DREXEL UNIVERSITY COLLEGE OF ENGINEERING

Senior Design Projects 2014

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
Senior Project Design Coordinator
College of Engineering

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CAEE-01
DREXEL INNOVATION CENTER

Advisor: ***Dr. Frank Moon***

Team:

Peter Albano	Architectural Engineering
Ryan Donahue	Architectural Engineering
Raquel Mocelo	Civil Engineering
Adrian Orio	Civil Engineering

MODA Engineering proposed and completed the full demolition and new construction of the 3101 Market Street site. This project has provided Drexel University the opportunities to generate additional revenues outside of tuition through technology commercialization. The newly developed site provides nearly 365,000gsf for the Drexel Innovation Center, 250 underground parking spaces, and ample future development square footage. The 14-story Innovation Center building will serve as the home for the Drexel Ventures program, which will stimulate innovation and collaboration through the functions of interdisciplinary research and start-up company incubation. MODA's deliverables included the designs of the architectural, structural, foundation, and sustainability systems, which all conformed to the Strategic Master Plan set forth by Drexel. Numerous BIM software packages allowed for integrated, three-dimensional building and site models to be constructed for design iterations. It is also important to note new sustainability features generate a 100% improvement in comparison to the former site.

CAEE-02
URBAN UPGRADING OF A SLUM IN BRAZIL

Advisor: ***Dr. Ivan Bartoli***

Team:

Esther Ninshuti	Civil Engineering
Nameita Toure	Architectural Engineering
Oumar Toure	Civil Engineering
Kyung Yoon	Architectural Engineering

Slums are defined as informal settlements characterized by lack of proper sanitation, overpopulation and substandard housing. We are proposing a design to upgrade a slum in Brazil, where these underprivileged communities are home to 11 million people. The design has four aspects that work together to insure a complete and sustainable upgrade: provide safe housing and decrease the occurrence of landslides, provide urban utilities, develop a serviceable transportation system, and provide public facilities to improve community living. We designed 6 three-story CMU housing units to house the 270 residents that currently live in landslide prone areas, and implemented a 700 feet long gabion retaining wall for soil stabilization. We designed a 2000 feet long asphalt road that will allow ambulances and garbage collection trucks to access the slum. With the implementation of a sewer network and stormwater management tools, our design will handle additional surface runoff resulting from our alterations.

CAEE-03
RESIDENTIAL HYDROELECTRIC POWER GENERATION

Advisor: Dr. Mira Olson

Team:

Kathie Cheng	Environmental Engineering, Civil Engineering
Steven Diemer	Environmental Engineering
Elise Hunter	Environmental Engineering
Joseph Midwig	Environmental Engineering

Implementation of a hydroelectric power generation system on a residential dam was explored. The dam is located in Bryn Mawr, PA along Mill Creek and both Mill Creek and Dove Lake feed the dam flow. Four options were designed and analyzed in a feasibility study including a direct catch basin at the base of the dam, channeling flow from Mill Creek only to a downstream turbine, channeling flow from Dove Lake only to a downstream turbine, and channeling flow from both Mill Creek and Dove Lake to a downstream turbine. An evaluation rating system indicated that the best option for implementation was channeling from the stream and lake. Estimated average power output for the system was 21,000 kWh/year, and estimated maximum power output for the system was 25,000 kWh/year.

CAEE-04
DESIGN AND IMPLEMENTATION OF AN ON-SITE WASTEWATER TREATMENT SYSTEM

Advisors: Dr. Franco Montalto

Team:

Katelyn Brubaker	Environmental Engineering
Sean Flynn	Civil Engineering
Charles Stillwell	Civil Engineering
Dominic Taglione	Civil Engineering

A summer camp owned by the First Evangelical Free Church of Brooklyn in Pike County, Pennsylvania was shut down in the 1990s due to the lack of a formal wastewater treatment system. The goal of this project was to reopen the camp. Site visits were conducted to gain an understanding of the existing conditions, to perform soil investigations and percolation tests, and to prepare a topographic survey of the property. Alternative designs were considered, and an at-grade absorption bed system was selected as the optimal system type. A full design package was completed and submitted to the Township Municipal Office for review. Upon approval, a construction permit was issued and the implementation of the wastewater treatment system was initiated. For financial reasons, the construction of the project was broken down into multiple phases. The project is currently in Phase II, and is scheduled to be completed prior to the permit's expiration.

Sponsor: Dingman Township Municipal Office, The First Evangelical Free Church of Brooklyn, Mr. Robert Banner

CAEE-05
HORSHAM AIR GURAD STATION AIR TRAFFIC AND STORM WATER FEASIBILITY STUDY

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

Team:

David Cossaboon	Civil Engineering
Patrick Prior	Civil Engineering
Michael Rolli	Civil Engineering
Zachary Zukowski	Civil Engineering

After Base Realignment and Closure, Horsham Air Guard Station was left without an active runway. Agencies and tenants at Horsham Air Guard Station require the use of infrequent air transportation, especially during an emergency situation. However, adding new infrastructure will increase the amount of impervious surface at the base. The current storm water basin is not equipped to handle this additional storm water load. Through extensive site field investigation and laboratory testing, a new runway was developed from the former base taxiway to meet the needs for all necessary aircraft at the base. This required soil classifications and concrete strength analysis. Additionally, to handle the extra storm water load, a first-flush bioretention green space was designed and the current storm water basin was modified. These improvements helped to handle the extra storm water load, while also improving the quality of the runoff leaving the site.
Sponsor: Pennsylvania Air National Guard

CAEE-06
SITE REUSE AND FACILITY REPURPOSING AT HORSHAM AIR GUARD STATION

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

Team:

Daniel Little	Civil Engineering
Phillip Riviezzo	Architectural Engineering
Gregory Scott	Civil Engineering
Ricardo Torres	Civil Engineering

Horsham Air Guard Station, in Horsham, Pennsylvania, is a former joint service military installation that was maintained by the Department of Defense. In 2009, the Base Realignment and Closure Act shuttered most of the installation and left a 237-acre portion of the facility to be utilized by State National Guard organizations. The geographic proximity of the installation to several major metropolitan areas and current force protection assets in place provide a variety of opportunities for federal, local, and other state assets. In order for the implementation to take place, however, a condition assessment of the facility infrastructure had to be accomplished. For this, several nondestructive testing methods were utilized in order to return the current fuel storage area to service. A building envelope assessment and redesign for an existing fixed-wing aircraft hangar that was damaged during Hurricane Sandy was also conducted. The major design effort focused on the reuse of an idled aircraft maintenance facility to serve as a prototype structure that incorporates an additional level of security to an already secure site. The design included a building-within-a-building, modeled after the “cliff houses” of the Pueblo Indians, in order to provide aerial operational security measures to the building’s inhabitants. A full structural assessment of the original building was conducted, and an internal structure was designed to serve as the cliff house. This project incorporated several aspects of the Drexel CAEE curriculum, serving as an appropriate culmination of the student’s education.

CAEE-07
THE PIER

Advisor: Dr. Eugenia Ellis

Team:

Fatimah Al Taqui	Architectural Engineering
David Bregande	Architectural Engineering
Chunzi Chen	Architectural Engineering
Endri Gina	Civil and Architectural Engineering
Brian Vazquez	Civil and Architectural Engineering

Our group proposed to renovate and improve the area over the rail yard, located to the east of Drexel Park. The site had lots of unused air space, and the tracks don't sit well within the neighborhood. Our mission was to transform and cultivate this area into an aesthetically pleasing, green, and magnetic space that would create a stronger neighborhood environment for both, the student body, and the general public. In order to solve the problem, we designed The Pier. The Pier functions as an expansive green roof structure with the focal point being a modern winter garden that can be utilized year round. The platform originates from Drexel Park and transverses the adjacent Powelton Avenue Train Yard. The inspiration for the platform came from The High Line in New York City and from the Promenade Plantee in Paris.

CAEE-08
THE DESIGN OF A 30-STORY OFFICE BUILDING IN SAN FRANCISCO, CALIFORNIA

Advisor: Prof. James Mitchell

Team:

Nathan Barry	Civil and Architectural Engineering
Katrina Connors	Architecture
Jeanine Lancellotti	Architectural Engineering
Natasha Martines	Architectural Engineering
James Myers	Electrical Engineering
Jalpesh Patel	Civil and Architectural Engineering
Michael Sawin	Civil and Architectural Engineering

As competitors in the ASCE Charles Pankow Foundation Annual Architectural Engineering Student Design Competition, the team worked to design the structural, mechanical, electrical, and building systems integration for a 492,000-SF high profile office building located at 350 Mission Street in San Francisco, California's Business District. Through interdisciplinary collaboration, the team met design goals in LEED accreditation, reductions in carbon emissions, and reduction of energy consumption. The mechanical design utilized a space-saving system to meet heating, cooling, and ventilation needs. With the implementation of a cogeneration system, power consumption from the grid was reduced by approximately 25%. The structural design team was able to decrease the carbon emissions by implementing a unique timber structure and using an innovative alkali activated cement rather than typical concrete. The team was awarded a Runner-up in the Structural category and won the award for Innovation in the Pankow competition.

CAEE-09

DRAGON SQUARE: MIXED-USE URBAN DEVELOPMENT

Advisor: Prof. Eugenia Ellis

Team:

David Barbalace	Civil and Architectural Engineering
Alexander Barbone	Architectural Engineering
Edward Bruder	Civil and Architectural Engineering
Michael Fratoni	Civil Engineering
Ryan Taylor	Architectural Engineering

The Five Star Parking lot, located north of John F. Kennedy Boulevard between 31st and 32nd Streets is an underutilized property owned by Drexel University. By 2017, Drexel intends to begin developing this plot into the Superblock, which, in the opinion of Archer Designs, does not remain faithful to the principles of Drexel's Master Plan. By examining various citywide initiatives such as Green City, Clean Waters and Philadelphia2035, a mixed-use retail-residential-entertainment complex was developed along a five-pronged strategy that (1) reduces stormwater runoff on the site, (2) increases housing options for an expanding student body, (3) creates a cultural hub for University City residents, (4) invites private business to a developing urban area, and (5) addresses the needs of the community outside of the university. The completed complex is a portal that connects Drexel's Campus to the larger Philadelphia Metropolitan Area physically and figuratively.

CAEE-10
DREXEL STUDENT UNION CENTER

Advisor: Prof. James Mitchell

Team:

Canaan Colwick	Civil Engineering
John Kile	Architectural Engineering
David Morrison	Civil and Architectural Engineering
Giles Wozniak	Civil and Architectural Engineering

The goal of this project was to design Drexel University's new Student Union Center located on 32nd Street and JFK Blvd in Philadelphia. This Student Union Center will bring the university's students together in a centralized meeting spot to engage with their peers and collaborate on new ideas. The Student Union Center will include spaces for retail food stores and a grocery store for the students and faculty. The Steinbright Career Development Center will be moved into this building to highlight one of Drexel University's greatest promises it offers its students: to prepare the student for the professional world. The floors above are designed to be collaborative spaces for the students. These spaces range from large studios to small group study rooms. The design also includes two large assembly spaces, a ballroom and an auditorium for large events. The upper portion of the building will be a residential area for students.

CAEE-12
NORTHSIDE DINING TERRACE RENOVATION

Advisors: Dr. Ahmad Hamid and Prof. Robert Brehm

Team:

Abdulrahman Alkraidees	Architectural Engineering
Dongyan Qi	Architectural Engineering
Weiyang Wang	Civil Engineering
Kshitij Jain	Civil Engineering

The Northside Dining Terrace at Drexel University is a dining hall that contains several different restaurants and a small market. Different residential halls, and student houses surround the building. The site is a one-story building with a floor area of 4,300 ft2. The maximum capacity is 200 students. However, Drexel University's students have been increasing the past few years. Therefore, renovating the Northside Dinning Terrace becomes important. A survey of 30 students was conducted asking if there is a need to renovate the Northside Dining Terrace. Majority of the students agreed on renovating the building to provide more dining space, and increase the limited options available.
Three different design alternatives were suggested considering different criteria. When comparing the three alternatives, extending the building vertically upward by building a second floor with an area wider than the first floor seemed the most effective. Thus, a structural plan for the 2nd floor was designed, and HVAC system was added to the building. Renovating the Northside Dining Terrace will add an extra 3,300 ft2 dinning area, and increase the student's maximum capacity from 200 to 300 students.

CAEE-13
UNIVERSITY CROSSING BIO-WALL

Advisor: Dr. Charles Haas

Team:

Tim Bruckner	Environmental Engineering
Brandon Emig	Architectural Engineering
James Gallagher	Environmental Engineering
Anthony Jerbasi	Civil Engineering
Matthew Paris	Environmental Engineering

The objective of this project is to promote sustainability around campus and address the issue of poor aesthetics associated with the southern façade of University Crossings. It was found that a 4,677 ft2 biowall with a rain gathering system on the roof was the best design option. The base cistern directly beneath the biowall was refigured due to potential construction issues, and relocated 100 ft west beneath a loading dock area. This cistern will be constructed of precast concrete and capable of storing 2,880 ft3 of water. The concrete cistern was designed to withstand the loads of the loading dock area above. The original pipe design was altered for the new cistern which included modifying the selected pump to accommodate energy losses corresponding to the added bend in the piping. The remaining water that was not transpired throughout the biowall will be drained towards the existing sewers along 32nd Street. The potential use of 118 photovoltaic modules which is capable of generating over 33,000 kWh/year for the rain gathering system on the roof; was examined using economic analysis. The Pennsylvania State Rebate Program for solar systems and the PWD stormwater credits were used as variables in this analysis. Overall feasibility for the biowall was determined through economical, sustainable, and aesthetical benefits for the property.

CAEE-14
ROUTE 76 CONGESTION RELIEF PROJECT

Advisor: Dr. Kurt Sjoblom

Team:

Christopher Commons	Civil Engineering
Peter Constanzo	Mechanical/Civil Engineering
Paul Higgins	Civil Engineering
John Meehan	Mechanical/Civil Engineering

It is the team's objective to alleviate the traffic congestion on Route 76 by means of a traffic mitigation design. This stretch of highway through the city did not properly take into account population increase in its initial design. Multiple infrastructure ideas were weighed in a design matrix based on stakeholders, cost effectiveness, traffic flow increase, etc. With roughly 30% of annual average daily traffic passing through the city exits, a tunnel became the most viable and effective option. The tunnel stretches from the University City exit to the Girard Avenue exit on Route 76 while increasing the level of service from E to B. Pre-cast segments put in place by the tunnel-boring machine were used to construct the 2.63-mile length of tunnel. Two tunnels, consisting of two lanes each, runs through the bedrock and small portions of alluvial silt that underlies West Philadelphia.

CAEE-15
LOGAN TRIANGLE REDEVELOPMENT AND REMEDIATION

Advisor: Dr. Patricia Gallagher

Team:

Joanna Bermingham	Environmental Engineering
Dylan Borger	Environmental Engineering
Meghan Cash	Environmental Engineering
Samantha Cowan	Civil Engineering
Sarah Dollarton	Civil Engineering

Logan Triangle is a 41.2-acre site in North Philadelphia. The site was used as a dumping ground for fly ash and construction debris prior to the construction of homes. In the 1980s, 957 houses were demolished due to unstable foundations, one of which led to a gas explosion. The City of Philadelphia asked that the site be remediated and made suitable for development. The block bounded by 9th St, 11th St, Louden St, and Wyoming St was chosen as the site of development for this project. Of three alternatives considered, one was chosen and accepted by the city to include a grocery store and small retail on the site as well as remediation. Deep dynamic compaction was used to compact the soil, and the area was refilled with clean soil for stability. All structures were built according to The Living Building Challenge, achieving net-zero energy and water on the site.

CAEE-17
PHILADELPHIA – GREAT LAKES EXPRESS CONTAINER PORT

Advisor: Dr. Joseph Martin

Team:

Antonio Alaimo	Civil Engineering
Kaitlin McLaughlin	Environmental Engineering
Robert Pletcher	Civil Engineering
Glenn Santulli	Civil Engineering

With the renovation of the Panama Canal, new opportunity is presented in the form of New Panamax sized container ships gaining entry through the canal. Historically the Saint Lawrence Seaway has provided shipping entry to the Great Lakes, supplying cities such as Chicago and Toronto. However the Seaway cannot handle the new Panamax ships that will be making their way up the US coast. Therefore shipping trade to Canada will be limited to trucking and rail. Therefore our group proposes to open a port in the Philadelphia Navy Yard in order to capitalize on this new shipping demand. This new Philadelphia port will have the advantage of being serviced by not only Norfolk Southern and CSX, but additionally by Canadian Pacific Railroad. This will position the port to be able to rapidly handle and expedite bulk cargo as well as specialty cargo such as bananas, cocoa, and steel products.

CAEE-18
PINE GROVE FLOOD REMEDIATION

Advisor: Dr. Robert Muir

Team:

Charles Aungst	Civil Engineering
Joe Cotis	Mechanical Engineering
Alex Pollard	Architectural Engineering
Matthew Remner	Civil Engineering

The township of Pine Grove, PA has experienced recurring flooding events due to its location along the Swatara Creek. In 2011 Tropical Storm Lee swept through North East and caused major damage in many towns and cities, Pine Grove included. A number of industrial businesses in the town have expressed that unless the town creates a flood protection plan they will be forced to move their operation. Three possible solutions were examined. They included channel rehabilitation; a retention basin; and a pump station. The pump station would have been too costly and would cause an eyesore. The retention basin and channel widening was further designed. The retention basin was located where a manufacturing plant once stood. During non-flooding events it served as a recreational field. Channel rehabilitation would occur down river. It included the clearing of silt accumulation, widening the river, and placing riprap to prevent erosion.

CAEE-19
RIVERVIEW CULTURAL CENTER

Advisors: Dr. Ahmad Hamid and Prof. Robert Brehm

Team:

Brian Gibson	Civil and Architectural Engineering
Chinh Nguyen	Civil Engineering
Camille Roberts	Civil Engineering
Maureen Wangari	Civil and Architectural Engineering

The purpose behind the Riverview Cultural Center is to provide a location where the residents of South Philadelphia can be culturally enriched and safely engage in recreational activities. Located at 1499 S. Columbus Blvd, Philadelphia the proposed plan for the center includes two structures which are the Ice Stadium and the Cultural Center Annex. The Ice Stadium is 144,000 square feet and will allot time for both private and public use, while the Cultural Center will provide classes to the public as well as a bookless library. Lastly the remainder of the site will be used as a multiuse park for outdoor recreation activities. The facility will be LEED certified, and create an opportunity to teach the public about innovative technologies and renewable energy systems. After discussion it was decided that the project will be a Public-Private Partnership with the goal being that the private owner of the property will assist in the funding of the design and construction.

