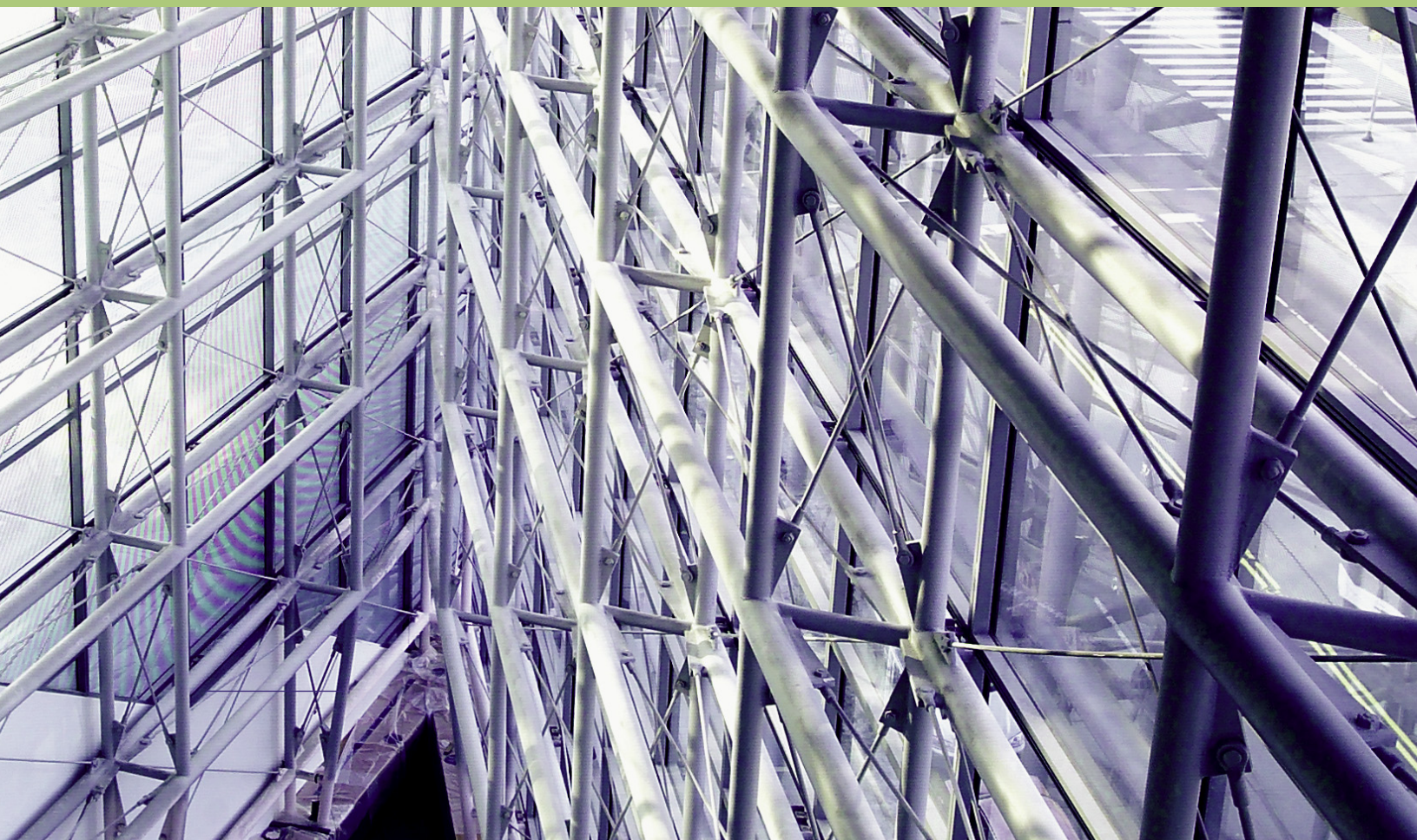
DREXEL UNIVERSITY COLLEGE OF ENGINEERING

Senior Design Projects 2012



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.

This year more than 500 seniors formed approximately 135 design teams. There were over 100 faculty, industrial and governmental personnel serving as advisors. These projects demonstrate the wide variety of interests and abilities of the seniors.

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.

This Spring, eight groups will be selected as the best representatives of their department with at least one group from each department. These students will compete at the Group Competition to be held on June 6, 2012. Students will receive prize money and award certificates. The competition will be held in the Bossone Research Center Auditorium from 9:00 a.m. – 3:30 p.m.

