is composed of a lumbar retractor and an external driver. AMPLIO will maintain its enclosure at all times during procedures and expand via the driver. A force analysis has be performed on porcine tissue to ensure patient safety. The final retractor will be prototyped through 3-D printing but the final product would be made out of Grade 5 Annealed Titanium. Finite Element Analysis will test the material to ensure the retractor can withstand the stresses it endures. An enclosed retractor will distribute equal forces to the surrounding tissues and muscles, thus accelerating recovery time for the patients, which limits their hospital time by minimizing tissue/nerve complications.

BMES-07
BRAIN SIGNAL FALL DETECTION RESEARCH TOOL USING EEG-ACCELEROMETER COUPLED SIGNALS

Advisor: ***Bruce Katz***

Team:

Jillian Born	Biomedical Engineering
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Megan Levis	Biomedical Engineering
Sonia Selvan	Biomedical Engineering
Drishty Vora	Biomedical Engineering

There is a need for devices to quickly, accurately, and autonomously detect falling due to the numerous failures in real-world testing of accelerometer-based devices. Electroencephalography (EEG) has been implicated as a further means of fall detection with high specificity. The developed tool time-correlates EEG and accelerometer signals in a novel format, which results in data that may be further analyzed by researchers for identification of EEG-pattern changes correlated with unintentional falling. The tool first determines a potential fall by the accelerometer and then pulls the corresponding EEG data for further verification. This project combines the two inputs for the purposes of research and design of a marketable autonomous fall-detection device.
Sponsor: Brain Signals, Inc.

BMES-08
DEVELOPMENT OF A VALIDATION APPARATUS FOR ADVANCED COMPUTER MODELS OF PEDIATRIC TRAUMATIC BRAIN INJURY

Advisor: ***Dr. Matthew Maltese***

Team:

Ryan Norville	Biomedical Engineering
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Robert Ryan	Biomedical Engineering
Steven Snow	Biomedical Engineering
Brian Wise	Biomedical Engineering

There are 700,000 cases of pediatric traumatic brain injury in the United States annually. Currently, a finite element model of the preadolescent brain, skull and falx is being developed, but it lacks experimental data for validation. The test apparatus was designed to apply and measure an angular displacement as low as 0.5°, measure low resulting torque values ranging from 0.3 N-mm to 25.5 N-mm, and prevent axial force from being placed onto the specimen. The resulting solution is a proof of concept prototype that utilizes a strain gauge based reaction torque sensor and amplifier to measure torque resulting from angular displacements manually applied by an antibacklash worm gear assembly. A potentiometer measures the applied displacement, a support frame maintains the apparatus in a vertical position via a ball bearing connection, and a spline feature on the lower drive shaft eliminates axial loads on the specimen.
Sponsor: Children's Hospital of Philadelphia

BMES-09
POWERED ASSISTIVE DEVICE FOR EXTENSION OF SECOND AND THIRD PHALANGES

Advisors: Dr. Fred D. Allen, Dr. Nathaniel N. Mayer, Moss Rehab Einstein Health Network

Team:

Denariel Benn	Biomedical Engineering
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Mohil Parakhiya	Biomedical Engineering
Brandon Rozelle	Electrical Engineering

In the United States, approximately 61% of people who suffer from neurological traumas each year sustain long lasting injuries that can hinder activities of daily living, such as opening their hand. There is a need for a solution that can help users regain some functionality in their impaired hands. A device was created that utilizes a motor and cable tensioning system to extend the fingers and restore functional range of motion. This is controlled via a force sensor placed in the user's shoe for hands-free operation. Current technologies are limited by bulky profiles and the inability to tailor the device to user's needs. This device has a smaller profile and has the ability to be customized to individual users. The overall goal of this device is to help these patients regain independence.

BMES-10
PORTABLE NEAR-INFRARED CRANIAL PROBE FOR HEMATOMA AND TISSUE OXYGENATON DETECTION

Advisor: Dr. Kurtulus Izzetoglu

Team:

Karmini Mondal	Biomedical Engineering
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Alex Thoele	Biomedical Engineering

There does not currently exist a device capable both hematoma and tissue oxygenation detection to aid in the diagnosis of blast-related traumatic brain injuries. Working with Infrascanner, a probe was designed to house the necessary sensors for simulated hematoma and tissue oxygenation detection. The probe was constructed with the necessary sensors strategically placed to enable sub-cranial measurements and to ensure complete contact with the scalp at multiple locations on the head. Following calculations generated through the production of a simplified ellipsoid model of the skull, pressure testing was conducted using a prototype and a cranium model to confirm that coinciding contact did occur. Testing was also conducted using simulated hematomas and oxygenation in a phantom model to ensure the efficacy of sensor configuration. A prototype was produced that can be integrated into a future Infrascanner device capable of detecting hematomas and measuring tissue oxygenation.
Sponsor: Infrascanner, Inc.