CAEE-20
EXPANSION OF DREXEL UNIVERSITY FACILITIES

Advisor: Dr. Joseph Mullin

Team:

Davon Edgecombe	Civil and Architectural Engineering
Ken Ishimura	Civil Engineering
Christopher Oster	Civil Engineering
Michael Wright	Civil Engineering

Design Team 20 has determined that Drexel University's facilities are becoming congested, especially in the library and dining areas. To remedy this problem we proposed three alternatives: take no action, renovate or rent existing facilities, or begin new construction. After evaluating these alternatives, the team determined that new construction in the form a multi-use facility was the most favorable alternative. The site determined was the Penn Coach Yards utilizing a structural platform along 31st Street near Drexel Park. It is our position that this multi-use facility constructed on a structural platform above the Penn Coach Yards will provide Drexel University with a space that enables the University to expand as well as enhance the student experience by utilizing the previously undeveloped northeastern side of Drexel's campus. The design team analyzed this solution by performing a comprehensive site analysis and the design of the architectural, structural, HVAC and MEP systems.

CAEE-21
LIQUID NATURAL GAS EXPORT TERMINAL IN THE PHILADELPHIA REGION

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

Team:

Antonino Badalamenti	Civil and Architectural Engineering
Adam Brooke	Civil and Architectural Engineering
Kyle Mathews	Civil Engineering and Architectural Engineering
Sanil Patel	Civil Engineering
Christopher Sadowski	Civil Engineering

This project investigates the feasibility of constructing a Liquefied Natural Gas (LNG) export terminal in the Philadelphia area in order to export Natural Gas (NG) from the Marcellus Shale region to global markets. Various locations for the facility were analyzed for the client, the Philadelphia Gas Export Committee, using a decision matrix to select Hope Creek as the ideal location. To provide the fastest turnaround time for LNG vessels and to deliver LNG to market as soon as possible, a temporary solution was developed which utilizes the existing cryogenic capabilities of the Philadelphia Gas Works plant in Port Richmond, in conjunction with specialized railcars and an insulated pipeline. The temporary solution will operate while the necessary landside and maritime structures of the permanent facility are built. Finally, in order to have a self-sustaining and fully operational facility, a dedicated NG pipeline to the terminal from Philadelphia was designed as well.

CAEE-23
JFK BOULEVARD DEVELOPMENT

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

Team:

Brian Benson	Civil and Architectural Engineering
Kara Hammon	Civil Engineering
Ian Lagrang	Architectural Engineering
Iván Piñeiro	Civil and Architectural Engineering
Melanie Wayne	Civil and Architectural Engineering

The objective of this project was to provide Drexel University with a fully designed building that would serve as an entrance to campus and incorporate intercity bus loading (currently located on JFK Blvd). A 22-story office tower, designed for 10-stories of future expansion, sits above 3 levels of retail and restaurants. The main structural systems are an external diagrid to transmit the lateral loads created from the U-shape of the tower, and a substructure that spans the existing SEPTA tracks to carry the load from the 3 lower levels and a rooftop terrace across the 130’ span. Additional aspects of the design include: a reconfiguration of JFK Blvd; a patron drop-off area; stormwater management systems, which exceeding requirements by 27%; bus terminal and atrium ventilation systems; and an active chilled beam HVAC system.

CAEE-24
UNITARIAN SOCIETY OF GERMANTOWN STORMWATER MANAGEMENT

Advisor: Dr. Patricia Gallagher

Team:

Brendan Diener	Civil Engineering
James O'Connor	Civil Engineering
Anthony Petras	Civil Engineering
James Sieracki	Environmental Engineering

The Unitarian Society of Germantown (USG) is situated in the Germantown area of Philadelphia. In addition to a 60' elevation drop from the highest point to lowest point on-site, it is located in the flood prone Wissahickon watershed. The Philadelphia Water Department (PWD) has implemented a new stormwater management regulation (effective January 1, 2014) where customers must retain the first inch of runoff on-site for 24 hours before releasing it into the storm sewer system within 72 hours or be faced with a substantial increase in the stormwater bill. As an effort to offer financial assistance to non-residential PWD customs, PWD along with the Philadelphia Industrial Development Corporation (PIDC) have created a grant provided by the Stormwater Management Incentives Program (SMIP). The project assists USG in applying for the SMIP Grant by devising practical stormwater management infrastructure including a retention basin, an infiltration trench, and a rain garden.
Sponsors: Mr. William Blasdel, Mr. Scott Murray, Mr. Tom Schoonmaker- USG Buildings and Grounds Committee

CAEE-25
DESIGN OF M3: A MOBILE AND MODULAR OUTDOOR AIR MONITORING VEHICLE

Advisor: Dr. Peter DeCarlo

Team:

John Kij	Environmental Engineering
Cady Piarulli	Environmental Engineering
Bonnie Vu	Environmental Engineering

Philadelphia and its surrounding areas have air monitoring stations scattered throughout the city. However, each station is not equipped to measure all pollutants of concern and many areas are far from these stations. To address this, a mobile and modular outdoor air monitoring vehicle (M3) was designed to collect pollutant concentrations versus geographical locations. A Mercedes Sprinter was chosen as the base vehicle and was designed to be retrofitted with inlet piping sized to ensure laminar flow and reduce particle loss, rooftop A/C units and foam insulation on interior walls for cooling, and a Unistrut floor system to install and remove instrument racks easily for modularity. Instruments measuring greenhouse gases, criteria pollutants, aerosols, and metals were installed on shock-mounted racks. A small-scale test run was completed using ozone, aerosol, and particulate-measuring instruments. Results showed higher overall concentrations with closer proximity to the South Philadelphia refinery area and sports complex.

CAEE-26
RENEWABLES-BASED DISTRICT HEATING SYSTEM FOR FLEISCHMANN'S, NEW YORK

Advisor: Dr. Sabrina Spatari

Team:

Edward Davis	Environmental Engineering
Kenya Lovill	Environmental Engineering

The Village of Fleischmann's, NY was considering the implementation of a wood-fired district heating system in conjunction with the Catskill Forest Association to promote education, research, regional fuel development and a renewable heat source for the Village. Alternative energy sources were evaluated through research, site visits and discussions with energy consultants for the remote village without natural gas infrastructure. A dual biomass boiler, fuel storage and feed system, state of the art emissions control and hot water distribution system were developed to be housed in a LEED-certified teaching and energy production facility. The entire system was engineered and 3D modeled for the Village with a full Life Cycle Analysis combined with capital and operating costs. Staged construction and development schedules were developed for the Village to begin construction within the next three years. The facility will provide an educational tourist hub and a secure energy future for this region of New York state.

CAEE-27
HIGH PERFORMANCE PHILADELPHIA ROW HOUSE

Advisor: Dr. Michael Waring

Team:

Michael Magee	Architectural Engineering

In general all buildings we build today are degenerative in the sense that they consume resources and leave a negative impact on people, the planet and prosperity; the Triple Bottom Line. For a building to be considered sustainable it must be either neutral in terms of what it consumes and it's impact, or regenerate resources making a positive impact. A 19th century row home in Northeast Philadelphia was restored with the objective to minimize energy consumption and have the least negative impact on the environment through sustainable design. Whole building design and analysis was utilized towards eliminating operational costs, providing a healthy and comfortable living environment, maintaining responsible construction practice and reducing the environmental impact of the building. Deep green engineering resulted in a house that features several innovative design solutions to reflect a commitment to energy efficiency, water conservation, reducing the carbon footprint, and preserving the natural world.

CBE-01
NATURAL POLYMER PRODUCTION: POLY(LACTIC ACID)

Advisor: Dr. Michael Grady, DuPont

Team:

Lauren Davis	Chemical Engineering
Amanda Decker	Chemical Engineering
Krysten Minnici	Chemical Engineering, Materials Science & Engineering
Zarina Yurchenko	Chemical Engineering
Mary Katharine Ziegler	Chemical Engineering, Materials Science & Engineering

The focus of this Senior Design project is to design of a corn wet mill co-located Poly(lactic acid) [PLA] manufacturing plant. PLA is a leading biodegradable polymer competing commercially with petrochemical-based counterparts. Most notably, people will recognize this revolutionary polymer from its brief use in the 100% compostable Sun Chips™ bag. PLA is currently used in many commercial products, such as disposable cups, credit cards and even phone cases. Corn, a renewable feedstock, is the primary glucose producer for PLA production. Currently 360MMlbs of PLA are produced annually in North America alone. Team 1 has designed a plant intending to capture 10% of the global market—producing 72MMlbs of PLA a year. The production of this facility was determined the to be feasible and further work is ongoing to optimize the process.

CBE-02
UPGRADING VACUUM RESID THROUGH HYDROCRACKING

Advisor: David Kolesar, DOW Chemical Company

Team:

Caitlin Gottier	Chemical Engineering
Allison Kirkpatrick	Chemical Engineering
Shawn Magauran	Chemical Engineering
Thomas Minford	Chemical Engineering

Fossil fuels have historically been the frontrunner of energy sources in most parts of the world, but the depletion of conventional oil reserves has directed more attention to processing unconventional opportunity crudes (opcrudes). Current estimates report a significantly high ratio of opcrude reserves to conventional crude reserves, globally. Our Capstone project investigates the efforts involved in revamping an existing refinery to include a hydrocracking system capable of processing opcrudes. Due to the heavy nature of opcrudes, which contain a large fraction of heavy residual material (resid), hydrocracking technology provides the means to upgrade low-value resid to higher-value products. The feasibility study found that this process is both achievable and profitable. Significant fractions of high-demand fuel products such as naphtha and distillate were produced from the hydrocracking process leading to an estimated profit of over $500 MM over a fifteen-year project life.

CBE-03
HETEROGENEOUS PROPYLENE GLYCOL PLANT

Advisor: David Kolesar, DOW Chemical Company

Team:

Samantha Blanford	Chemical Engineering
Janell McCarroll	Chemical Engineering
Ha Pham	Chemical Engineering
Xiaonan Xu	Chemical Engineering

The project determined the feasibility of a process designed for a catalytic reaction to generate propylene glycol from propylene oxide (PO) and water. Products include monopropylene glycol (MPG), dipropylene glycol (DPG) and tripropylene glycol (TPG). Multi-stage evaporators recycled unreacted water, reduced utility cost, as well as the number of stages required for the drying tower, compared to a conventional distillation process. The heterogeneous process utilized a proprietary catalyst developed by R&D group to achieve 100% conversion of propylene oxide, increased the selectivity of MPG and reduced excess water. Water and PO are fed to a fixed bed reactor with a 5:1 molar ratio instead of the conventional 16:1.The economic study suggested the plant to be sized at 360 MMlbs MPG/yr, and estimated a lower capital and utility cost.

CBE-04
TRAVELING WAVE REACTOR

Advisors: Prof. John Speidel, Dr. Christopher Peters

Team:

Samuel Capizzi	Chemical Engineering
Phillip Hagerty	Chemical Engineering
Alexander Miller	Chemical Engineering
Stephanie Riner	Chemical Engineering

Nuclear waste is accumulating quickly across the world as a result of nuclear power generation. A traveling wave reactor (TWR) has been developed to burn spent nuclear fuel, converting un-enriched uranium to plutonium for power generation while producing less radioactive waste than conventional nuclear reactors. Electricity from the TWR is produced much like conventional reactors, whereby heat energy from nuclear fission passes through a heat exchanger to form saturated steam. The steam powers a turbine to generate electricity, which is sized for the energy needs of small communities and can be suitably positioned in diverse locations worldwide. At 34% thermal efficiency in the heat exchanger, the plant produces 100 megawatts of electricity from approximately 300 megawatts of reactor heat energy. This TWR represents sustainable design for the future of nuclear power generation.

CBE-06
MATERIAL BALANCE TO/FROM EUROPA

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

Team:

George Fox	Chemical Engineering
Milu Mathew	Chemical Engineering
Brittany O'Neill	Chemical Engineering
Benjamin Rochon	Chemical Engineering

Europa has recently been found to contain large pockets of water under its massive icy crust, and thus is believed to have the potential to sustain extraterrestrial life. This research project has been proposed to study ways in which to utilize the waste produced by human presence on board a space shuttle to recycle into useful materials for life support and fuel for the journey to explore Europa. The journey to and from Europa is expected to take approximately 10 years and a crew size of six, which was used as the basis for calculations. The reactions used in the recycle plant are a combination of a combustion (oxidation) reaction, a Sabatier reaction, and an electrolysis reaction. This combination of reactions was chosen to ensure optimal recycling of the major waste components.

CBE-08
ECONOMIC PRODUCTION OF TRIFLUOROACETIC ACID VIA OXIDATION OF 1,1-DICHLORO-2,2,2- TRIFLUOROMETHANE

Advisor: ***Michael Keane, DuPont***

Team:

Jeff Carlson	Chemical Engineering
Thomas Hunter	Chemical Engineering
Andy Jones	Chemical Engineering
Brendan Reif	Chemical Engineering

This project explores the feasibility of an economical commercial production process for trifluoroacetic acid (TFAA). The first step of the process converts R-123 to TFAA and trifluoroacetyl chloride (TFAC). The TFAC is then converted to TFAA through reactive distillation. The process includes an incinerator to destruct unreacted CFCs and other byproducts. The final process was chosen due to higher conversion and lower capital costs compared to alternative processes. High capital costs are required because much of the equipment requires exotic, corrosion resistant material. The plant will require about 4 operators per shift and an automated control system will monitor production. The project has a life of 14 years because R-123 will be banned by 2030. A large amount of production will be shut down and it will difficult and expensive to acquire the raw material; however, the process has been determined to be economically feasible with an 18% rate of return.

CBE-09
SINGLE MOLECULE DIESEL FROM SHALE GAS PROPANE

Advisor: Dr. Gennaro Maffia

Team:

Anran Huang	Chemical Engineering
Alda Kapllani	Chemical Engineering
Kelly Muth	Chemical Engineering
Purvi Patel	Chemical Engineering

The purpose of this project is to convert shale gas propane to pentadecane, which can be used as a single molecule diesel. The process includes three steps: first a propane dehydrogenation unit, followed by a propylene polymerization unit, and lastly a hydrogenation unit to convert the 1-pentadecene to pentadecane. This process will utilize the abundance of shale gas that is available in the United States. The plant produces 240,000 lb/hr of 100% single molecule diesel, as well as 675,000 lb/hr of other valuable products to be used as gasoline, jet fuel, and lubricants. The fixed capital investment for the plant is $149,500,000, and total cost of manufacturing is $1.24 billion. The project has a positive net present value of $23.52 million with 10.0% rate of return. In this project, 25.19% is discounted rate of return and payback period of 2.7 years is expected.

CBE-10
METHANATION OF SEQUESTERED CARBON DIOXIDE

Advisor: Michael Kain, Dow Chemical Company

Team:

Anthony Caramagno	Chemical Engineering
Justine Han	Chemical Engineering
Alexander S. Holt	Chemical Engineering
Bincy Ouseph	Chemical Engineering
Leonid Miroshnik	Chemical Engineering

Increasing carbon dioxide (CO_2) emissions is an increasing global concern as it accounts for approximately a third of total greenhouse gas emissions. Combustion of fossil fuels such as natural gas to produce electricity is a primary contributor to the release of CO_2 into the earth's atmosphere. Sequestered CO_2 from a natural gas fired power plant can be reacted with hydrogen gas to form methane and water by use of a nickel catalyst – a process known as the Sabatier reaction. A pilot plant was designed to use this reaction to effectively recycle CO_2 gas to the original gas-fired power plant as a cheaper, more sustainable fuel source than their raw material. The process developed would consume 93.41 lbs of CO_2 from flue gases per hour to form 640 lbs of methane gas per hour available for recycle. The projected financial analysis shows a discounted cash flow rate of return of 83.82% over a 12 year period.

CBE-11
PRODUCTION OF LIQUID POLYSULFIDES

Advisor: Steven Schon

Team:

Steven Farrell	Chemical Engineering
Sarah Flowers	Chemical Engineering
Natalie Gogotsi	Chemical Engineering
Dan Lee	Chemical Engineering

This process is a joint venture with Arkema, Inc. to manufacture liquid polysulfides from mercaptan and elemental sulfur using a continuous process through a packed bed catalytic reactor. Each year there are three separate campaigns, which employ one of three mercaptans provided by Arkema: tert-dodecyl-, tert-butyl- or tert-nonyl mercaptan. The three polysulfides produced are di-tert-dodecyl, di-tert-butyl, and di-tert-nonyl polysulfide. Operations are located in the immediate vicinity of Arkema's Houston, TX plant to lower costs and safety risks associated with product transportation.
Given the product's status as a "specialty" chemical, the plant is expected to produce 10 million lbs of product annually. Annual costs are approximately $22 million for raw materials and utilities. According to current market prices for liquid polysulfides, annual sales are expected to be $41 million; factoring in upfront investment capital yields a discounted cash flow rate of return (DCFROR) of $19.5 million.

CBE-13
BIODIESEL PRODUCTION IN A BUBBLE COLUMN REACTOR

Advisor: Dr. Richard Cairncross

Team:

Lauren Bucher	Chemical Engineering
David DeVitis	Chemical Engineering
Maxine Morris	Chemical Engineering
Gregory Wallowitch	Chemical Engineering

Researchers at Drexel University have developed a reactor that converts high free fatty acid feed (FFA) stocks into biodiesel. Brown grease is separated from the trap grease collected from restaurant grease traps and has the high FFA content needed for the reaction. The reaction occurs by esterification of FFA by the use of methanol in the presence of an acid catalyst. This reaction will be carried out in a bubble column reactor, in which methanol is bubbled through the grease, reacting and simultaneously stripping the water produced. A process to produce 50MMlb biodiesel/yr has been developed using the knowledge of kinetics found by the Cairncross Research Group.
The location of the plant will be in northwestern New Jersey due to its proximity to the New York City and Philadelphia metropolitan areas. This area will provide the amount of brown grease needed for the process. The preliminary cost estimates give a payback period of three years and a non-discounted cash flow after payback of $6.9 million per year.

CBE-14
TURNING GREEN INTO GOLD

Advisor: Dr. Richard Cairncross

Team:

Stephen Hausler	Chemical Engineering
Joseph Kozacheck	Chemical Engineering
Gregory Nicosia	Chemical Engineering
Vincent Vita	Chemical Engineering

The project "Turning Green into Gold" explores the topic of sustainability, by focusing on the production of biodiesel from algae as an alternative renewable energy resource compared to fossil fuels. The process involves remediating leachate from a local landfill as the main nutrient source of the algae and producing high grade biodiesel with other byproducts such as glycerol. *Chlorella minutissima* was selected as the choice algae strain, for its robust features associated with plant operating conditions, cost effectiveness, and promise of high yield purified biodiesel. The main design aspects include various series of serpentine ponds, glycerol/cyclohexane separation, algae flocculation techniques, and transesterification for biodiesel production. The location of the algae biodiesel facility will be Aberdeen, Brown County, South Dakota along the James River. Complications with the process arise due to economics and the high capital intensive investment with the ponds.