Adam Fontecchio
Associate Dean
Senior Project Design Coordinator
College of Engineering

CAEE-01	SCHULYKILL RIVER TRAIL CROSSING AT GRAYS FERRY AVENUE
CAEE-02	DELAWARE RIVER INTEGRATED WATERFRONT LINE
CAEE-03	PILOT-SCALE SURFACE-POND BIO-REACTOR AT A MUNICIPAL SOLID WASTE LANDFILL
CAEE-04	EXPANSION OF THE PROPOSED COLLEGE OF ENGINEERING DESIGN FACILITY
CAEE-05	THE INTEGRATED DESIGN OF A GOVERNMENT OFFICE BUILDING LOCATED IN OMAHA, NEBRASKA
CAEE-06	ESTABLISHING WATER DISTRIBUTION SYSTEMS IN LÉOGÂNE, HAITI
CAEE-07	SOUTH STREET – PENN'S LANDING PEDESTRIAN BRIDGE REDESIGN PROJECT
CAEE-08	REDEVELOPMENT OF BUILDING 624 AT THE PHILADELPHIA NAVY YARD
CAEE-09	MIRIMAR WATER DISTRIBUTION
CAEE-10	GREEN REDEVELOPMENT OF DREXEL UNIVERSITY STUDENT RESIDENTIAL QUAD
CAEE-11	POMPESTON CREEK BRIDGE RENEWAL PROJECT
CAEE-12	THE LIFE TOWER
CAEE-13	BIOGAS FACILITY – LEOGANE, HAITI
CAEE-14	A FRAMEWORK FOR THE DESIGN AND IMPLEMENTATION OF ENVIRONMENTAL SENSOR NETWORKS IN COMMERCIAL BUILDINGS TO PROMOTE ENERGY EFFICIENCY AND IAQ
CAEE-15	QUARTERS A" RETROFIT FOR SUSTAINABILITY
CAEE-16	REDUCING THE ENVIRONMENTAL FOOTPRINT OF ALUMNI ENGINEERING LABS AT DREXEL
CAEE-17	FEASIBILITY STUDY TO INVESTIGATE THE NEED FOR A PUBLIC TRANSPORTATION CONNECTION ACROSS THE DELAWARE RIVER WITHIN BURLINGTON COUNTY, NEW JERSEY
CAEE-18	DESIGN OF A CENTRALIZED WASTE TREATMENT FACILITY FOR HYDRAULIC FRACTURING WASTEWATER
CAEE-19	REDESIGN AND RECONSTRUCTION OF THE DELAIR BRIDGE
CAEE-20	REPURPOSING OF THE MANAYUNK BRIDGE AS URBAN GREEN SPACE
CAEE-21	WARMINSTER COMMUNITY PARK - BASEBALL AND SOFTBALL COMPLEX
CAEE-22	STORMWATER MANAGEMENT FOR UNITARIAN SOCIETY OF GERMANTOWN
CAEE-23	KERR CLUB BOATHOUSE PROJECT
CAEE-24	DREXEL PARK DORMITORY
CAEE-25	REDEVELOPMENT OF MOYERS LANDFILL AS A LAND IMPROVEMENT PROJECT
CAEE-26	RENOVATIONS AND IMPROVEMENTS TO THE ACADEMY OF NATURAL SCIENCES OF DREXEL UNIVERSITY
CAEE-27	NORTHEAST EXTENSION OPTIMIZATION
CBE-01	LIQUID FLUORIDE THORIUM REACTOR
CBE-03	DRY-FRACTURING PROCESS
CBE-04	FEASIBILITY STUDY FOR LANDFILL GAS TO ELECTRICITY PLANT DESIGN -LMFGO-
CBE-05	GAS-TO-LIQUID (GTL) PLANT
CBE-06	MANUFACTURING HMBA FROM MMP SARSINE INC
CBE-07	PRODUCTION OF ATACTIC POLYPROPYLENE THROUGH PROPYLENE-ETHYLENE COPOLYMERIZATION
CBE-08	OLEFIN/PARAFFIN SEPARATION USING REACTIVE DISTILLATION
CBE-09	OLIGOMERIZATION OF OLEFINS TO MAKE POLYGASOLINE
CBE-10	THE REMOVAL OF NITROGEN- AND PHOSPHORUS-BASED COMPOUNDS FROM ANIMAL WASTE
CBE-11	RENEWABLE DIESEL PRODUCTION FROM MICROALGAE
CBE-12	ALLYL ALCOHOL PRODUCTION VIA ISOMERIZATION OF PROPYLENE OXIDE