BMES-11
PEGYLATED ULTRASOUND CONTRAST AGENTS FOR DRUG DELIVERY TO PANTREATIC TUMOR CELLS

Advisor: ***Dr. Margaret Wheatley***

Team:

Timothy Hoang	Biomedical Engineering
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Stephen Zachariah	Biomedical Engineering

Pancreatic cancer chemotherapy treatment is ineffective due to excessive interstitium and connective tissue (stroma) surrounding the tumor and impeding drug access. Ultrasound used with drug-loaded microbubbles combats this by targeting the delivery of the gold standard drug gemcitabine, increasing tumor vasculature permeability and loosening stroma. This platform consists of micron-sized, biodegradable poly(lactic acid) microbubbles that shatter into nano-sized drug-loaded shards. However, microbubbles and nanoshards in circulation are recognized as foreign and tagged by the C3 complement system for immune clearance, reducing maximal drug delivery potential. This work seeks to design microbubbles that retain ultrasound microbubble properties (echogenicity and shattering capacity), incorporate gemcitabine into the shell, and manifest polyethylene glycol (PEG) chains on the surface to create a barrier to C3 tagging. It was determined that the 5 wt% PEG and 3 wt% gemcitabine microbubbles best met the design criteria, providing the most viable agent for targeted pancreatic cancer drug delivery.

BMES-13
SENSOR SYSTEM FOR TRACKING OF BICIPITAL GROOVE IMAGING

Advisor: ***Dr. Joseph Sarver***

Team:

Tigran Edinjiklian	Biomedical Engineering
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Diane Osborne	Biomedical Engineering

Athletes involved in overhead sports such as baseball are at increased risk for injury to the long tendon of the biceps (LTB). This tendon lies within the bicipital groove (BG) on the lateral surface of the humerus, and abnormal morphology of the BG has been shown to be indicative of increased risk of injury to the LTB. Ultrasound imaging of the BG is an effective first-step preventative measure to determine if an athlete is at risk for injury. However, current freehand ultrasound imaging techniques are prone to transducer handling error and, consequently, inconsistent images. A modular housing unit was custom-designed and 3D printed to rigidly attach to the Terason T3000 12L5 transducer, and a sensor system with a real-time user interface was developed to allow the physician to track and correct the orientation of the probe throughout the procedure. This device was qualified against the Polhemus Tracking System.

BMES-14
LOW PRESSURE LYMPHATIC PUMP AS NOVEL TREATMENT FOR CONGESTIVE HEART FAILURE

Advisor: ***Dr. Amy Throckmorton***

Team:

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Marisa Cottrill	Biomedical Engineering
Patrick Lenahen	Biomedical Engineering
Neharika Ramani	Biomedical Engineering

A novel booster pump for the low pressure lymphatic system has been developed as a novel treatment for patients having congestive heart failure (CHF). Once commercialized, this new medical device will meet an unmet therapeutic need for those patients with congestive heart failure who experience fluid retention in the lymphatic system, which can lead to further decompensation of the cardiovascular system. Research indicates that alleviation of lymphatic congestion may lead to circulatory homeostasis and symptom improvements. To meet physiology demand, the booster pump can produce an output pressure of at least 20 mmHg and output flow of at least 830 mL/hour. We have created two designs of axial pump geometries, which have served as the basis for the computational studies and prototype manufacturing. Based on the numerical simulations, both designs met the performance requirements. Experimental hydraulic testing of the pump prototypes has confirmed that the design parameters were met.

BMES-15
DEVICE FOR MEASURING STIFFNESS OF THE GLENOHUMERAL JOINT

Advisor: ***Dr. Joseph Sarver***

Team:

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Shoulder stiffness is commonly encountered in clinical settings and is described as the resistance of shoulder motion experienced over the range of motion, and is typically accompanied by pain. Joint stiffness can be idiopathic or can result from immobilization, acute trauma or overuse. Athletes that perform repetitive overhead motions, such as baseball pitchers, are susceptible to shoulder stiffness. This can potentially end their careers prematurely. The current standard evaluation for determining shoulder stiffness is a subjective test where the patient performs internal and external rotation in the supine position. This evaluation can be greatly enhanced by quantifying stiffness. Therefore, a device has been constructed to supplement the current evaluation by providing a quantitative measure of stiffness. A torque sensor and inclinometer have been incorporated to measure the moment about the humeral axis and the angular displacement of the joint. The data is then analyzed through MATLAB to quantify joint stiffness.

BMES-16
NON TRADITIONAL POWER SOURCE FOR LOW POWERED BIOMEDICAL DEVICES

Advisor: ***Dr. Ryszard Lec***

Team	
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Uktarsh Gupta	Mechanical Engineering
Sakina Kanji	Biomedical Engineering
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Portability has become an essential characteristic to exsistening biomedical devices. This is because individuals may require the use of their biomedical device on the go, therefore these devices tend to be lightweight and small. However portability cannot only be defined by its size and weight, instead it most also be defined as its ability to be used on the go. Therefore it is essentaial that these low powered biomedical devices have the capabiliity to be charged while not being tied down to an outlet. In other words there is a need for a non traditional power source. This power source should have the capaility of genertaing power through some human interaction in order to ensure that the individual will always have the capacity to generate power. This power source will use electromagnetic induction and human movement in order to generate electric.