CBE-15
EPOXIDIZING NATURAL FURANS FOR COATINGS AND COMPOSITES

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

Team:

Badreya Almarzouqi	Chemical Engineering
Susan Budhoo	Chemical Engineering
Alvenne Goh	Chemical Engineering
Olamide Olayinka	Chemical Engineering

The growing worldwide demand for epoxy resins signifies a promising future for growth of the epoxy market. A chemical plant was designed to determine the economic feasibility of manufacturing 2, 5-bis[(2-oxiranylmethoxy)methyl]-Furan (BOF), a furan-based epoxy resin for use as an essential material in various applications, specifically coatings and composites. The plant location was proposed to be in Shanghai, China, where 79.4% of the epoxy resin market is situated globally. The chemical plant has the capacity of producing 60 million pounds per year of BOF, which is 1.2% of the world's epoxy resin market, with a grade purity of 95%. The cost of manufacturing was found to be $240 million. As the selling price of BOF was determined to be $2.50 per pound, the yearly profit of the plant would be $150 million. The projected life of the plant is 20 years starting from October 2016 - October 2036, including the 9 months of planning and design, which started in October 2013 and was completed in May 2014.

CBE-16
HOME-BASED DIMETHYL ETHER

Advisors: Steven Schon and Chris Altomere

Team:

Lynn Dao	Chemical Engineering
Tamuno George	Chemical Engineering
Hanh Nguyen	Chemical Engineering
Vipul Patel	Chemical Engineering
Richard Recchione	Chemical Engineering

With gas and diesel prices rising, a need for an alternative fuel exists. Dimethyl ether (DME) can be used as a substitute fuel for diesel powered cars with minimal modifications. DME can be synthesized from natural gas. In the U.S., natural gas is cheaper than diesel per fuel value. DME has lower CO2 emissions than conventional diesel, making it more environmentally friendly. The DME unit was designed to be installed on a wall of a garage within the dimensions of 9' x 20' x 1'. The process comprised of three regions: feed preparation, reaction, and final product separation. This project looked at the technical and economic feasibility of converting household natural gas into DME.

CBE-17
DESIGN OF A PROCESS TO MANUFACTURE CARBON FIBERS FROM COAL

Advisor: Michael J. Kain, Dow Chemical Company

Team:

My-Huu Nguyen	Chemical Engineering
Sunny Patel	Chemical Engineering
Ankit Tuteja	Chemical Engineering

Carbon fiber is a recent industrial development and the demand for it is increasing across the globe. This process is a modification of an existing plant in Oak Ridge, Tennessee that manufactures 95% pure carbon fibers from coal.
The 40, 000 square feet facility will produce approximately 250,000 pounds of carbon fiber annually. This process will take advantage of the abundance amounts of resources for coal, which are sold at a relatively low cost.
The primary use for this product is related to the automotive industry as they move towards building cars with more carbon fiber material.

CBE-18
CARBON DIOXIDE TO METHANOL

Advisor: ***Michael Keane, DuPont***

Team:

Abdulkarim Alabdulkarim	Chemical Engineering
Hadeer Almutairi	Chemical Engineering
Haley Keister	Chemical Engineering
John Toumeh	Chemical Engineering

This project examines the feasibility of converting Carbon Dioxide to Methanol using a new non-metallic catalyst. A pilot plant was designed to discover if this method will be able to reduce greenhouse gases efficiently keeping in mind economic constraints.
Research was done to determine the most appropriate chemistry to convert Carbon Dioxide to Methanol. The method that was chosen focused on the use of Boric Acid and Toluene-Di-isocyanate. In theory these two reactants will regenerate themselves in the chosen process. Carbon Dioxide can be used from multiple plants across the world which emit Carbon Dioxide in large quantities. The pilot plant was chosen because there is a lack of physical property data for the intermediates created in this process. If the data obtained can be feasibly used to scale up this process, the impact to the environment is of high importance and can positively affect future generations to come.

ECE-01
PROBEE FIREFIGHTER ACCOUNTABILITY SYSTEM

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

Team:

Kurt Russell	Electrical Engineering
Nora Corinne Sauer	Electrical Engineering
Daniel Shirley	Electrical Engineering

PROBEE Safety is a firefighter accountability and rescue tool developed by three senior electrical engineering students at Drexel University for their Senior Design Project. The project began in the summer of 2013 with research in the fire industry delving into the resources available to firefighters and the causes of fatalities during structural firefighting operations. Using their research and experience the team developed a combination hardware and software system capable of recognizing life-threatening situations for firefighters wearing the PROBEE hardware, and alerting fire officers by providing them with crucial information necessary for launching effective rescues. The prototype consisted of a sensor network, rapid prototyped hardware cases, matlab data collection interface, Android user interface, PCB board design, signal filter design, and much more. Throughout the course of the nine month sequence, the PROBEE team continued to develop and test their prototype alongside fire officers and firefighting instructors with the use of county-wide surveys, one-on-one interviews, and testing in live-fire training structures. More information about this project is available at: www.probeesafety.com.

ECE-02
REPLICATION AND POWER OPTIMIZATION OF HUBO'S MOTOR CONTROLLER BOARD

Advisors: ***Dr. Youngmoo Kim, Evan Dissanayake***

Team:

Mary McVaugh	Electrical Engineering
Yuqing Peng	Electrical and Computer Engineering
Xiao Peng	Electrical and Computer Engineering
Shengyang Song	Electrical Engineering

Hubo is a humanoid robot created by the Korea Advanced Institute of Science and Technology that is currently being developed in part by Drexel University. Currently Hubo has performance issues related to its hardware such as short battery life and weak joints. The objective of this project is being able to replicate the motor controller board of Hubo and then modify the design in respect of power efficiency. The motor controller boards themselves consumes around 30% of the total power usage, and also responsible for controlling the flow of signals and power between Hubo's motors and central computer units. In particular, we plan to design a motor controller board with a similar layout and interface as the existing Hubo motor controller and improve its power efficiency and overall functionality in hardware and firmware perspective.

ECE-03
TOUCH CONTROLLED INTERNET BOX FOR LARGE DISPLAYS

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

Team:

Bryan Antell	Computer Engineering
Matt Coppola	Engineering

Connectivity to the internet and the consumption of its content has become an essential part of everyday life. There currently are no methods to view internet content on televisions which resemble a browsing experience similar to that found on a computer or smart phone. This project aims to enable a browsing experience on a television that is comparable to other methods through the use of a touch surface controller and manipulation of a web browser to optimize navigation and display of content. By utilizing small and powerful embedded systems such as the Raspberry Pi and BeagleBone Black, our group will work to create a working prototype to solve this problem.

ECE-04
HYBRID 3D TOPOLOGY USING RECONFIGURABLE ANTENNAS FOR NETWORK ON CHIP

Advisor: ***Dr. Baris Taskin***

Team:

Gjergi Konica	Electrical Engineering
Katie Leis	Electrical Engineering
Scott Lerner	Electrical and Computer Engineering
Vasil Pano	Computer Engineering

Network on Chip architecture has emerged as a promising technology to tackle design challenges of the conventional bus architecture by using network-like interconnection among multiple cores. Today's multi-core chip multiprocessors (CMP) support tens to hundreds of cores such as Tilera's 64-core TILE64 or Intel's 80-core TFLOPS. However, on-chip interconnects carrying signals across different components will be the bottleneck to system performance, impacting area, power and latency, especially when CMPs scale to hundreds or thousands of cores on a chip. This project will produce a methodology where wireless interconnects can be placed optimally in terms of throughput, area, and power dissipation.
The simulator has been modified by removing selective crossbar interconnects without increasing congestion and creating an infrastructure that will have to support the added antennas. Understanding the antenna's properties when put on a silicon chip and investigating the benefits of wireless communication on this small scale compared to the area and power overhead are the main objectives of the overall project. The wireless interconnects are not meant to replace the wire-based interconnects but be used in combination, where their utilization leads to an improvement in the Network on Chip simulations.

ECE-05
ANDROID CONTROLLED QUADCOPTER FOR POWER PLANT USE

Advisor: Dr. Christopher Peters

Team:

Vishal Bhatia	Computer Engineering
Wayne Gibson	Computer Engineering
Zack Hunkins	Mechanical Engineering
Joe Ippolite	Computer Engineering
Bowei Zhang	Computer Engineering

Currently health physicists perform daily maintenance at a nuclear power generation plant when it is in shut down mode in an effort to reduce the possibility of radiation leakage. Radiation in high doses can be dangerous to a persons health if said person endures exposure for any period of time, the effects being more drastic for higher levels of radiation [1]. There are few, if any, low cost radiation detection instruments that allow a person to safely take measurements at various locations without ever having to be exposed to the hostile environment themselves, let alone move from a single spot. The objective of this proposed project is to have a person remotely gather radiation data via a quadcopter. The idea is to equip a quadcopter with various sensors that would allow for flight to multiple locations, tracking the data as it flew. The sensors that are included on the quadcopter are: a Geiger counter, a video camera, a GPS navigation system and a thermal array. With these sensors one would be able to remotely fly the quadcopter into a radioactive plume, take measurements from the Geiger counter while plotting the data as pinpoints to a map, all the while having a live streamed video feed. A custom made interface for the controller would allow one to switch between live stream video feed, and the thermal array overlay to detect any heat signatures exposing any potential leaks.

ECE-06
SUBWOOFER AMPLIFICATION SYSTEM

Advisors: Dr. Bahram Nabet, Joe Land Indy Audio Labs

Team:

Gavin Bence	Electrical Engineering
Jeff Boman	Electrical Engineering

The goal of the design project is to make a commercially viable, biamplified, rack-mountable subwoofer amplifier. This amplifier will have webbased application control and sound quality optimization through selectable highpass, low pass, and crossover frequencies. This subwoofer amplifier will power 2 binding post outputs each with 250 watts. It will have an active frequency crossover network, output level control, and various other settings that will be subject to change through the Web-App.

ECE-07
WIRELESS POWER TRANSFER FOR SMART TEXTILE APPLICATIONS

Advisors: Dr. Kapil Dandekar ECE, Dr. Genevieve Dion CoMAD, Dr. Yury Gogotsi MSE

Team:

Andrea Cook	Electrical Engineering
Jonathan Fisher	Electrical Engineering
Michael Le	Electrical Engineering
Stephen Watt	Electrical Engineering

A novel wireless energy harvesting system knit with conductive textile materials is currently being developed to enable powering of sensors in body-worn applications. Several PCB rectenna prototypes have been de- signed and fabricated, with the best performing design demonstrating a recti_ed voltage of 0.20V at the 2.45GHz Wi-Fi band. This antenna design has been translated into a textile form factor yielding an antenna structure with an acceptable resonance of -17dB at 2.45GHz. Next steps include exploring a connection method between fabric and electrical components, as well as fabrication of the power management (voltage boosting) circuit for the harvesting system. The boosting circuit will be used to provide a workable voltage for charging a supercapacitor using the DC voltage from the rectenna.

ECE-08
FORMULA HYBRID/SAE ELECTRIC CAR DESIGN

Advisor: Dr. Kevin Scoles

Team:

Chizi Anyene	Electrical Engineering
Jacob Chapman	Electrical Engineering
Scott Kirkwood	Mechanical Engineering
Kameron Palagi	Mechanical Engineering

The Drexel Formula Hybrid/SAE Electric Car Design project's scope is to design, simulate and construct all electrical aspects of a new electric race car model, from accelerator pedal to motor, and everything in between. Due to racing regulation changes and insufficient serviceability of Drexel's previous (2011) car model, a full redesign is required. The design consists of three major subsystems: the shutdown circuit, drive train and tractive system. Completion of the project includes research of current racing regulations, high and low voltage electric system design, circuit simulation, parts specification and procurement, construction, testing, and failure analysis. The final product deliverable is a full working electrical system on a test board (punchboard). A Failure Modes and Effects Analysis (FMEA) study and an Electrical System Form (ESF) will be published with the design, and are required for a final vehicle to be qualified to race.

Drexel's 2011 electric race car, as well as other competing university's cars, have been referenced in creating the new electric system design while implementing modifications and newer technologies. Work completed to date includes researching and understanding Formula Hybrid (FH) and Formula SAE (FSAE) regulations and the car's shutdown circuit, as well as a small amount of work in the drive train. The high level shutdown circuit design is complete, as well as the brake system plausibility device design. The design has been simulated, parts have been specified and are ready to procure. In the drive train, the throttle encoder design is partially complete. Lastly, a detailed parts list has begun to be generated, detailing which parts are owned, which may be removed from the previous car model, and which need to be ordered.

ECE-09
POWER AGILE KERNEL MODULE FOR ANDROID PLATFORM

Advisos: ***Dr. Mark Hempstead***

Team:

Isuru Daulagala	Electrical and Computer Engineering
Xin Guan	Computer Engineering
Pavan Kantharaju	Mechanical Engineering
Zachary Lee Schoenstadt	Mechanical Engineering

Mobile consumers typically list battery life as one of the most important features of their devices. Components of mobile devices, such as networking, audio, and screens, depend on battery life to give users the best experience on their devices. Yet, energy density of batteries have scarcely improved over the last two decades. Therefore, mobile designers have turned to power management techniques to improve battery life by decreasing power and energy consumption. Mobile user habits are very diverse. Therefore it is very difficult to devise to general solution. Current power management techniques are rudimentary and are not adaptive to user habits. This project aims to devise a user specific solution to conserve mobile power and energy by adapting the mobile device and by scaling frequency of the GPU.
The project will consist of three primary system components: Runtime Monitor, Usage Classifier, and Power Manager. The Runtime Monitor will intercept user event, buffering data for the Usage Classifier, and notifying the Power Manager. The Usage Classifier will classify the users habits based on the users individual habits, using machine learning. The Power Manager makes use of learned user interaction pattern statistics to run its energy management algorithms.

ECE-10
PARALLEL ALGEBRAIC RECONSTRUCTION FOR MEDICAL IMAGING

Advisors: ***Dr. Nagarajan Kandasamy, Greg Sharp MGH***

Team:

Arda Aridici	Electrical and Computer Engineering
William Goehrig	Computer Engineering
Kyle Juretus	Electrical and Computer Engineering
Dave Werner	Electrical and Computer Engineering

The purpose of the “Parallel Algebraic Reconstruction for Medical Imaging” project is to implement the Algebraic Reconstruction Technique (ART) as a tomographic reconstruction algorithm for CT scanners with the goal of reducing the number of 2D projections required to reconstruct the 3D volume. By limiting the projections required for the reconstruction, the radiation exposure of the CT scan is also reduced. While ART has been shown to reduce the required projections needed for reconstruction, the major concern with ART is that current implementations are slow compared to filtered back-projection. To address this concern NVIDIA’s CUDA programming interface, which extends the C language to program GPUs, will be used to extract the parallelism from the ART algorithm. By utilizing the GPU, it is anticipated that the reconstruction of a single projection will be on the order of a few seconds, which would make ART a feasible replacement for filtered back-projection.

ECE-11
MONITORING PHASE ANGLE MEASUREMENT DEVIATIONS TO AID IN MONITORING SYSTEM VIOLATIONS OF HIGH VOLTAGE POWER SYSTEMS

Advisor: ***Dr. Dagmar Neibur***

Team:

Jared DelColombo	Electrical Engineering
Jessice Koh	Electrical Engineering
Kyle Martin	Electrical Engineering
Jignesh Pande	Electrical Engineering

This project was developed to observe and analyze voltage and current phase angle measurements on a power system captured by Phasor Measurement Units (PMUs) placed at certain substations in the system. Using the PMU phase angle data, a method to determine the condition of the system under abnormal system operation such as large changes in load and faulted equipment. This is accomplished by analyzing and developing a statistical approach to determine deviations from phase angles captured at a substation under normal, unconstrained system operation, and also in abnormal system operations.
In the scope of the project, data was generated using MATPOWER, an open-source MATLAB files developed by Cornell University. The phase angle data collected from the PMUs were observed under various assumptions, which depict a normal and abnormal system.

ECE-12
MOMENTARY OVERLOAD WITHHOLD CAPABILITIES FOR STATIC FREQUENCY CONVERTERS

Advisors: ***Dr. Chika Nwankpa, Tiffany Lakins, Jonathan Schimpf Burns Engineering***
Brandon Swartley Systra

Team:

Jay Giunta	
Marsiana Hoxholli	Electrical Engineering
Stanley Muzylowski	Electrical Engineering
Chun Lung (Kyle) Ng	Electrical Engineering

The technology for electrical current uses massive copper machines (motors, generators) to supply power to dynamically-loaded power systems. The mass and heat dissipations and qualities of the copper allow the machines to handle momentary overloads without adverse effects. Some industries are trying to move to steady-state electronics to replace expensive and hard to maintenance machines, such as static frequency converters (SFCs).
This could lead to the replacement of motor-generator sets for the purpose of power frequency conversion in large power systems. Currently, solid-state devices cannot reliably handle momentary overloads and the imposing inrush current that can affect the semiconductor components, such as diodes, MOSFETs, transistors, etc. Therefore, SFCs are not yet a contender in large dynamically-loaded power systems (railroad and transit).
This report will cover the concepts used to prevent inrush current with static frequency converters. Also, it will provide a method that could use SFC implementation including simulations in Cadence PSpice and hardware simulation of small scale models developed with semiconductor devices readily available in the industry.

ECE-13
SMARTPOWER STACK DIAGNOSTIC SYSTEM

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

Team:

Todd Bickel	Electrical Engineering
Dylan Dignan	Computer Engineering
AJ Elliot	Electrical Engineering
Kevin Tucker	Electrical Engineering
Tyler Wildman	Electrical Engineering

The SmartPower Stack, a product sold by AgileSwitch, is used as a subsystem inside inverters for energy conversion. This PowerStack is comprised of three Insulated Gate Bipolar Transistor (IGBT) modules as well as many other integral components. When a customer's PowerStack fails, companies simply remove the PowerStack and replace it without performing any analysis concerning the failure. Simply replacing a PowerStack without knowing the root cause of the failure is an inefficient solution. This creates the necessity for a diagnostic system that can collect normal operational data as well as data at the time of failure. The proposed diagnostic system will be able to display real-time PowerStack data to a user and log historical data to a remote server for post analysis. The data collected from this diagnostic system can be used for PowerStack improvement, production testing, and failure prediction. The user of this diagnostic system will not only be able to view their data on a computer, but also on a mobile device such as a cell phone to allow troubleshooting of a PowerStack while out in the field.

ECE-14
CROWDSOURCING FORENSICS

Advisor: ***Dr. Pramod Abichandani***

Team:

Aishwarya Sivaraman	Computer Engineering
Timothy Wade	Computer Engineering

The two major objectives of this project are to provide a dataset of laypeople handwriting forensics performance and to create an intuitive system that will allow the user to quickly deploy image based crowdsource tasks to Mechanical Turk (Mturk). The system and the resulting datasets will accelerate both handwriting forensics data science. Specifically, crowdsourcing the collection of laypeople handwriting forensics performance will generate a much larger and diverse dataset than those used in past research. Due to the influential role of testimony provided by Forensic Document Examiners (FDE) it is essential that researchers determining the efficacy of FDEs have a diverse and accurate point of comparison. The system has been designed to be abstract enough for use with any type of image based crowdsourced task. The configuration used here leverages Amazon Web Services. To the best of our knowledge, this is the first implementation of a system that enables researchers to study croudsourced handwriting forensics data. The modular design allows for use with any system that provides the necessary resources. This paper documents the team's current progress toward implementing the chosen design and collecting the required datasets.

ECE-15
ADVANCED VISUAL DISPLAYS FOR CONCERTS AND MUSICAL PERFORMANCES

Advisors: Dr. Pramod Abichandani, Jeff Gregoria, Luke Schantz

Team:

Colin Crandell	Computer Engineering
Nick Garthoff	Computer Engineering
Emeka Nnachetta	Electrical Engineering
Saurin Sethia	Electrical Engineering

The importance of the particular problem related to the use of unmanned vehicles in concert use is that it enhances an already interesting experience. It takes a unique experience and makes it even more unique and exciting by using unmanned vehicles to deploy various features, while utilize lighting and motor control techniques, as well as possible projection and sound enhancement techniques. The proposed method of reaching the team's objective is to first focus on one arm to fully model a finished arm feature, which will eventually be turned into eight arm features attached to one central hub. Along these same lines, another method being used to resolve the problem at hand is computer aided design for the purely physical hardware involved, as well as three dimensional printing and use of machine shop fabrications. In terms of developing a concept of what is desired to be achieved, three dimensional software modeling is being used to create a simulation of how the final arm will act once physically deployed. In addition, beat tracking is being used to allow both an autonomously operated mode as well as a manually controlled mode with a graphic user interface that can be chosen by the operator of the vehicle at the given event. Also being included is an interface that will allow the developer to make changes on the fly through an interface that links a raspberry pi to an Arduino, with the Arduino being the main microcontroller that controls the rotational speed of features, as well as the expansion and contraction of the arm.

ECE-16
UNDERWATER ROBOT

Advisor: Dr. Pramod Abichandani

Team:

Phoebe Loh	Electrical Engineering
Jinwei Ren	Electrical Engineering
John Mattes	Electrical Engineering
Bang Tran	Electrical Engineering

Underwater robotics is an important area of robotics for various reasons. Underwater robots can be used for national security, in forms of surveillance and patrolling, and ship hull inspection for explosives or other threats. Other uses include environmental monitoring, including checking for pollution in different forms. The team's goal is to create a platform that can be used for research in developing motion planning algorithms involving multiple robots working together on a task or mission while maintaining connectivity and communication between robots. The team's design involves the use of three motors to allow for adequate control in a three dimensional body of water. The team's design provides a robot hull that is accessible for electronics and allows for the addition of various sensors needed for a specific task. The robot allows for full customization in the weight and Buoyancy distribution to allow for different electronic load outs. In order to allow for more freedom of the robot, the robot is tethered to a receiver that will float on the surface of the water to allow for wireless transmission to the robot itself. The robot will be controlled via inputs into an XBox controller which a PC processes the commands and sends packages wireless to the robot. This allows the team to see how the robot behaves with different commands and motor speeds in order to develop semi-autonomous controls with motion planning. Overall this platform will be effective in underwater movement and create the first usable platform for future Drexel research teams and projects.

ECE-17
FAST DATA ACQUISITION SYSTEM FOR A GYROTRON

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

Team:

Carl Breuninger	Electrical Engineering
John Carto	Electrical Engineering
Colin Child	Electrical Engineering
Charles Green	Electrical Engineering
Jon Stanley	Computer Engineering

Pulsed power is a technology capable of delivering substantial amounts of power. It accomplishes this by first consolidating energy over a (relatively) longer period of time and then releasing it all at once as a means to increase instantaneous power output. The U.S. Naval Research Laboratory (NRL) has initiatives which use pulsed power in order to supply energy to various types of equipment, such as a gyrotron. However, rapid technological advances in the area of pulsed power have resulted in a need for a system that can capture and analyze data in a small amount of time. As such, NRL has expressed interest in a fast data acquisition system that analyzes real-time system state to determine if operation of the pulsed power device should continue. The proposed system uses a combination of pattern recognition and other techniques to form a stability profile and make an accurate decision. The system allows modification of the parameters affecting this decision and thus is reconfigurable to suit the end user's needs. Other auxiliary concerns addressed by the proposed system include a need for detailed state information and a way of archiving the data for the purpose of further analysis at a later time.

ECE-18
ACTIVE POWER FILTER DESIGN

Advisor: ***Dr. Chika Nwankpa, Sachi Jayasuriya***

Team:

Arnav Bagga	Electrical Engineering
Vivek Jani	Electrical Engineering
Dennis Ruto	Electrical Engineering
Sunny Verma	Electrical Engineering

Pulsed power is a technology capable of delivering substantial amounts of power. It accomplishes this by first consolidating energy over a (relatively) longer period of time and then releasing it all at once as a means to increase instantaneous power output. The U.S. Naval Research Laboratory (NRL) has initiatives which use pulsed power in order to supply energy to various types of equipment, such as a gyrotron. However, rapid technological advances in the area of pulsed power have resulted in a need for a system that can capture and analyze data in a small amount of time. As such, NRL has expressed interest in a fast data acquisition system that analyzes real-time system state to determine if operation of the pulsed power device should continue. The proposed system uses a combination of pattern recognition and other techniques to form a stability profile and make an accurate decision. The system allows modification of the parameters affecting this decision and thus is reconfigurable to suit the end user's needs. Other auxiliary concerns addressed by the proposed system include a need for detailed state information and a way of archiving the data for the purpose of further analysis at a later time.

ECE-19
REAL-TIME REACTIVE JAMMING IN WIRELESS NETWORKS

Advisor: ***Dr. Kapil Dandekar***

Team:

Shayna Allen	Electrical Engineering
Paul Stauskas	Electrical Engineering
John Tangradi	Electrical Engineering

Reactive jammers are able to identify signals in wireless mediums based on the standard and reactively jam packets of information that are already in the air. The purpose of this project is to improve already existing reactive jamming technology created by Drexel's Wireless Systems Lab (DWSL) so that it can identify packets from standards other than 802.11g (Wi-Fi) such as, 802.16e (WiMax) or 802.11a/n/ac and reactively jam them. This prototype of a real-time capable, channel-aware, reactive jammer will be developed using GNU Radio, the Universal Software Radio Peripheral (USRP), N210 software-defined radio (SDR), custom field programmable gate array (FPGA) design, and custom firmware design. Our team will be expanding on the existing technology developed by DWSL to successfully detect and jam overthe-air packets using digital signal processing techniques. The reactive jammer will successfully jam packets of information from a specified network in real time.

ECE-20
SMALL-SCALE SOLAR POWERED SYSTEM

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

Team:

David Carney	Electrical Engineering
Maxwell Nyoni	Electrical Engineering

In rural areas of Africa, most citizens do not have access to electricity. This is because fuel sources and power plants are few and far to come by. Providing a way to charge cellular devices and DC lighting systems is in demand, and for many, the only means of doing so is through on-site generation.
The objective of this project is to design a photovoltaic system which will provide African villages with an efficient way to power their electronics. By providing the citizens with the specifications and blueprints produced in this project, we hope to alleviate the hardships of designing and installing such a system.
The proposed methods of reaching our objectives are research, simulation, and testing. With the specifications proposed below, we will build a prototype of the system and test the output so that it is congruent with the needs of African citizens. In addition, the schematics and specifications produced will be provided to a Malawi village at no cost to them.

ECE-21
STORY--DRIVEN MULTIPLAYER AUGMENTED REALITY ADVENTURE GAME

Advisors: Dr. Youngmoo Kim, Santiago Ontanon

Team:

Aaron Bilenky	Electrical Engineering
Kazim Bukhari	Electrical Engineering
Awais Ghayas	Electrical Engineering
Matt Lawrence	Electrical Engineering

"A portal to a parallel world has appeared, a world abundant in resources. Factions vie for control of the colonization of this parallel world, and the trade and auction of its wealth. Which group will you represent in this amazing world of countless treasures? How will you forge your path through the uncharted future?" In traditional location--based games, player interaction is not emphasized for two reasons: it is hard to design a method for players to connect virtually while in the real world in a seamless fashion, and it is difficult to construct a gameplay design around this constraint even if such a method is formulated. We propose that a combination of Bluetooth and GPS location technology be used in such a way to provide a secure Ad--Hoc network between the phones of strangers. The gameplay we are designing centers on the mechanic of haggling. By constructing a virtual economy, replete with resources and ways to spend such resources, we hope to incite a passionate player--driven economy, similar to the one seen in EVE Online and other MMORPG games [13]. This solution is ideal because it will also allow us to narratively influence the mechanics of the game, providing a dynamic narrative built on the ways players choose to interact with each other and trade their resources. We can give players more tools to work with when they interact in haggling scenarios, such as the ability to steal from a nearby trade, to make trading even more enticing.

ECE-22
POWER-ASSISTED "FOLLOW ME" OXYGEN TANK CART

Advisors: Prof. Thomas Chmielewski

Team:

Julie Lin	Biomedical Engineering
Nicholas Ross	Electrical Engineering
Hunter Valentine	Mechanical Engineering
Rachel Wang	Biomedical Engineering

Our project mission is to design and develop "follow me" technology which assists in pulling a device. For demonstrating the applications of this technology, we will design the project on a smaller scale. The project will focus on the issue that many elderly patients using respiratory systems encounter on a daily basis. The cumbersome oxygen tank is most commonly towed using a small portable hand cart; however, due to the bulky and heavy nature of the tank on the cart, it is counterintuitive for respiratory-impaired patients to physically overexert themselves to transport the very thing that sustains their life. The primary goal is to design and build a low cost power-assisted oxygen tank cart to demonstrate this technology. The secondary goal is to create a business plan that reserves the "follow me" technology for future development and intellectual product ownership.

ECE-23
LOAD LEVELING BATTERY ENERGY STORAGE SYSTEM IN AREAS WITH PHOTOVOLTAIC GENERATION

Advisors: Dr. Chika Nwankpa, Jesse Hill

Team:

Matthew Helker	Electrical Engineering
Christopher Vaile	Electrical Engineering
Matthew Yoder	Electrical Engineering

The electricity demand of both residential and commercial customers is a constantly changing characteristic of large scale power systems. This is a challenge that utility companies all over the world are faced with every day. One of the methods that is currently being used to help with the challenges created by fluctuating load during peak demand is called load leveling. The basic premise behind load leveling is that energy during off-peak times is stored using some form of an energy storage system. During peak demand times, this energy that was stored previously during off-peak times is discharged to the load. There are many benefits to approaching energy management in this fashion from both the utility and customer point of view.

The objective of this project is to provide successful load leveling capabilities to a simulated commercial customer using a battery energy storage system (BESS). This particular battery storage system will be incorporating the functions of 1.6kW of photovoltaic (PV) generation in order to maximize load leveling capabilities and enhance voltage regulation of the battery units. Both lithium ion and lead acid batteries will be considered with the PV generation.

Through successful implementation of a load leveling algorithm incorporating both the batteries and PV generation, quantifiable results will be presented detailing the positive impact seen by the commercial customer, as well as the utility company.

ECE-24
REDESIGNING SIMON, A SEQUENTIAL MEMORY GAME

Advisor: Dr. Thomas Chmielewski

Team:

Kante Abdoulaye	ECE
Dickens Omondi	Electrical Engineering
Matthew Sattel	Computer Engineering
Jason Simon	Electrical Engineering
Ryan Soliwoda	Computer Engineering

Simon is a patented microcomputer controlled sequential memory game which was popular in the 1980s. The patent has since expired. The objective of this project is to implement the expired patent (US patent # 4,207,087, Morrison, et al, June 10, 1980) [1] for the Milton Bradley Simon hand held game using current technology. The group's design will retain the classic Simon game's functionality, while incorporating new features to provide a better user experience, and to popularize the game in the current gaming market. The methodology will involve studying the expired patent to gather information, obtaining and reverse engineering a copy of the original (patented) hand held game to match the claims to the actual device and understand how it works, obtaining and reverse engineering the latest version of the game to see the improvements so far made to the original game, coming up with the team's design, programming the game and making two working prototypes. At the end of the project, the group will deliver two working hand held games demonstrating detailed improvements on the original game, and a website for the game.

ECE-25
NON-DESTRUCTIVE TESTING OF STEEL CABLE DEFECTS

Advisor: ***Dr. Iman Salama***

Team:

Andrea Pavia	Computer Engineering
Michael Swiencki	Electrical Engineering
Jenna Zegrino	Electrical Engineering

The project is the investigation of a non-destructive testing approach for inspecting steel cable used for arresting aircraft aboard aircraft carriers. The progress made since the initial proposal includes the design of the sensors and the circuitry required for defect detection. A signal generator was constructed and an encoder for distance detection was conceived and tested. The code for the Arduino as a data acquisition device was written as well as Matlab code for data analysis, processing and display via a graphic user interface (GUI). There were repeated tests of each system, and a mechanical prototype was designed for fabrication and construction. Sensors were made to measure the effects of the induced currents by winding magnetic wire into coils which were conceived, constructed, tested and then refined. A differential circuit was designed and modeled in PSpice and then implemented and refined in the lab. An optimum operating frequency was established and a signal generator was constructed from a LCM555 timer which was tuned to that frequency. Defects were found and located through testing and the results recorded.

MEM-01
REAL-TIME AUTOMATED FATIGUE CRACK GROWTH MEASUREMENT

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

Team:

Stephen Chant	Mechanical Engineering
Ryan Gallagher	Electrical Engineering
Justine Malandra	Mechanical Engineering
Matthew Papineau	Electrical Engineering

A prototype for an automated fatigue crack growth measurement system has been designed, fabricated, and validated for testing in accordance with ASTM E-647. The project is sponsored by the Federal Aviation Administration (FAA) Technical Center in Atlantic City. The automated fatigue crack growth measurement device is capable of detecting, monitoring, and measuring crack growth under cyclic loading using pattern recognition software. Through intersystem connections, images are automatically captured and transferred to the program for analysis. A camera is mounted to a two-degree-of-freedom system, in order to allow precise tracking of the crack tip through its progression. The all-inclusive stand, consisting of the two-degree-of-freedom system and a rigid base, allows for easy setup, storage, and transportation. The crack growth measurements are synchronized with the corresponding load cycle to produce the necessary data, such as the characteristic crack growth rate vs. stress intensity plots, in real time.
Sponsor: The Federal Aviation Administration

MEM-02
MODULAR ESCALATING WHEELCHAIR LIFT

Advisor: Dr. Jonathan Awerbuch

Team:

Jordan Berman	Mechanical Engineering
Steve Eggert	Mechanical Engineering
Giancarlo Migliuolo	Mechanical Engineering
Nick Raiser	Mechanical Engineering

Due to injury or illness, nearly 7 million people in the United States required the use of a mobility assisting device in the year 2000. 1.7 million required the use of a seated device - a wheelchair or scooter. Under 40% of wheelchair users live in a single floor home, and less than 20% have an elevator, chair lift, or stair glide available. These existing solutions have high costs, additional installation costs, obtrude the stairway, and many require assistance from an able-bodied person.

After deciding between several different solutions, a novel device was designed. This device was designed, among other benefits, to be affordable, to keep the stairway clear when not in use, to be modular, to not require assistance, and to be easy to assemble. These design advantages were achieved using innovative methods in order to perform existing functions. Using lightweight, low-cost materials a prototype was assembled and tested.

MEM-03
DESIGN OF A DISSOLVE AIR FLOATION SYSTEM TO CONCENTRATE WASTEWATER GREASE

Advisor: Dr. Richard Cairncross

Team:

Andrew Bihl	Mechanical Engineering
Joshua Gover	Mechanical Engineering
Colin Stacy	Mechanical Engineering / Chemical Engineering
Samantha Starkey	Mechanical Engineering

Trap grease, a mixture of lipids, greases, food particles, and mostly water, is a waste product of the food service industry. Research at Drexel University has focused on extracting the lipid layer of the trap grease and turning those lipids into biodiesel. Dissolved Air Flotation (DAF) systems are common throughout wastewater treatment systems. Creating a system that can separate and discharge wastewater safely to sewers so that all components of trap grease can be separated and treated at prices that are lower or equal to current disposal costs can greatly benefit trap grease haulers and companies that process each component of trap grease. A small scale DAF system was constructed and designed to understand the effectiveness of a DAF system on the separation of trap grease into its water, lipid, and sediment layers in an energy efficient manner so that each component can be disposed of separately.
Sponsor: The Boeing Company

MEM-04
THE DREXEL RIDE PROJECT – CONTROLS TEAM

Advisor: Dr. Bor-Chin Chang, Dr. Paul Diefenbach (CoMAD)

Team:

Md Shafayat Alam	Mechanical Engineering
Khaled Alsuwaidi	Electrical Engineering`
Saket Dalal	Mechanical Engineering
Michael Sinja	Mechanical Engineering
Terrence Willocks	Electrical Engineering

The Drexel Ride is a 3-DOF motion platform simulator ride used for educational, entertainment, and research purposes across the university. It provides a sense of virtual reality by implementing its motion capabilities (heave, pitch, and roll) simultaneously with its visual display. The existing software used to operate this ride is limited by lack of direct inputs, which restricted control and functionality of the system. A new interface was designed and created that allows engineers to fully control, and simulate any desired motion. The NI CompactRIO is a control and monitoring device that was embedded into the existing system by electrically mapping the previous system using reverse engineering processes. The dynamics model created by the Dynamics team was then used to verify the signal responses recorded by the system. This provided the engineers with a complete command of the system utilizing optimized closed loop controls, and thus significantly enhanced the performance of the ride.
Sponsor: National Instruments

MEM-05
MEASUREMENT OF LIQUID HEIGHT VARIATION IN A CAPILLARY TUBE

Advisors: Dr. Young Cho, Dr. Bor Chin Chang

Team:

Rishi Dubey	Mechanical Engineering
Aman Kumar Talawat Jain	Electrical Engineering
Alex Nash	Mechanical Engineering
Bilal Sheikh	Mechanical Engineering
Harshdeep Singh	Mechanical Engineering

At present, there are limited means to determine liquid flow rates in micro and nano-channels, thus creating the motivation to design a device which would use the height change with respect to time through which flow rate would be calculated. The flow rate of any liquid travelling through a transparent vertical tube can be determined by differentiating the height change in height with respect to time to obtain velocity. This velocity can then be utilized to determine the rate at which the fluid flows through the channel. The team carefully examined four unique concepts which included an LED system, a laser system, a resistance wire method, and finally a glowing ball mechanism. Primary stakeholders include university researchers, pharmaceutical companies, medical device manufacturers and physicians. After careful considerations including cost efficiency, reliability and safety of the proposed device, the LED system proved to be the best option among all the alternatives.