BMES-17
MECHANICAL CAVOPULMONARY ASSIST DEVICE CAGE FOR FONTAN PATIENTS

Advisor: ***Dr. Amy Throckmorton***

Team:

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Khyati Bhayana	Biomedical Engineering
Jacob Clouse	Biomedical Engineering
Christopher D'Souza	Biomedical Engineering
Mi Ta	Biomedical Engineering

Fontan patients currently lack heart assist devices specifically tailored to their unique single ventricle physiology. Drexel BioCirc laboratory has produced an impeller for percutaneously placed axial-flow blood pump to attain parameters relevant for Fontan physiology.Thus, our project aimed to design a protective cage that structurally supported and augmented performance of the impeller. Specific filament arrangement, enumeration, contours, and cross-sectional shape chosen for our design facilitated the impeller operating at lower energy expenditure, which *in vivo* translates to less trauma to the patient's physiology. Guided by knowledge of hydrodynamic principles and relevant engineering standards, a blocked-in model of the cage was developed in SolidWorks, 3D printed, was rigged around the impeller in a fluid-flow testing loop, and statistically compared for performance to the same stand-alone impeller. This design adds a critical module to the BioCirc Lab's pump design, as another step further toward clinical trials and matching modular mechanical performance.

Sponsor: Drexel BioCirc Laboratory

BMES-18
SEQUENTIAL RELEASE OF PROTEINS FROM HYDROGEL MICROSPHERES

Advisor: Dr. Kara Spiller

Team:

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Dev Patel	Biomedical Engineering
Vishal Shah	Biomedical Engineering
Dominic Strohmeyer	Biomedical Engineering

Hydrogel-based drug delivery systems have been used for treatment of a variety of conditions ranging from cancer to osteoporosis, yet despite their many favorable characteristics this system has not seen broad clinical applications. The major limitation of this system has generally been the quick release due to rapid degradation under physiological conditions. In order to increase clinical viability our team sought to create a system for sequential protein release from hydrogels to allow for control over the release profile of loaded proteins, to better mimic actual physiological systems for repair. In order to demonstrate the effectiveness, our group chose peripheral artery disease as the example condition which can be treated through sequential release of two proteins: vascular endothelial growth factor (VEGF) in the first 3 days and platelet-derived growth factor (PDGF) in days 5-7, which promotes the formation of healthy vasculature through therapeutic angiogenesis.

BMES-19
CONTINUOUS MONITORING OF PATIENT AIRWAY FOR LARYNGOSPASM

Advisors: Dr. Fred Allen, Dr. John Fiadjoe, Dr. Lin Han

Team:

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Bhavit Vora	Biomedical Engineering

Laryngeal masks (LM) are airway management devices used during surgical procedures. Perioperative airway complications, such as laryngospasms or closure of the vocal cords, occur in a significant number of surgeries. The most common method of detection of airway obstruction during surgeries is the pulse oximeter; however this method produces a significant time delay in notification and fails to determine the type of airway closure. Thus, a need exists for a timely and accurate detection and notification system for detecting laryngospasms. A device was developed that is compatible with current LMs and utilizes fiber optic light transmission to detect obstruction in the airway. The device continuously monitors the airway for the occurrence of laryngospasms by measuring the light transmission; a significant decrease in light transmission would indicate airway obstruction due to laryngospasm. Utilizing porcine larynges, the device was tested and the threshold at which vocal cord closure occurs was determined in order to build an optimized device.

BMES-20
SMARTPHONE APPLICATION ALGORITHM FOR GINGIVAL RECESSION CLASSIFICATION

Advisors: Dr. William Dampier, Dr. Andrew Lisko DDS

Team:

Michael Chang	Biomedical Engineering
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Jonathan Phung	Biomedical Engineering
Konstantinos Vrontis	Biomedical Engineering

Gingival recession is a common dental problem that is marked by the receding of gingiva due to over-aggressive bushing. Dental patients are typically unaware of gingival recession and this lack of awareness presents a need for a tool to allow non-dental professionals to detect recession. We developed a computer vision algorithm for a smartphone application that distinguishes gingival recession. The classification algorithm can achieve 90% sensitivity, 76% specificity in under two seconds of computation. The image processing algorithm was coded in Python using the SimpleCV library and implements a decision tree for image classification. We expect positive societal impacts through a more available application that can detect gingival recession at an early stage without having to visit a dental professional. This would allow the user to initiate necessary behavioral changes to prevent further gingival recession.

BMES-21
METHOD TO MEASURE THE ROTATIONAL STIFFNESS OF THE TORSO

Advisor: Dr. Sriram Balasubramanian

Team:

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Spinal stiffness is an important indicator of the progression of spinal diseases and conditions. No device or method currently exists that accurately quantifies spinal stiffness using inexpensive and non-invasive techniques. The solution utilizes the Microsoft Kinect v2 for Windows video camera device and iPi software for motion capture collection and data acquisition of spinal movements in the three anatomical planes of motion. The solution analyzes the motion capture data using MATLAB software to calculate rotational stiffness from kinematic equations and subject anthropometric data. Through this new method, proper assessment and tracking of spinal diseases can lead to more focused and beneficial rehabilitation treatments for patients.

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