MEM-06
PR441 ALZHEIMER'S DISEASE TESTING DEVICE

Advisor: Dr. Alisa Morss Clyne

Team:

William Hanna	Mechanical Engineering
Joseph Piombino	Mechanical Engineering
Derek Preston	Mechanical Engineering
Aaron Szymborski	Mechanical Engineering

Alzheimer 's disease is a leading cause of dementia, and there is currently no treatment. Dr. Marenda has developed a fruit fly model to study the disease. However, it is time consuming to test memory in individual fruit flies. The MEM senior design team has developed a testing apparatus that helps increase experiment efficiency when testing fruit fly memory. The concept began as a low profile grid with heated tiles to train fly memory. The latest design, and the final prototype, used electrical shock in place of heat as the memory enforcing method. Associative memory can be further trained using two different odor stimuli and/or two different light stimuli. Lastly, efficiency is improved though automation; the entire testing procedure is controlled via a customizable program on a computer with LabVIEW software. Stakeholders in this endeavor include pharmaceutical companies, biologists, researchers of memory and Alzheimer's disease, and those with Alzheimer's disease.

MEM-07
DESIGN, CONSTRUCTION AND TESTING OF CONTROL UNITS TO PREVENT WATER WASTE AND FLOODING IN HOMES

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

Team:

La' Shell Jones	Mechanical Engineering
Jared Kern	Mechanical Engineering
Matthew Scholl	Mechanical Engineering

Unattended water leakage in homes can cause large amounts of monetary loss in both damaged property and water loss. To prevent these losses a detection and control system was designed, built, and tested for two specific applications. The first application was for toilets that malfunction and fail to shut off the water supply after the toilet bowl has emptied. The second application was for shutting down the main water supply line when continuous, unintended flow is detected in the main. Several novel concepts were proposed and compared, and the best design encompassed a programmable micro-controller allowing the device to measure the amount of water being used and for how long. If a leak or other water waste was detected, the controller sent a signal to close an automatic ball valve, shutting off the water flow. The concept was built and successfully tested to prevent water loss in conditions simulating a leaking toilet.

MEM-08
DESIGN AND CONSTRUCTION OF A CRYOGENIC PULSE TUBE REFRIGERATOR WITH ACTIVE MECHANICAL PHASE SHIFTING

Advisors: ***Dr. Bakhtier Farouk***

Team:

Nham Dinh	Mechanical Engineering
Bryan Jen	Mechanical Engineering
Quan Le	Electrical Engineering

The objective of this project was to design, build, and test a pulse-tube thermoacoustic refrigerator with active mechanical phase shifting. A thermoacoustic refrigerator is a device that uses high-amplitude sound waves to generate a thermal gradient to induce refrigeration. The group spent fall term performing computer simulations and researching three different types of cryocoolers: passive, active mechanical, and active electrical. Active mechanical was chosen due low relative cost and its ability to meet the required 2W cooling power and 70K temperature. Further simulations were done in the winter to calculate the dimensions of parts for idealized performance. As of this writing, the group has obtained and constructed the majority of parts needed before pressurizing the system. At the conclusion, the team will have completed the remaining parts required for an active mechanical system. It is expected that the design can be used in a multitude of fields including cryosurgery and space-related applications.
Sponsor: Boeing

MEM-09
DESIGN AND CONSTRUCTION OF A SUPERCRITICAL FLUID (CO2) FLOW REACTOR

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

Team:

Engin Aktas	Mechanical Engineering
Ashley Brooks-Torrence	Mechanical Engineering
Thang Nguyen	Mechanical Engineering

Food and cosmetic industries frequently require specific elements that can only be obtained after an extraction process. Often times, these extraction methods (which require chemicals such as methanol and ethanol) leave behind harmful residues that can have an adverse effect on the consumer. Researchers have determined that using supercritical CO2 as a solvent will complete an extraction process without leaving any remains behind. Unfortunately, the yield from this procedure does not suffice its production cost. For this reason, a laboratory scale supercritical flow reactor was created to allow fundamental investigations of heat and mass transfer processes in supercritical fluid (CO2) flow under a variety of operating conditions. This lab-scale extractor will allow researchers to continue developing and improving the novel heat and mass transfer processes in supercritical fluids so that it will be more commonly used across various industries. This will lead to the application of safer and sustainable technology.

MEM-10
DESIGN OF A ROBOT TOUR GUIDE/USHER

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

Team:

Tyler Aaron	Mechanical Engineering
John Burchmore	Mechanical Engineering
Ian DeOrio	Electrical Engineering
Jeff Gao	Mechanical Engineering

Many buildings today, such as government institutions and laboratories, are secured to restrict access to only people with proper clearance. Due to this security precaution, guests often experience difficulty entering and finding their destination. The numerous Mechanical Engineering and Mechanics (MEM) research laboratories within the Science Center serve as prime examples of this issue. Lab members with valid ID cards often suffer decreases in work productivity due to the task of escorting visitors into the building. While the option of employing an individual to serve as a dedicated ID card “usher” is plausible, it is not very feasible as the job itself would be very menial. Utilizing an autonomous robot with the ability to identify and guide human visitors solves this issue. Designed as a case study with broader implications, this project developed a robotic guide/usher to perform this task.

MEM-11
COOPERATIVE AIR AND GROUND AUTONOMOUS VEHICLES FOR NUCLEAR MONITORING - AIR (PR408A)

Advisor: Dr. M. Ani Hsieh

Team:

Alison Krick	Mechanical Engineering
Thanh Nguyen	Mechanical Engineering
Dayu Zhang	Mechanical Engineering
Jaymeen Shah	Mechanical Engineering
Vincent Truong	Mechanical Engineering

UAV usage is continuously increasing for recreational purposes, monitoring, and performing various tasks. Companies are limited to the current UAVs which require constant human attention and have poor flight and charging time efficiencies. An autonomous aerial drone surveillance and recharging system was created using the library tool, Robot Operating System (ROS) and MATLAB via Inter-Process Communication (IPC). Images taken by cameras onboard the drone was used to derive positional information via color segmentation and shape/blob recognition in MATLAB. Controlled movements calculated from the drone's position were transmitted back to the drone. By creating a precise control system, the drone approaches its desired landing platform and proceeds to land in an optimal, correctly oriented position. This design project would potentially allow a system of autonomous drones to become practical for businesses or government use which would benefit human safety concerns and overall efficiency.

MEM-12
COOPERATIVE AIR AND GROUND AUTONOMOUS VEHICLES FOR NUCLEAR MONITORING – GROUND

Advisors: Dr. Ani Hsieh, Dr. Christopher Peters

Team:

Krishna Baweja	Mechanical Engineering
Stephen Brennan	Mechanical Engineering
Jeremy Lim	Mechanical Engineering
Stephen Mich	Mechanical Engineering

The cooperative air and ground vehicles for nuclear power plants will autonomously monitor the health and safety of a nuclear power plant floor and aerial environment to enhance the safety and security of the environment. To achieve this objective, this project will develop an autonomous ground vehicle to monitor the floor of the plant in addition to supporting the charging demands of the aerial vehicle. The goal of this project is to provide a proof of concept to illustrate the feasibility of autonomous monitoring a nuclear power plant floor while supporting the charging needs of the aerial vehicle. Our group will determine whether or not it is feasible to monitor a nuclear power plant floor while accommodating for the needs of the aerial vehicle counterpart based upon the results from the proof of concept testing.

MEM-13
BIOLOGICALLY INSPIRED FLAPPING WING MICRO AERIAL VEHICLE

Advisor: Dr. MinJun Kim

Team:

Jun Young Kim	Mechanical Engineering
Lincoln Lagasi	Mechanical Engineering
Josue Louis	Mechanical Engineering
Donghyeok Shin	Mechanical Engineering
Varun Varghese	Mechanical Engineering

The proposed project was to create a biologically inspired flapping micro aerial vehicle (FMAV) based on the flight of the Allomyriana Dichotoma beetle. The surveillance need for an unmanned vehicle with high level of maneuverability and small footprint is shared by many fields such as the military, civil infrastructure, and commercial. Our focus was to advance the gear mechanism and decrease overall weight. Several gear mechanisms were explored using computer simulation and physical prototypes to determine the best option. The prototypes were constructed using mainly 3D printing. The final work was tested for its flight dynamics in comparison to the actual beetle's using a wind tunnel built specifically for this smoke test.
Sponsor: Wright-Patterson Air Force Base (WPAFB)

MEM-14
MULTISPECTRAL AND MULTISCALE OPTICAL METHODS FOR STRUCTURAL HEALTH MONITORING

Advisors: Dr. Antonios Kontsos, Dr. Matthew McCarthy, Dr. Ivan Bartolii-CAEE, , Dr. Michel Barsoum, MSE

Team:

Sadaf Bahaza	Mechanical Engineering
Jeremy Monteiro	Mechanical Engineering
Harold Montilla	Civil Engineering
Aditi Ramadurgakar	Materials Engineering and Science

The objective of this project is to design a novel Nondestructive Testing & Evaluation (NDTE) technique that uses non-contact, full-field optical metrology methods in a multiscale and multispectral setting for Structural Health Monitoring (SHM). The design involved the use of Digital Image Correlation (DIC) and Infrared Thermography (IRT) to track deformation on structures using a thermally contrasting Quick Response (QR) Code pattern, thus resulting in Infrared Image Correlation (IRIC) measurements. To validate this approach, cantilever beam bend tests were carried out. The infrared images of the pattern were imported into the DIC software. The resulting data validated the execution of IRIC. The proposed approach could potentially allow the quantitative identification of civil infrastructure damage, including cracking, delamination and corrosion.

MEM-15
DREXEL FLYING DRAGON 100cc LAND SPEED MOTORCYCLE: ENGINE AND DRIVE TRAIN

Advisor: Dr. John Lacontora

Team:

Joshua Bryant	Mechanical Engineering
Barry Buchter	Mechanical Engineering
Anthony Dambrosio	Mechanical Engineering
Alex Nauman	Mechanical Engineering
Christopher Silva	Mechanical Engineering

Current land speed records for an A/G-100/2 motorcycle for the East Coast and Southern California Timing Associations stand at 82.053mph and 99.816mph, respectively. The purpose of this project is to develop and modify a Kawasaki KX100 two-stroke engine and drivetrain to help propel a singular rider to speeds in excess of 100mph. Modifications to a variety of subsystems are targeted to improve performance at high RPM ranges, in an effort to increase the top speed of the vehicle. While no one singular alteration of the vehicle will allow for speeds capable of exceeding the target, small improvements for a variety of subsystems will ensure the success of the project. Calculations reveal that the modified engine will have the potential to set new records at both the ECTA and SCTA events by propelling the vehicle to well over 100mph.
Sponsors: Boeing, Bike Works, Forward Motion, N-spire Performance

MEM-16
FLYING DRAGON-100CC LAND SPEED RECORD MOTORCYCLE: FRAME/AERODYNAMICS

Advisor: Dr. John Lacontora

Team:

Kaya Hontz	Mechanical Engineering
Edd Lalo	Mechanical Engineering
Skylar Olson	Mechanical Engineering
Franklin Sailot	Mechanical Engineering
Rylan Treffinger	Mechanical Engineering

The purpose of this project is to set an SCTA and ECTA land speed record for a 100cc motorcycle at over 100 mph. Because the motorcycle competed in both SCTA and ECTA racing, the design of the motorcycle had to satisfy both competitions rules and regulations. This project displayed the teams engineering capabilities and competitive drive to compete and set a world record. A light weight, and aerodynamic single cradle steel tube frame, as well as an aluminum girder style front suspension was developed and constructed, by use of a full CAD model to insure the structural stability and aerodynamics of the frame. In conjunction with the engine team, a custom land speed racing motorcycle was constructed and raced.

MEM-17
NAVAIR AUTOMATED FLIGHT DECK CART TUG

Advisors: Dr. John Lacontora

Team:

Brock Bailey	Electrical Engineering
Alexander Juskovic	Electrical Engineering
Tom Kusturiss	Mechanical Engineering
Damian Lawler	Electrical Engineering
Kanaan Salloum	Mechanical Engineering

The amount of manpower has proven to be the most critical asset on a military aircraft carrier. In order to maximize the available manpower on an aircraft carrier, automation is necessary. Using the autonomous tug would reduce the sailors needed for resupplying aircraft from 4-5 to 1-2 sailors allowing for more efficient use of manpower. The stakeholders for this project include Dr. John Lacontora, the United States Navy, and the RISE Lab under the NAVAIR Lakehurst Division. The goal of this project is to refine the tug design inherited from a previous senior design group to add semi-autonomous capabilities. The desired final outcome of this project is a semi-autonomous tug that would be able to take navigation commands from an operator while transporting a realistic load of three to five thousand pounds. The cart is also capable of following the operator under semi-autonomous operation. A suite of sensors in addition to a control system was designed for achieving this goal.

MEM-18
BLADE-LESS UNDERWATER PROPULSION DEVICE

Advisor: Dr. John Lacontora

Team:

Matthew Alfano	Mechanical Engineering
Dyton Clark	Mechanical Engineering
Michael Darlington	Mechanical Engineering
Patrick McPeak	Mechanical Engineering
Jordan Rupy	Mechanical Engineering

The stakeholders for this project consisted of underwater laborers, researchers, and military divers who have a need to move safely around a work site without the hassle of reorienting or cluttering their hands. A model was developed for a device that could propel the diver in multiple directions while offering a greater versatility of motion and hands free control. It also made use of a helical impeller and jet nozzles as opposed to a standard propeller so as to create a safer, more stable flow. The final device uses standard PVC fittings, a laser cut acrylic frame, and a thermoplastic shell to deliver a substantial amount of controlled thrust within a small space and tight budget. An Arduino controller allows the diver to set their speed and adjust directional thrust options. The final device proves to be a substantial improvement over all current personal underwater propulsion models.

MEM-19
PRESSURE-DIFFERENTIAL HYPERVELOCITY IMPACT RANGE (PHIR)

Advisor: Dr. Leslie Lamberson

Team:

John Barber	Mechanical Engineering
Andrew Canosa	Mechanical Engineering
Mike Lancellotti	Mechanical Engineering
Brenden O'Brien	Mechanical Engineering
Connor Whaland	Mechanical Engineering

With more than 100 trillion artificial objects smaller than 1 micron in low and geostationary Earth orbit, space assets are subject to the constant threat of space debris impact. These collisions occur at hypervelocity, or speeds greater than 1 kilometer per second. In order to characterize material behavior under this extreme event, as well as study next generation materials for space exploration, the project is to design and build a two-stage light-gas gun capable of replicating hypervelocity impacts. While a limited number of these types of facilities exist, they are extremely large, particularly costly, and rather dangerous to operate. This design is novel in that it does not use combustion in the first stage, and costs 1 to 4 orders of magnitude less to build and operate. The gas-gun initiates from a pressure differential, firing a projectile 1 to 3 km/s in order to accurately reproduce hypervelocity impact damage.

MEM-20
PROJECT CROFT

Advisor: Dr. Leslie Lamberson

Team:

Timothy Chua	Mechanical Engineering
Dylan Paproski	Mechanical Engineering
Joseph Rappazzo	Mechanical Engineering
Nikhil Tandon	Mechanical Engineering

Composite materials are becoming more commonly used to reduce the weight of structural components. A prototype rotary fatigue testing machine for a composite hybrid gear provided by NASA Glen Research Center will be tested. The composite hybrid gear will undergo a load vector of 300 pounds. The force vector is at an angle of 20 degrees below the horizontal causing an overturning moment. This applied load will rotate around the circumference of the disc at 5,000 rpm while trying to reach 25,000 rpm to achieve accelerated fatigue testing. During disc testing, deformation was measured using a combination of two-dimensional digital image correlation and laser displacement gauge. The major stakeholders are NASA Glenn Research Center and the aviation industry. The secondary stakeholders include the automotive industry, the power/energy sector and the marine/naval industry. A test fixture incorporating a motor, drive train and force applicator will be used to satisfy requirements.

MEM-21
HUMAN POWERED AIRCRAFT: POWER SYSTEMS

Advisor: ***Dr. Alan Lau***

Team:

Stephen Bercik	Mechanical Engineering
Steven Howell	Mechanical Engineering
Matt Kuttner	Mechanical Engineering
Emily Romani	Mechanical Engineering, Materials Science & Engineering

Human powered aircraft require the pilot to output power for the entire duration of the flight. Currently only Olympic class athletes can fly for long periods of time. The Royal Aeronautic Society of the United Kingdom, similar organizations, and small groups of pioneers are pushing technology forward. This project investigated two different power systems in order to make human powered flight more accessible to people who are not professional athletes. The two competing systems were designed, drawn up in PTC Creo, and tested in a CAD program so that the efficiency of both systems could be compared. The power system that required the least amount of power from the pilot was chosen to be the better system based on the project requirements and criteria.

MEM-22
AUTOMATED EXTRUSION CAPPER

Advisor: ***Dr. Alan Lau***

Team:

Leila Aboharb	Mechanical Engineering
Mark Baskin	Mechanical Engineering
Doug Knudsen	Mechanical Engineering
John Petrozziello	Mechanical Engineering
Steven Rutsky	Mechanical Engineering

Petro Packaging Co. Inc. is a custom plastic extrusion company creates uniquely dimensioned plastic tubes per customer request. Some of these tubes are used for storage, and are sealed at one end and open at the other. For the sealed ends, the tubes must be dipped in an acetone solution and pressed onto the cap until the adhesive sets. While their process utilized hand-operated and semi-automated machinery, both of these were antiquated. Therefore, Petro Packaging Co. Inc. required a low cost alternative that would act more efficiently than their machinery. As a team, we created design needs and specifications, created detailed models and plans for the process, then obtained and created all of the necessary parts for the process. The finished machine could process many different sizes of tubes without difficulty, and could switch between them with little effort on the part of the operators.
Sponsor: Petro Packaging Co. Inc.

MEM-23
MECHANICAL SPOTTING MACHINE

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

Team:

Mark Begley	Electrical Engineering
Timothy Frederick	Mechanical Engineering
Harsh Patel	Mechanical Engineering
Steven Popola	Mechanical Engineering
Brian Walling	Mechanical Engineering

Given the current line of physical fitness equipment available, exercising alone can be limiting. A second person is often required in order to achieve a complete workout, as they can assist with the last few repetitions of an exercise, which are generally the most difficult, yet extremely beneficial. In addition, patients of physical therapy are allotted a certain amount of time to exercise with the help of an assistant. In most cases, however, the recovery process takes much longer, leaving the patient to finish on their own. The solution that we have developed is a machine that performs the same tasks a personal spotter. A modified smith machine can monitor the user's activity, and then provide a slight upward force on the weight bar when the user is detected to be struggling with those last few difficult, yet beneficial, repetitions. This allows weightlifters to achieve a complete workout, and physical therapy patients to be more independent in their recovery.

MEM-24
EXPERIMENTAL APPARATUS FOR MEASURING NANOSTRUCTURED HEAT AND FLUID FLOW

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

Team:

Andres Bisono	Mechanical Engineering
Noah Gross	Mechanical Engineering
Matthew Patane	Mechanical Engineering
Nicholas Rossino	Mechanical Engineering

Our team built an experimental apparatus for characterizing two-phase fluid flow in a microchannel environment for Dr. McCarthy and the Drexel Multiscale Thermofluidics Laboratory. Dr. McCarthy will use the apparatus to break into the research field of two-phase heat transfer in microchannels. Potential applications of this research include the cooling of microelectronics in computers and mobile devices. The motivation for this project is for Drexel to enter into the research field of two-phase internal flow. The device that our team constructed pushes water at user defined conditions through a heated microchannel test section, under vacuum, and measures temperature and pressure drop due to phase change as the working fluid absorbs heat. The test section also has a transparent top so that the user can record and observe the flow with a high-speed camera. The device will enable future graduate students to research the effects of flow boiling on heat transfer.

MEM-25
SUSTAINABLE DEVELOPMENT FOR RURAL THAILAND: IMPROVED RICE PLANTER

Advisor: Dr. Alexander Moseson

William Bernhard	Mechanical Engineering
Dario Rainone	Mechanical Engineering
Anupma Sahay	Mechanical Engineering
Zachary Schrammel	Mechanical Engineering
Thea Weaver	Mechanical Engineering

This project is the third iteration of the agricultural tool development in the SEED Lab – Sustainable Engineering & Entrepreneurship for Development. A rice planting tool has been designed to benefit the 30,000 subsistence farmers of Bo Klua, Thailand who, due to their current farming practices, suffer from chronic back pain, malnutrition and poverty that greatly exceeds their country averages. Our technology seeding approach has proved its ability to provide an immediate, feasible, long-term solution, aiming to help and simultaneously empower the farmers. Literature research, physical prototyping, and systematic design tools have all been utilized in the development of the final product. The planter has been successfully implemented in conjunction with a manufacturing center in Bo Klua in the Spring of 2014.
Sponsor: Bill and Melinda Gates Foundation

MEM-26
SUSTAINABLE DEVELOPMENT FOR BO KLUAE, THAILAND: CLEAN WATER

Advisor: Dr. Alexander Moseson

Team:

Dosse Akpeko	Mechanical Engineering
John Bakuckas	Mechanical Engineering
Michael James	Mechanical Engineering
Sukitta Oumcomesung	Mechanical Engineering
Yijun Qian	Civil Engineering
Sarah Flowers	Chemical Engineering (Adjunct Member)

Bo Kluae, Thailand is one of many regions in the world lacking clean, healthy water due to physical and biological contamination. Expanding on the initial work performed by the 2012-2013 Senior Design team, extensive research was performed in order to understand the BioSand filter, a form of slow sand filtration, with a goal of optimizing the ranges of the system's parameters. Eighteen filters were constructed in order to directly compare the impact of numerous variations to the system. Batches of influent water were created with physical and biological characteristics in order to compare results to other BioSand projects throughout the world. Additional research and experiments were performed in an effort to understand the biolayer, where harmful bacteria are consumed, and decrease its growth time. Optimization of the BioSand filter system paves the way for future scale-up work for larger systems that can be locally manufactured in Bo Kluae.
Sponsors: Ricci Bros. Sand Co., Inc.; Boeing

MEM-27
HUBO WITH CONTINUOUS TRACK LOWER BODY

Advisor: ***Dr. Paul Oh***

Team:

Taegoo Kim	Mechanical Engineering
Young Kwang Lee	Mechanical Engineering
Duc Nguyen	Electrical Engineering
Sahil Shah	Mechanical Engineering

In major disasters, a zone inaccessible to human first responders, such as firefighters, develops for a prolonged period of time. During this period, the severity and urgency of the disaster escalates rapidly. To mitigate these problems, this project seeks to improve first disaster response time using autonomous robots. The team concluded that a robot with a humanoid upper body, interfaced with a tank-treaded base, is most suited for traversing difficult terrains and performing dexterous tasks in the inaccessible zone. To develop this robot, a small-scale prototype was created to establish technical design requirements. The prototype tank base's design was scaled and adapted for compatibility with a fully-sized humanoid upper body. Scaled components were substituted with off-the-shelf components, reducing cost and assembly time. It is expected that the assembled robot's performance will be comparable to the prototype's performance. The final deliverable is a fully sized technical demonstration of this robot.
Sponsor: Drexel Autonomous System Lab (DASL)

MEM-28
AUTOMATED PACKAGING EQUIPMENT FOR SOY MILK CARTONS

Advisor: ***Dr. Wei Sun***

Team:

Khalil Johnson	Mechanical Engineering
David Mensah	Mechanical Engineering
Jaimin Patel	Mechanical Engineering
Yuan Jie Wen	Mechanical Engineering

Our goal was to design an automated packaging process to assemble a 3 x 3 array of full soy milk cartoons into the respective boxes. Our focus was on the mechanical aspect of the design with provisions being made to affix electrical motors to actuate the process. The mechanics of the design incorporates form and structure of the packaging process as the milk cartoons exit the assembly line. Correct placement of the soy milk cartons as they exit the assembly line, proper alignment as the actuator pushes the cartons into their 3 x 3 array, and effective boxing with minimal damage done to the cartons and packaging constitutes were the main focus of this preliminary prototype. The goal was to perfect the mechanics of this process, while allowing for future retrofitting of electrical motors to the process. Despite full integration with the electric components, the mechanical components were able to achieve the preliminary goal, stated above, as standalone components much to the satisfaction of the stakeholders of this project: NatureSoy inc; the Mechanical Engineering and Mechanics Department at Drexel University; Prof. Wei Sun (project advisor); and, the senior design team.

MEM-29
FORMULA SAE ENGINE COMPONENT DESIGN FOR PERFORMANCE

Advisor: ***Dr. Nicholas Cernansky, Dr. Tein-Min Tan***
Consultant: ***Michael Stichter***

Team:

Jonathan Bryant	Mechanical Engineering
Scott Miller	Mechanical Engineering
Tim Molinaro	Mechanical Engineering
Zac Mutter	Mechanical Engineering
Tom Seifert	Mechanical Engineering

Drexel FSAE designs, builds, and races open wheeled racecars for use at SAE sponsored competitions. The goal of this project was to provide Drexel FSAE with an updated engine system that will enable them to improve their performance at competition by regaining the power lost due to the mandatory air intake restriction. This was accomplished through the design and fabrication of new intake and exhaust systems, as well as development and implementation of improved fuel and ignition controls via ECU mapping. The tools used to accomplish this goal include CAD modeling, one-dimensional engine simulation, three-dimensional CFD simulation, as well as ECU mapping software. Success was determined by dynamometer testing, where the objective was to produce horsepower and torque figures comparable to the unrestricted stock engine.
Sponsors: Drexel FSAE, Drexel MEM Department, Swarr Auto, FARO, Performance Electronics

MEM-30
VACUUM ARC REMELTING (VAR) ALLOY CONTAMINATION PREVENTION

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

Team:

Sean Dolan	Mechanical Engineering
Ramzi Gunselman	Mechanical Engineering
Divya Patel	Mechanical Engineering
Obusom Okafor	Electrical Engineering
Jason R. Sanders	Mechanical Engineering

As domestic production of steel continues to decline, companies such as Carpenter Technology Corporation are forced to innovate new alloys and reduce costs to meet global demands. Since the purity of these specialty alloys are critical to their use, all production equipment must be thoroughly cleaned from one melt cycle to another in order to prevent contamination. A furnace clean typically required an operator to manually climb inside the enclosed space; a 6-8 hour process. An automated device was designed to clean the furnace, which resulted in lower recurring costs and reduced production downtime. This device utilizes rotary abrasives, which is the optimal removal technology after adhesion-based testing. A proof-of-concept device was created in order to demonstrate operational capabilities and feasibility in design.
Sponsor: Carpenter Technology Corporation

MEM-31
THREE-PHASE SPACER WIRE BRACKET DESIGN FOR TREE IMPACT MITIGATION

Advisors: Dr. Christopher Weinberger

Team:

Luke Fox	Mechanical Engineering
Jason Gottlieb	Mechanical Engineering
Kevin James	Mechanical Engineering
Patrick Kennedy	Mechanical Engineering
Lok Ngan	Mechanical Engineering

Electric utility companies implement three-phase spacer wire systems to reduce the risk of power outages due to tree impact events. The spacer wire systems are connected to wood poles with a messenger wire attached to a pair of fixed tangent brackets. This is ideal to withstand a medium sized tree impact event. However, the added tension from the messenger wires increases the risk of breaking the supporting poles during larger tree impact events. A solution demands analysis of tree impact events and a redesign of the spacer wire system. A releasable bracket concept was determined to be the ideal solution. This concept was designed with a wire clamp that is intended to release in cases of critical loading. A static analysis tool was created in MATLAB to determine the tension of the messenger wire at the bracket, the correlating stress in the pole, and determine criteria for the releasable bracket.

MEM-32
GIMBAL-ACTUATED VTOL NACELLE

Advisor: Dr. Ajmal Yousuff

Team:

Matthew Brenner	Mechanical Engineering
Graham Donaldson	Mechanical Engineering
Christopher Killian	MEM Mechanical Engineering
Henry Tarplin	MEM Mechanical Engineering
Robert Walto	Mechanical Engineering

There is a need from stakeholders in military, commercial, and civil fields for a new propulsion control method that can continue to utilize the high-performance engines currently in development and production for large fixed-wing aircraft while incorporating the maneuverability and advanced control currently being developed in small-scale UAVs.
The senior design team developed biaxial gimbal hardware and a low-level operational control system to provide vertical take-off and landing (VTOL) capacity to an aircraft by modifying the direction of the thrust vector instead of the magnitude of thrust output (as is currently done with small UAVs). The project included the designing, modeling, fabrication, and testing of a prototype vehicle featuring three Gimbal-Actuated VTOL Nacelles (GAVNs) in a triangular configuration as a proof of concept platform. The project showed that these GAVN systems are an effective method of VTOL aircraft maneuvering.
Sponsor: Boeing Company

MEM-33
DEPLOYABLE PACKAGE FOR ENHANCED POWER AND DEORBIT CAPABILITIES IN CUBESATS

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

Team:

Ian Bournelis	Mechanical Engineering
Matthew D'Arcy	Mechanical Engineering
Anthony Iacono	Mechanical Engineering
Matthew Mazur	Mechanical Engineering

CubeSats are small satellites invented as an inexpensive means of providing academic, government, and commercial entities access to space. Over the years, CubeSats have become more capable research spacecrafts with increased energy needs. Dedicated efforts have increased the power generation for 2U and 3U platforms but there has not been significant progress for 1U satellites. Additionally, CubeSats are limited in their maximum altitude due to the ISO 25-year maximum orbit life requirement for orbital debris. This project focused on the design of a mechanical solution to these two issues: increasing the power generation capabilities for a 1U CubeSat and enabling a faster deorbit time for the satellite at the conclusion of its useful life. Specifically, a passive actuator was developed that satisfies these requirements for the stakeholder, Dr. Jin Kang. The device maximized the satellite's power generation, while minimizing the added mass, use of internal volume, and post-mission deorbit time.

MEM-34
SAE DESIGN, BUILD, FLY

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

Team:

James Brodovsky	Mechanical Engineering
Gary Brooks	Mechanical Engineering
Alex Meier	Mechanical Engineering
Aashish Murti	Electrical Engineering
Kushagra Pundeer	Mechanical Engineering

Unmanned aerial vehicles (UAVs) are seeing ever increasing use in law enforcement and in the military, with novel uses being developed in other fields. SAE's Design, Build, Fly competition uses design criteria for problems faced by these industries to pose a design problem to engineering students. For this year's regular-class competition the goal was to maximize the weight of payload carried given limits to size, power, and overall weight. To accomplish this task the group researched and designed an electrically powered aircraft that maximized lift and thrust, while minimizing weight and adhering to the rules of the competition. This resulted in an aircraft weighing approximately ten pounds with a maximum payload of forty pounds.
Sponsors: Drexel Space System Lab, NASA Space Grant, American Institute of Aeronautics and Astronautics

MEM-35
ADDITIVE MANUFACTURING OF THE SMART SKELETAL FRACTURE SLEEVE

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

Team:

Deyvid DeMelo	Mechanical Engineering
Damien Kahmer	Mechanical Engineering
Shane Mulhern	Mechanical Engineering
Danielle O'Brien	Mechanical Engineering
Anthony Tucceri	Mechanical Engineering

This project involved the process of creating a working prototype for an alternative solution to the currently widely implemented plaster cast; used primarily in the treatment of bone fracture. The primary objective of this design was to create a product that was comfortable for the patient in order to reduce the daily inconveniences brought about by current fracture solutions. In order to achieve ideal form for the design the team took a more modern approach that would give the product a more aesthetically pleasing look, as well as a more comfortable feel, while still maintaining the performance seen by current casts. By the end of the nine month period the team's goal was to determine the correct method for replicating this procedure, which was ultimately determined to be the process of additive manufacturing, so that it could be implemented in the medical field.

MEM-36
MULTI-FUNCTIONAL ADDITIVE MANUFACTURING MACHINE FOR BIOMEDICAL APPLICATIONS

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

Team:

Robert Calderoni	Mechanical Engineering
Alex Kelechava	Mechanical Engineering
Joshua Piccioni	Mechanical Engineering
Christopher Quaglia	Mechanical Engineering
Jeremy Toner	Mechanical Engineering

In the past few decades, the field of tissue engineering has grown exponentially with advancements in solid freeform fabrication techniques. These new techniques allow the medical industry to develop biological substitutes that restore, maintain, and improve human tissue or organ function through the construction of tissue scaffolds. The ability to 3D print these scaffolds allows for a customized external shape, predefined internal morphology, and a controlled pore size. A fused deposition modeling (FDM) 3-D printer was developed to print heterogeneous scaffolds composed of multiple biodegradable and biocompatible materials. This system was designed to handle various curing methods of popular biomaterials such as solution-based evaporation and UV light curing. Polycaprolactone (PCL) and Darocur (a polyurethane based resin) were used to demonstrate the heterogeneous capabilities of the printer.

MEM-37
QUADCOPTER DYNAMIC MODELING AND SIMULATION FOR CONTROL SYSTEM DESIGN

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

Team:

David Hartman	Mechanical Engineering
Joo "Matthew" Kim	Mechanical Engineering
Kevin Landis	Mechanical Engineering
Matthew Mehrer	Mechanical Engineering
Sergio Moreno	Mechanical Engineering

Multirotor vehicles provide a versatile aerial robotics platform with numerous practical applications. Developers including academic researchers, military contractors, and entrepreneurial engineers have demonstrated increasing interest in these aircraft. Control system designers face a common challenge in creating a useful and accurate dynamic model and simulation of vehicle performance. A complete low-cost, streamlined, and documented solution was developed to address these needs. Hardware and software tools for experimental data collection were designed to provide performance measurement and parameter estimation. A MATLAB graphical interface and parameter-driven Simulink models were created which provide a flexible simulation of flight dynamics and control system performance. Results of this process were used to design and implement an embedded quadcopter attitude control system and were shown to produce accurate prediction of system performance. This complete package has been made available online for free download and provides an effective modeling and simulation solution for quadcopter control system design.
Sponsor: Boeing

MEM-38
DESIGN AND IMPLEMENTATION OF STABILITY CONTROLLER FOR QUADCOPTER

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

Team:

Gerald Jean Jacques	Mechanical Engineering
Tony Kan	Electrical Engineering
Minh Lac	Mechanical Engineering
Liju Raju-Kaneelil	Mechanical Engineering

The project goal is to design a Quadcopter that autonomously attains self-stabilization. Furthermore to design and build testing fixtures for the Quadcopters for system characterization of motors that would be utilize for the theoretical system research for developing a low cost microcontroller based hover control design, a first eye resource in hazardous fire situations, a robust adaptive control of a Quadcopter and many more. Being one of the main features of research in the field of automation a Quadcopter has all the good qualities that are possess by a helicopter such as agility and vertical movements also at the same time has higher power efficiency that could be compared close to a fixed wing aircraft. Building a testing base of a Quadcopter would save a lot of time for the researchers, funding of the sponsors and would be able to achieve a lot in small period of time.

MEM-39
AUTONOMOUS DOCKING OF NANO-SATELLITES

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

Team:

Aditya Kothiwal	Computer Engineering
Vaidehi Dixit	Mechanical Engineering
Saif Raza	Mechanical Engineering
Bilok Chattopadhyay	Mechanical Engineering

The project aimed at providing the best possible solution to dock two nano satellites in space. It included a model of a nanosatellite that attached itself to another stationary nanosatellite. The main idea of the project was to autonomously dock the two nanosatellite modules while consuming minimal space inside each of them.
Since the design specifications of a nano-sat were fixed, the size of each component was a major constraint that limited the use of various sensors and circuitry. The project used a snap and grab mechanism that helped in aligning the two modules in case of any misalignment. Since the real life scenario of docking involved a zero G environment, the idea was to make this simulation with as low friction as possible.
Sponsor: Boeing

MEM-40
THE DREXEL RIDE - DYNAMICS

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

Team:

Can Ergdogan	Mechanical Engineering
Daniel Flanigan	Mechanical Engineering
Shreesha Muthyala	Mechanical Engineering
Hiep Nguyen	Mechanical Engineering

The Drexel Ride is an existing motion simulation platform that creates a virtual reality. It was an amusement park ride now converted into a gaming and scientific research platform for the use by Drexel University's College of Media Arts & Design. This platform's existing system comprised of a proprietary software that offered limited control and functionality. A fully controllable model needed a clear representation of the system's dynamics and working. This was done by reverse engineering the existing system. A hydraulic map was created and kinematic relations between the ride motions and actuator motions were established. A control and monitoring device was used to replace the existing control computer. This device was used to send input signals to measure responses. The response was used to model the dynamics of the system. The Controls team (Team 4) created a closed loop effective system based on these dynamics that can be used to conduct further motion research.
Sponsor: National Instruments

MSE-01
ECAP OF FE-ZR AND FE-CR ALLOYS TO STUDY THERMAL STABILITY OF ULTRA-FINE GRAINS

Advisor: ***Dr. Mitra Taheri***
Mentor: ***Christopher Barr***

Team:

Abraham Crook	Materials Science and Engineering
Jason Kusher	Materials Science and Engineering
Trace Silfies	Materials Science and Engineering

Equal Channel Angular Pressing (ECAP) is a novel metal processing technique that is used to obtain ultrafine grain microstructures in metals through severe plastic deformation (SPD). The mechanical properties of metals improve as the size of the grains decrease. This relationship is known as the *Hall-Petch e*ffect and is commonly utilized in the metals industry through cold working. ECAP is a very aggressive form of cold working that significantly increases the strength of metals by introducing strains of up to 400% into a material. The disadvantage of ultrafine grain microstructures, however, is that once the grains are heated, they begin to grow, losing mechanical properties. To slow the growth and movement of the grains, solutes such as zirconium have been introduced into pure iron samples. This study compared the strains introduced by ECAP and SPD rolling to determine whether rolling could produce similar texture and microstructural results in pure iron and iron solute systems.

MSE-02
EFFECT OF PROCESSING PARAMETERS ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF LASER SINTERED INCONEL 718

Advisors: ***Dr. Mitra Taheri, Dr. Garritt Tucker***
Mentors: ***Greg Vetterick, Jacob Gruber***

Devon Beckett	Materials Science and Engineering
Carly Hendricks	Materials Science and Engineering
Jonathan Kaufman	Materials Science and Engineering

Direct Metal Laser Sintering (DMLS) is a developing technology utilizing Computer-Aided Design data to rapidly manufacture metallic components. The purpose of this study was to characterize DMLS manufactured Inconel 718 for aerospace applications funded by SpaceX. The effects of hot isostatic pressing (HIP) and surface finishing techniques were studied to optimize the post-processing parameters. Large-scale Atomic/Molecular Massively Parallel Simulator (LAMMPS) software was used to simulate the grain growth behavior of pure nickel under varying processing conditions in an attempt to mimic laser heating in DMLS. Potts modeling using Stochastic Parallel PARticle Kinetic Simulator (SPPARKS) was also performed to simulate grain growth. Samples were tested which included no HIP treatment and HIP with the surfaces finishes as-printed, bead blasted, shot peened, and electropolished. Tensile testing, hardness testing and microstructural analysis were performed to evaluate the various processing parameters.
Sponsor: Space Exploration Technologies Corporation (SpaceX)

MSE-03

SUSTAINABLE NANOCOMPOSITE POLYMERS: THE EFFECT OF FORMIC AND SULFURIC ACIDS ON CELLULOSE HYDROLYSIS AND THE RESULTING THERMAL AND MECHANICAL PROPERTIES OF POLY(LACTIC) ACID AND NANOCRYSTALLINE CELLULOSE COMPOSITES

Advisor: ***Dr. Christopher Li***
Mentor: ***Gabriel Burks***

Team:

David Giambri	Materials Science and Engineering
Yunus Gorur	Materials Science and Engineering

The negative impacts of petroleum-based plastics, such as their toxic by-products and sourcing from non-renewable resources, has led to the need for a sustainable and biodegradable plastic, produced in an environmentally-friendly way. One such material is a poly(lactic) acid (PLA) and nanocrystalline cellulose (NCC) composite. Sulfuric acid is commonly used in the hydrolysis of NCC, however, it is harmful to the environment, and a more eco-friendly hydrolysis procedure is needed – one that will retain the overall properties of the composite. One solution is the use of formic acid in the hydrolysis. The mechanical and thermal properties of an NCC/PLA composite made by way of sulfuric acid hydrolysis were compared to those of a composite made by formic acid in an effort to demonstrate that this new synthesis technique is acceptable. NCC with an average width of 48 nm was hydrolyzed using formic acid, indicating that this is a viable way to hydrolyze nanocrystals.

MSE-04

THE EFFECTS OF POLYMER CHAIN ORIENTATION ON WEAR CHARACTERISTICS OF MEDICAL GRADE ULTRA-HIGH MOLECULAR WEIGHT POLYETHYLENE (UHMW-PE)

Advisor: ***Dr. Christopher Li***
Mentor: ***Gabriel Burks***

Team:

Daniel Quinn	Materials Science and Engineering
Joel Robbins	Materials Science and Engineering

Hip and knee implants have failed to meet the demands of their patients, often requiring an individual go back to replace the implant multiple times over the course of the patient's lifetime. The high demand for implants that are capable of lasting the lifetime of the patient requires that implants made of ultra-high molecular weight polyethylene (UHMW-PE) exhibit improved wear characteristics in addition to increased mechanical strength to keep up with the growing younger patient population. Friction deposited polymer films have been shown to induce material growth of the film surface with advanced degrees of polymer chain alignment. This alignment has been shown to induce increased mechanical strength and toughness, however, few studies have been done to measure the wear characteristics of friction deposited UHMW for medical implant applications. This study focused on the effects of such orientation of the wear characteristics of thin film UHMW-PE.

Sponsor: Westlake Plastics

MSE-05
MXENE SUPERCAPACITOR ELECTRODES FOR FLEXIBLE ENERGY STORAGE APPLICATIONS

Advisor: ***Dr. Yury Gogotsi***
Mentor: ***Maria Lukatskaya***

Team:

Elliot Huston	Materials Science and Engineering
N. Calahan Kirkner	Materials Science and Engineering
William Snyder	Materials Science and Engineering

Over the past few years interest in flexible devices has been shown by major mobile device manufacturers and consequently, a call for flexible components has been made, including flexible electrochemical power sources. Rather than conventional batteries, which are highly rigid due to the properties of required electrode materials, electrochemical capacitors have drawn interest in this area due to their lack of dependence on specific electrode materials. Supercapacitor performance is largely dependent on surface area and intercalation sites in materials. A new subset of materials, MAX phases, are capable of being processed into 2-dimensional, high surface area sheets called MXenes. These new materials show promise as supercapacitor electrode materials due to their flexibility and 2-dimensional microstructure. The MXene electrodes developed were highly flexible and performed well under mechanical tension leading to promising performance in wearable applications. Electrochemical characteristics showed promise but did not show high repeatability suggesting variability through processing and electrochemical testing.

MSE-06
EFFECTS OF THERMO-MECHANICAL PROCESSSING ON THE CORROSION RESISTANCE AND MECHANICAL PROPERTIES OF 5XXX SERIES ALUMINUM ALLOYS BY MICROSTRUCTURAL CHARACTERIZATION AND ATOMISTIC SIMULATION

Advisor: ***Dr. Mitra Taheri, Dr. Garritt Tucker***
Mentor: ***Dan Scotto D'Antuono***

Team:

Matthew James	Materials Science and Engineering
Jacob Parrott	Materials Science and Engineering
Brian Sparber	Materials Science and Engineering

The goal of this project was to quantify the effects of thermo-mechanical processing on the corrosion resistance and mechanical properties of 5083 Aluminum Alloy through macro scale experimental characterization and atomic scale numerical simulation. Exposure to high temperatures on board marine vessels leads to the precipitation of a secondary phase at grain boundaries that preferentially dissolves in corrosive environments and becomes susceptible to intergranular corrosion and stress corrosion cracking, *via* a process known as "sensitization". AA5083-H116 was subjected to cold rolling and annealing to improve the corrosion resistance of the alloy. Orientation Imaging Microscopy (OIM), *in situ* tensile testing, and nitric acid mass loss testing were performed to characterize the material's microstructure and properties. Atomistic simulations were performed to create and analyze grain boundaries of varying energies, one of the principal factors behind secondary phase precipitation. Molecular statics and nudged elastic band methods quantified the changes in energy associated with Mg segregation.
Sponsor: *United States Navy*

MSE-07
BEHAVIOR OF MODEL FISSION PRODUCTS (AG) IN B-SIC BY *IN-SITU* TEM ANNEALING FOR TRISO FUEL CLADDING

Advisor: ***Dr. Mitra Taheri***
Mentor: ***Michael Jablonski***

Team:

Patrick Anstine	Materials Science and Engineering
William Alexander Hanson	Materials Science and Engineering

Heavy metal fission product retention is vital to the development and success of very high temperature reactors (VHTR). In order to function at temperatures above those of pressurized water reactors, VHTRs utilize tristructural-isotropic (TRISO) fuel particles designed to operate at temperatures up to 1600 °C. However, long lived heavy metal fission products, most specifically ^{110}Ag and ^{137}Cs, have been observed to penetrate the fission product retention layers, *β-SiC* and pyrolytic carbon (PyC). To gain an understanding of the release mechanism, the diffusion behavior through β-SiC must be characterized. This project focused on the fission product with more prevalent release, ^{110}Ag. Previous research suggested a variety of driving forces for Ag mobility within the TRISO layers. Thus far, no distinct mechanism has been identified. Based on results gathered there is clear evidence of Ag mobility in the PyC layer. *In-Situ* tests have shown this mobility begins above 400 ˚C.

MSE-08
NANODIAMOND-KYNAR® THIN FILMS

Advisors: ***Dr. Yury Gogotsi, Dr. Vadym Mochalin***
Mentor: ***Dr. James Giammarco***

Team:

Tianjiao Cai	Material Science and Engineering
Shawn Cole	Material Science and Engineering
Sean Orzolek	Material Science and Engineering

Thin films can be used as environmental and mechanical barriers by providing scratch resistance and UV absorption. In this study, Nanodiamond (ND) was dispersed into dimethylformamide (DMF) with Kynar® (polyvinylidene fluoride, or PVDF) and then spin coated onto silicon wafers. Nanodiamond (ND) is a powder composed of spherical diamond particles with a mean particle diameter of 5 nm, which also exhibits all of the optical, thermal and mechanical properties of diamond at the nanoscale. The addition of ND resulted in films with improved mechanical properties without sacrificing any optical properties. Transparency was measured by UV-Vis spectroscopy. Surface roughness was determined by atomicforce microscopy. The Young's modulus and hardness were determined by nanoindentation. It was also observed that thermal annealing the films after spin coating produces more uniform films; therefore this process improved the transparency.

MSE-09
SYNTHESIS, CHARACTERIZATION AND THEORETICAL STUDY OF ZNXSN1-XS SOLID SOLUTION QUANTUM DOTS

Advisors: ***Dr. Wei-Heng Shih, Dr. Wan Shih & Dr. James Rondinelli***
Mentors: ***Johnson Lu, Antonio Cammarata***

Team:

Yinong Cao	Materials Science and Engineering
Cheng Fang	Materials Science and Engineering
Shi Fang	Materials Science and Engineering

Applying bio-imaging technology to the study of pathogenesis of human disease is of great importance in the future medical treatment. $Zn_{1-x}Sn_xS$ quantum dots are a potential candidate as a bio-imaging agent because of their low toxicity and near-infrared skin-penetrating emission radiation. The goal was to study $Zn_{1-x}Sn_xS$ quantum dots by means of computational simulation, quantum dot synthesis and X-ray crystallography. The results of cluster expansion indicated that the lowest formation energy structure could be achieved by a 1:1 composition. Synthesis by co-precipitation of ZnS and SnS resulted in two-phase products, demonstrated by one near-ultraviolet peak and one near-infrared peak in a photoluminescence intensity scan. The intensity of two peaks reached their maximum when the ZnS:SnS ratio = 1:1 in the core composition. X-ray diffraction analysis showed that the crystal structure of $Zn_{1-x}Sn_xS$ matched the result from the computational simulations.

MSE-10
MEASUREMENT OF THE SEEBECK COEFFICIENT ACROSS A TEMPERATURE GRADIENT

Advisors: ***Dr. Steven May & Dr. James Rondinelli***
Mentor: ***Mark Scafetta***

Team:

Robert Sorgi	Materials Science and Engineering
David Trider	Materials Science and Engineering

The goal of this project was to design, build, and test an experimental setup to measure the Seebeck coefficient of bulk and thin-film materials. A material with known Seebeck coefficient, n-type silicon, was tested first to demonstrate that the experimental process worked, and then a material with an unknown Seebeck coefficient was evaluated. Modules that measure Seebeck coefficient already exist, but cost on the order of $50,000. The major advantage that this project had was that its budget was under $500. The technique developed produced results similar to previously published values for silicon and there is promising preliminary data for characterizing the MAX phase Ti_2SbP. Finite element analysis and modeling of the Seebeck Coefficient using Density Functional Theory (DFT) was used to confirm the accuracy of the experimental results.

MSE-11
MULTISPECTRAL AND MULTISCALE OPTICAL METHODS FOR STRUCTURAL HEALTH MONITORING

Advisors: ***Dr. Antonios Kontsos, Dr. Michel Barsoum***
Mentors: ***Ivan Bartoli, Matthew McCarthy***

Team:

Sadaf Bahaza	Mechanical Engineering and Mechanics
Jeremy Monteiro	Mechanical Engineering and Mechanics
Harold Montilla	Civil Engineering
Aditi Ramadurgakar	Materials Science and Engineering

The objective of this project was to design a novel nondestructive testing and evaluation (NDTE) technique using non-contact, full-field optical metrology methods in a multiscale and multispectral setting for structural health monitoring (SHM). The design involved the use of digital image correlation (DIC) and infrared thermography (IRT) to track deformation of structures using a thermally contrasting quick response (QR) code pattern, thus resulting in infrared image correlation (IRIC) measurements. To validate this approach, cantilever beam bend tests were carried out. The infrared images of the pattern were imported into DIC software. The resulting data validated the execution of IRIC. The proposed approach could potentially allow the quantitative identification of civil infrastructure damage, including cracking, delamination and corrosion.

BMES-01
AUTOMATED HFO DETECTION USING MATLAB ANALYSIS

Advisor: Dr. Karen Moxon & Dr. Michael Sperling

Team:

Joshua Cige	Biomedical Engineering
Jacob McGranaghan	Biomedical Engineering
Charles Szymanski	Computer Engineering

Epilepsy affects approximately 3 million people in the US, with annual medical costs of $17.6 billion. Sufferers often deal with debilitating seizures that limit independence and quality of life. Symptoms are commonly treated with anti-epileptic drugs, which are insufficient for 30% of patients. Resection surgery can be performed on these patients to remove affected areas of the brain in an attempt to stop seizures. High frequency oscillations (HFOs) are abnormal electrical brain waves theorized to originate from the seizure onset zone. HFOs can be recorded using electroencephalogram (EEG) from electrodes implanted in the patients head, but the gold standard for finding them in recordings is visual inspection, which can be time consuming for research clinicians. To automate HFO detection, an algorithm was made using an advanced neural network system to identify HFOs by recognizable features. The program reported onset and offset times of HFOs to aid in clinical evaluation.

BMES-02
PATIENT MONITORING UNDER GENERAL ANESTHESIA UTILIZING FUNCTIONAL NEAR-INFRARED SPECTROSCOPY (FNIR)

Advisors: Dr. Meltem Izzetoglu, Dr. Kurtulus Izzetoglu, Dr. Hasan Ayaz

Team:

Nate Gelfant	Computer Science
Niharika Jain	Electrical Engineering
Ethan Kim	Biomedical Engineering
Nick Klingos	Electrical Engineering
Chirstopher Veale	Biomedical Engineering

fNIR devices are novel alternative to EEG-based anesthesia monitoring devices used currently that operates by infrared light shined into the body and its optical properties. Their capability of measuring hemodynamics promotes the device well-suited for anesthesia application. The use of fNIR helps prevent under or overdosing of anesthetics, a significant problem faced presently, by assessing the brain activity. We developed an improved depth of anesthesia monitoring device which integrated heart rate and respiratory monitoring into the fNIR-based system. While predicate devices exhibited sensor-detector separation ranging from 2 to 4 cm to only measure frontal cortex hemodynamics, the new design had two sensors to each capture hemodynamics in the frontal cortex and the internal carotid artery separately. The forehead sensor had 1.2 and 3.0 cm, and the neck sensor, 2.5 and 4 cm. Through mathematical filtering of fNIR signals, the vital signs were acquired along with improve depth of anesthesia assessment.

BMES-03
WOUND DRESSING TO MANAGE MALODOROUS, HIGH-EXUDING CHRONIC WOUNDS

Advisor: Dr. Kara Spiller

Team:

Sonam Chheda	Biomedical Engineering
Charles Green	Biomedical Engineering
Ememabasi Okoh	Biomedical Engineering
Jason Sedlak	Biomedical Engineering
Zhelu Zheng	Biomedical Engineering

Chronic wounds, discontinuities in the skin that do not heal within the expected time frame, can emanate a very unpleasant odor. This odor can be distressing for patients and their caretakers, leading to a decreased quality of life. While clinical and commercial solutions for this problem do exist, these products lack efficacy for high exuding wounds. The design objective for this project is to design a wound dressing for odor control that can be used with high-exuding wounds. Beta-Cyclodextrin (BCD), the active ingredient in Febreze®, an oligosaccharide that can capture odors within its hydrophobic cavity, was incorporated into a poly(vinyl alcohol) (PVA) hydrogel. Preliminary work shows higher BCD content prevents more odor-like molecules from escaping the hydrogel. Higher PVA and BCD content increased the swelling capabilities of the hydrogel. Further work includes quantifying the odor capturing efficiency of BCD, and standards ISO 10993-5 (cytotoxicity) and BS 13726-1 (wound dressing absorbency).

BMES-04
LAYER-BY-LAYER CHITOSAN/ALGINATE POLYELECTROLYTE MULTILAYER FILM DRUG DELIVERY SYSTEM

Advisor: Dr. Lin Han

Team:

Jesse Chan	Biomedical Engineering
Andrew Hall	Biomedical Engineering
Veronika Martynova	Biomedical Engineering
Samuel Rozans	Biomedical Engineering

Diabetes is an epidemic that affects nearly 26 million individuals in the U.S. causing a quarter of a million deaths per year. Diabetes patients are burdened with having to monitor their blood sugar levels and may require the use of insulin on a daily basis. There are currently two forms to administer insulin: injection and automated insulin pumps with catheters. Both methods of insulin administration come with many possible complications that pose a risk to a patient's health. A drug delivery system was designed with a layer-by-layer polyelectrolyte multilayer film using chitosan and alginate which provides a possibility of insulin being delivered orally, making it less invasive. Swelling and modulus of the film were tested and analyzed according to the required performance criteria for its intended use. In order to control the diffusivity of drug diffusion, the swelling and modulus were measured against set performance criteria for the films intended use

BMES-05
DEVELOPMENT OF A WOUND DRESSING FOR BIOFILM INHIBITION IN CHRONIC WOUNDS

Advisors: Dr. Michael Neidrauer

Team:

Francis DiGennaro	Biomedical Engineering
Siddharth Joshi	Biomedical Engineering
Niraj Maniar	Biomedical Engineering
Dylan Narsingh	Biomedical Engineering
Kevin Sacherman	Biomedical Engineering

Bacterial biofilms are bacterial colony matrices which are resistant to traditional antibiotic therapies, delaying the healing process of chronic wounds and affecting millions of patients annually. Mechanical debridement is typically used to remove biofilms from chronic wounds but any remaining bacteria left within the wound will quickly reform biofilm. This project aims to develop a wound dressing capable of eliminating residual biofilm following debridement and suppressing the growth of new biofilm until the patient's next debridement session. This is achieved by incorporating a mixture of polyethylene glycol (PEG) ointment and Nitric-Oxide infused Zeolite aluminosilicate particles into a permeable membrane. Upon contact with wound fluid, water interacts with the zeolite particles releasing Nitric Oxide which diffuses out of the semipermeable barrier and into the wound. The dressing is capable of attaining a bactericidal Nitric Oxide release rate previously shown in literature to both eradicate existing biofilm and suppress new biofilm growth.

BMES-06
SHIVERING DETECTION METHOD FOR ADULT CARDIAC ARREST PATIENTS UNDERGOING TARGETED TEMPERATURE MANAGEMENT

Advisors: Dr. Kenneth Barbee, Dr. Vinay Nadkarni (Children's Hospital of Philadelphia)

Team:

Ellen Giranda	Biomedical Engineering
Caitlin Kealy	Biomedical Engineering
Allison Kosydar	Biomedical Engineering
Michael McNichol	Biomedical Engineering
Renee Nester	Biomedical Engineering

Targeted Temperature Management (TTM) is the recommended method to prevent brain damage in post cardiac arrest patients. However, when body temperature decreases, shivering can occur as part of homeostasis and ultimately counteract the benefits of TTM. Currently, a subjective visual assessment is utilized hourly by healthcare professionals to diagnose patient shivering, which can lead to delayed shivering intervention. Thus, a need exists to design a non-invasive method that will monitor, detect, and signal the onset of shivering. Electromyography (EMG) signals of various muscle groups were utilized to devel op an algorithm that recognizes the characteristic shivering signal and output an audio and visual alarm upon detection. To optimize the algorithm, real shivering EMG data was analyzed using MATLAB software. The algorithm was then tested using an artificial signal with the characteristics of a standard shivering waveform. This device could function as a stand-alone device or could be integrated into pre-existing monitoring devices for TTM patients.

BMES-07
DISTURBED FLOW CHAMBER FOR INVESTIGATING ENDOTHELIAL CELL MECHANTRANSDUCTION AT ARTERY BIFURCATION IN NORMAL AND DIABETIC CONDITIONS

Advisors: Dr. Alisa Morss-Clyne

Team:

Kevin Bockman	Biomedical Engineering
Stephanie Cicalese	Biomedical Engineering
Ariel Endress	Biomedical Engineering
Ae Rin Son	Mechanical Engineering

Blood flow throughout the vasculature applies a force to endothelial cells, which line the inside of blood vessels. This mechanical force, or shear stress, causes cells to elicit chemical signals as a response to their environment. In normal vessels, blood flow is laminar and causes cells to align in the direction of flow. In the bifurcations or branches of arteries, blood flow becomes disturbed and forms recirculation eddies, resulting in the inability of endothelial cells to align in the direction of flow. This chamber models this blood flow and can be used with endothelial cells to investigate their mechanotransduction.

BMES-08
OPTIMIZED VESICLE-BASED DRUG DELIVERY SYSTEM FOR THE DELIVERY OF A SYK INHIBITOR TO MITIGATE THE EFFECTS OF UV-RADIATION

Advisor: Dr. Andres Kriete

Team:

Chelsey Calvo	Biomedical Engineering
Jhan-Duc Duclos	Biomedical Engineering
Stephane Guillou	Biomedical Engineering
Jennifer Wilkin	Biomedical Engineering

United States. Spleen tyrosine kinase (Syk) is a protein constitutively over-expressed in response to UV exposure. Inhibiting Syk can mitigate the harmful effects of UV radiation. Systemic administration of a Syk inhibitor is not favorable, therefore we propose a transdermal vesicle-based drug delivery system composed of a lipid, surfactant, and a Syk inhibitor, piceatannol. A successful design will deliver an effective concentration of piceatannol through the stratum corneum to the dermal layers 20-75 minutes post UV exposure, during the window of maximal Syk activity. Drug-carrying vesicles must be manufactured with optimized characteristics including skin penetration, drug encapsulation, and drug release. Using a theoretical model in Matlab, we will identify the drug penetration profile through incorporating a correlative method of relating a cellulose membrane to the organic stratum corneum.

BMES-09
AT-HOME DIABETIC WOUND CHARACTERIZATION AND TRACKING MOBILE APPLICATION

Advisors: Dr. William Dampier

Team:

Lillian Hippel	Biomedical Engineering
Alycia Logue	Biomedical Engineering
Michael Ryan	Biomedical Engineering
Mena Schiano Lo Moriello	Biomedical Engineering

Diabetic wound management requires repeated measurement regimens along with long-term follow-up to ensure therapeutic effectiveness, and as the number of patients requiring wound management increases, the time available in clinical settings for simple wound tracking does not suffice. As such, there is a need to measure and track diabetic wounds outside of a clinical setting. To accomplish this, we designed a mobile phone application capable of automatically detecting wounds and calculating their surface area from wound images, displaying a graph of the wound's surface area over time. Our final mobile application functions with 90% wound measurement accuracy regardless of the user's skin tone, angle of the image, distance from camera to wound, and camera flash settings. We expect positive societal impacts through the availability of an at-home wound measurement system for diabetes patients and their caretakers, stemming from an increased self-engagement in wound care.

BMES-10
AN IMPLANTABLE ELECTRODE ARRAY FOR EPIDURAL STIMULATION OF THE SPINAL CORD

Advisor: Dr. Karen Moxon

Team:

Carl Beringer	Biomedical Engineering
Michael Dilacqua	Biomedical Engineering
Melissa Kortman	Biomedical Engineering

Epidural stimulation of the spinal cord has shown to be an effective method for the restoration of basic stepping and standing functions in animal models. Due to the lack of an epidural stimulator that can be used in awake animals, complex movements like adjusting the gait cycle for obstacle avoidance have not yet been explored. Using the microfabrication techniques of photolithography and metal deposition, we have developed a parylene-based array that uses platinum as the conducting material. The electrode array features two columns of 18 contact sites spaced across a 20 mm span that is in contact with the L4-L6 spinal cord levels. The electrical stimulation amplitude and location can be set by the user in order to allow for flexibility in the range of amplitude, frequency, and placement of signals for researching spinal cord stimulation.

BMES- 11
SPORTS INSTRUMENTED MOUTHGUARD IMPACT MONITOR

Advisors: Dr. Roy Carriker

Team:

Neha Arjunji	Biomedical Engineering
Muzammil Hasan	Biomedical Engineering
Karan Parikh	Electrical Engineering
Sita Patel	Biomedical Engineering
Vashina Shukla	Biomedical Engineering

Chronic Traumatic Encephalopathy is a progressive degenerative disease found in individuals who have been subjected to multiple concussions or other forms of brain injuries. About 300,000 concussions occur annually due to high-impact sports play, with no quantifiable means of detection. To address this problem, a mouthguard was modified to incorporate an accelerometer and gyroscope to quantify head impacts. An Arduino Nano microcontroller was utilized to program and control the sensors and transmit data via Bluetooth to a local computer. These components were placed onto a mouth palate covering piece attached to the mouthguard. The device was tested through a drop test for proper functionality of the sensors and the wireless connection. This model provides live detection of head impact; in the future, it can be used during sports play as a method to better understand concussions.

BMES-12
DESIGNING A DNA MICROARRAY TO IMPROVE THE CLINICAL IDENTIFICATION OF PATHOGENIC STRAINS OF STAPHYLOCOCCUS *AUREUS*

Advisor: Dr. Aydin Tozeren

Team:

Chris Flounders	Biomedical Engineering
Kyle Fennelly	Biomedical Engineering
Veronica Tomchak	Biomedical Engineering

The current gold standard of bacterial identification is cell culturing. Through literature research it was found that cell culturing has a number of pitfalls; 99% of bacterial species are not able to be grown in clinical cultures, contamination rates of up to 10%, false positive rates of up to 12%, and a turnaround time of 24-72 hours. With the aggressive nature of S.*aureus* (antibacterial strains and mortality rates of up to 40%) there was a need for a better method of identification. The method of our solutions was to utilize DNA microarray technology with probes designed from all known virulence factors expressed by pathogenic strains of S. *aureus.* The microarray was developed with the following criteria; a false positive rate below 12%, a noise/interference component of under 10%, a turnaround time of under 24 hours, and be able to provide a quantitative description of pathogenic and antibiotic genes expressed

BMES-13
PORTABLE, ADJUSTABLE, AND PERSONALIZED PARAMETER ULTRASONIC DEVICE FOR VENOUS ULCER HEALING TREATMENT

Advisor: ***Dr. Peter Lewin***

Team:

Jung Min An	Biomedical Engineering
Carolyn Gamble	Biomedical Engineering
Fergie M. J. Grizella	Biomedical Engineering

Recent studies have shown that low-frequency, low-intensity ultrasound (LFLIU) can accelerate venous ulcers healing. Drexel Ultrasound Lab had developed a portable LFLIU device that produces fixed ultrasonic output of pulsing frequency at 20 kHz, pulse repetition frequency (PRF) of 1 Hz, duty cycle of 50% and spatial peak-temporal peak intensity (I_{SPTP}) of 100 mW/cm^2. The senior design team has re-engineered the device to include personalizable ultrasonic output parameters in terms of acoustic intensity (50-100 mW/cm^2.), PRF (1-20 Hz), and duty cycle (10-90%). The parameters were wirelessly controlled via user interface (UI) on a computer or phone. The ultrasound was irradiated by eight cymbal transducers arranged in 2x4 array, that could be turned on/off by user in pairs depending on treatment needs. Transducers were embedded on a silicone to allow treatment on curving surfaces. Personalizable and wirelessly controlled parameters were mediated by programming of Raspberry Pi© microcomputer that was wired to the circuitry powering the transducers.

BMES-14
BIOMIMETIC AGGRECAN-BASED SYNOVIAL FLUID VISCOSUPPLEMENT

Advisor: ***Dr. Michele Marcolongo***

Team:

Zain Abdul Wahid	Biomedical Engineering
Christina George	Biomedical Engineering
Sriram Moparthy	Biomedical Engineering
Sona Rathod	Biomedical Engineering
Ritu Parna Sarkar	Biomedical Engineering
Viviana Serrato	Biomedical Engineering

Osteoarthritis is a chronic degenerative joint disease characterized by articular cartilage degeneration and bone hypertrophy. Synovial fluid (SF), a primary contributor to lubrication and shock absorption at the articulating surfaces of the knee joint, exhibits reduced viscoelastic and lubrication properties during osteoarthritic conditions. The most common treatment, hyaluronic acid injections, lack lubrication properties and are susceptible to enzymatic degradation. Therefore, the main objective was to design a viscosupplement injection that could impart lubrication and viscoelastic properties to the articulating joint to better mimic human SF while resisting enzymatic degradation. The proposed solution was a design-optimized concentration of biomimetic aggrecan (BA) in phosphate buffered saline (PBS). BA was chosen due to the bottlebrush structure that mimicked the lubrication molecule lubricin and the high negative charge density that could convey load-bearing capabilities. The lubrication and coefficient of friction of the optimized solution was tested with a Rheometer and a Pin-on-Disk machine, respectively.

BMES-15
PLASMA-ASSISTED HAND STERILIZATION AND DISINFECTION

Advisor: ***Dr. Greg Fridman***

Team:

Charles Bailey	General Engineering
Krishnateja Pemmaraju	Biomedical Engineering
Michael Phan	Biomedical Engineering
Arvind Radhakrishnan	Biomedical Engineering

Proper hand sterilization is an important practice necessary to reduce the spreading of nosocomial infections and is crucial in medical settings to satisfy the hand hygiene standards set for medical staff. According to studies, insufficient measures are taken to reach these standards; professionals stated that this was due to proper hand sterilization taking too long. Non-thermal plasma (NTP) has been shown to be an effective agent in killing a number of bacterial species while ensuring uniformity due to its xerographic properties. We have developed a device to deliver NTP antimicrobial elements in 3 stages via an aerosol. In stage 1, an atomizer vaporizes liquid water into a fine mist. The droplets are then infused with antimicrobial reactive oxygen species (ROS) in stage 2 as they pass through a dielectric barrier discharge (DBD) plasma. Stage 3 will evenly dispense the antimicrobial mist onto the user's hands resulting in proper hand sanitization.

BMES-16
ANTERIOR TALOFIBULAR LIGAMENT OPENSIM MODEL

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

Team:

Cathy Kaing	Biomedical Engineering
Ronak Patel	Biomedical Engineering
Nilay Shah	Biomedical Engineering
Basil Tharu	Biomedical Engineering

Approximately 2 million people suffer from sports related injuries every year, with the treatment cost of each injury ranging from $2000-$8000. The most prevalent injury in 33 different sports is ankle injuries, with highest occurrences in sports requiring frequent vertical landings. More than 80% of ankle injuries are sprains caused by inversion of the foot during landing, with the anterior talofibular ligament (ATaFL) as the first ligament to fail. Currently, there is no method of directly measuring ligament strains or forces in-vivo. Consequently, other methods involve in-vitro experimentation and computer simulations, which result in expensive resources and significant time consumption. Therefore, an ATaFL model was developed using an open-source software, OpenSim. The ATaFL OpenSim model can simulate dynamic motion data and estimate forces in the ATaFL. Better understanding of how a person's motion affects ligament forces may reduce the risk of ankle injuries and cost by developing proper treatment.

BMES-17
DRUG DELIVERY DESIGN FOR AN HIV BURSTING COMPOUND

Advisor: Dr. Irwin Chaiken

Team:

Rachael Cohen	Biomedical Engineering
Lea DeRosa	Biomedical Engineering

HIV infects ~2million people worldwide and there is currently no cure. There exists a peptide triazole thiol, which when conjugated to gold nanoparticles inhibits the HIV virus at the gp120 binding receptor. There is no delivery mechanism for the conjugated peptide to the infected site, and current delivery mechanisms only last for 1 day at most. The delivered device needed to release an active, stable peptide for the duration of one month and withstand 8N of inward and outward sheer force. The final drug delivery device was a polymer encapsulated osmotic. Poly(ester urethane)s containing hyperbranched three-arm PCL-block and PHBV-block was used to encapsulate the device in a film of microhooks and microneedles due to its shape memory and immunogenic properties. The final device was tested in-vitro and was found to maintain a controlled, long term release of active therapeutic and changed shape at body temperature to mechanically adhere to the mucus membrane.

BMES-18
SENSOR FOR MEASURING MAXIMUM ISOMETRIC FORCE IN PHYSICAL THERAPY EXERCISE EQUIPMENT

Advisor: Dr. Sriram Balasubramanian

Team:

Michael Barkofski	Biomedical Engineering
Robert McCollum III	Biomedical Engineering
Alexander Santangelo	Biomedical Engineering
Amanda Storm	Biomedical Engineering
Christopher Wysocki	Mechanical Engineering

Nine million adults and three million children receive physical therapy annually. Physical therapists assess a patient's rehabilitation progress by utilizing the Maximum Voluntary Isometric Contraction (MVIC) exercise. Practicing physical therapists lack an inexpensive, lightweight, and accurate method to assess a patient's progress. A solution consisting of a steel C-shaped bracket with an adjustable height screw was developed and can be inserted into weight-lifting machines. The bottom portion of the bracket is inserted below the plate platform. The top portion of the bracket acts as a pin and inserts into a weight plate. Two strain gauges adhered to the bracket are components in a half-Wheatstone bridge circuit. The signal from the bridge is amplified and received by an Arduino Uno microcontroller that communicates to a PC via a Bluetooth module. Utilizing Processing software and a developed algorithm, force measured during an isometric exercise e is plotted versus time. Maximum force exerted is sensed and displayed.

BMES-19
PLASMA TREATMENT OF OCULAR MELANOMA FOR EXPERIMENTAL USE

Advisor: Dr. Greg Fridman

Team:

Mehul Gurjar	Biomedical Engineering
Ajay Raghavan	Biomedical Engineering
Breanna Seiber	Biomedical Engineering
Ryan Smalley	Biomedical Engineering

Ocular melanoma is a particularly malignant strain of skin cancer that affects nearly 3 million individuals annually with tumors ranging in size from 7 – 10 mm in diameter. Non-thermal floating electrode dielectric barrier discharge (FE-DBD) plasma has been shown to cause apoptotic behavior of the melanoma cells, however the methods of treatment available have not been tailored to the eye. Currently, there is a need for a device that discharges non-thermal FE-DBD plasma at a fixed distance to target small areas below the surface of the ocular epithelium. The proposed solution follows a probe design, which applies a dosage of FE-DBD plasma proven to effectively induce apoptosis of the melanoma cells. The probe will also have a nonconductive attachment used to maintain a fixed distance between the probe tip and the surface of the eye so that plasma discharge may occur.
Sponsor: A.J. Drexel Plasma Institute

BMES-20
INJECTION OF BIOMIMETIC AGGRECAN INTO URETHRAL TISSUE FOR TREATMENT OF STRESS URINARY INCONTINENCE

Advisor: Dr. Michele Marcolongo

Stress Urinary Incontinence (SUI) is characterized by the involuntary loss of urine during physical activities, such as sneezing, coughing, or even laughing. It is the most prevalent type of Urinary Incontinence (UI) and affects approximately 15 million women whereas urinary incontinence itself affects about 25 million women. SUI is caused due to the weakening of the urethral sphincter and the stiffening of the urethral tissue by the loss of tissue compliance and volume. Current treatments involve the injection of bulking agents, primarily made up of synthetic polymer based solutions such as carbon particles, silicon beads, and autologous fat into the submucosal wall of the urethra to reduce the inner diameter. These agents act as a filler material and increase tissue volume, but do not restore tissue stiffness and pliability. Therefore, there is a need for an improved bulking agent. Biomimetic Aggrecan (BA) shows promise in treating SUI by integrating into the existing extracellular matrix at focalized injection sites and drawing in water due to its negative charge density. These biomechanical properties enable BA to increase urethral tissue volume and reduce tissue stiffness, combating the deteriorative changes of urethral tissue experienced by SUI patients. The design project will be able to implement a transurethral injection procedure for varying concentrations of BA into specific regions of fibrous porcine urethral tissue to determine the effect ratio of concentration on stiffness and tissue volume. The testing will include radial expansion force testing, tensile testing and a Micro CT imaging after two hours soak time, post injection to determine stiffness decrease and volume increase. The results imply an increase in tissue compliance by a reduction in tissue stiffness and increase of tissue volume. When applied to a volumetric flow model, the results exhibit the change in the behavior of the BA treated tissue and an improved urethra tissue quality can be seen, when compared to tissue in a typical SUI patient.

BMES-21
FEEDBACK-CONTROLLED SYSTEM TO TITRATE OXYGEN DELIVERY

Advisors: ***Dr. Kurtulus Izzetoglu, Dr. Richard Hamilton***

Team:

Parth Panchal	Biomedical Engineering
Kaushal Patel	Biomedical Engineering
Andrea Verghese	Biomedical Engineering
David Weinstock	Biomedical Engineering

Supplemental oxygen therapy is a common treatment for Chronic Obstructive Pulmonary Disease (COPD). Today, over 4 million Americans use supplemental oxygen, the majority of whom are in an outpatient setting where a physician cannot adjust oxygen dose to suit a patient's changing needs. Thus, there is a need to develop a feedback-controlled system to titrate oxygen delivery based on patient needs. This system must monitor, maintain, and determine oxygen-dosage levels with a real-time adjustment. A functional near-infrared (fNIR) sensor placed on the forehead can measure cerebral oxygenation, which offers a reliable measure of systemic blood oxygen saturation. Implementing oxygen saturation data from an fNIR sensor, this project aims to develop and test a closed loop system to control and titrate supplemental oxygen delivery to patients with COPD. The completion of this project will bring the medical community closer to personalized treatments for patients suffering from COPD.

DREXEL UNIVERSITY
COLLEGE OF ENGINEERING
3141 CHESTNUT STREET
PHILADELPHIA, PENNSYLVANIA 19104