CBE-14	WASTE TRAP GREASE TO BIODIESEL
CBE-16	RECOVERY OF SULFURIC ACID FROM AMMONIUM BISULFATE
CBE-18	SUPPLY GAS SYNTHESIS FROM WASTE PLASTIC
CBE-19	REDUCTION OF BENZENE IN CATALYTIC REFORMING PROCESS
CS-01	VisAssist
CS-02	TEAM ANACONDA
CS-03	INHERITREE
CS-04	AUTONOMIC COMPUTING: SENSORS AND DETECTORS FOR APPLICATIONS, VMS, AND HOST OSes
CS-05	DEPLOYMENT OF LARGE-SCALE DATABASE FOR CROSS-FUNCTIONAL MATERIALS RESEARCH
CS-06	DISTRO KON
CS-07	ASTRAEUS
CS-08	OPTIC RM
CS-09	UNICONF
CS-10	MATHDASH
ECE-01	ROBUST SECRET KEY GENERATION USING A RECONFIGURABLE ANTENNA
ECE-03	FORMULA HYBRID ELECTRIC CAR
ECE-04	DREXEL WIRELESS SYSTEMS LAB WiMAX APPLICATIONS TEAM
ECE-06	POWER AGILE COMPUTER
ECE-07	DESIGN OF FREE-SPACE OPTICAL TRANSMITTER AND RECEIVER MODULES FOR HELMET MOUNTED BROADBAND fNIR SYSTEM
ECE-08	DIGITAL PHILADELPHIA CONNECTIVITY TEAM
ECE-10	CELLULAR PHONE RADIATION EMISSION EXPOSURE MONITOR
ECE-11	WIRELESS SERVO CONTROLLER
ECE-12	AIR QUALITY MONITORING SENSOR NETWORK
ECE-13	DYNAMIC TRAFFIC CONTROL
ECE-14	LOAD FLOW STUDIES
ECE-15	MAZE TRAVERSING ROBOT WITH EDUCATIONAL INTERFACE
ECE-17	NUCLEAR REACTOR SIMULATION UTILIZING MICROSOFT KINECT
ECE-18	INTELLIGENT POWER STRIP
ECE-19	POOL-SPECTRE
ECE-20	CHARACTERIZING DISTURBANCES IN SMART POWER DISTRIBUTION NETWORKS AND LOADS
ECE-22	DROP-IN LED REPLACEMENT FOR INCANDESCENT VISUAL LANDING AIDS
ECE-23	AUTOMATIC TENNIS ASSISTANT TRAINER
ECE-25	AIR QUALITY MONITORING NETWORK - HARDWARE TEAM
ECE-26	CHARACTERISTIC CURVE TRACER WITH LabVIEW™
ECE-28	DESIGNING AND TESTING OF AN ENERGY STORAGE SYSTEM
ECE-29	ELECTRIC SOLAR CAR
ECE-30	MAXIMUM POWER POINT TRACKING FOR SOLAR APPLICATIONS
MEM-01	SMALL-SCALE THREE-DIMENSIONAL CELL PRINTING FOR POTENTIAL SPACE APPLICATION
MEM-02	AERODYNAMIC PACKAGE FOR LOW ALTITUDE ORBIT CUBESAT
MEM-03	LEAK DETECTION IN WATER MAINS – NAVIGATION
MEM-04	MEMS SHEAR STRESS SENSOR
MEM-05	FORMULA SAE: ANALYSIS AND DESIGN OF AERODYNAMICS
MEM-06	SLOWEST MOTORCYCLE LAND SPEED RECORD
MEM-07	DETECTION OF LEAKY PIPES IN WATER DISTRIBUTION NETWORK AND METHOD TO REPAIR USING A TRAVELING ROBOT (B)

MEM-08 KHR-4 HUBO FLEXIBLE TORSO

MEM-10 FEASIBILITY STUDY FOR THE USE OF PIEZOELECTRIC MATERIALS IN TRICKLE-CHARGING ONBOARD SMALL SATELLITE POWER SYSTEMS

MEM-11 DESIGN AND CONSTRUCTION OF A LINEAR MOTOR DRIVEN PULSE TUBE CRYOCOOLER FOR INFRARED CAMERAS

MEM-12 BIO-TEMPLATED NANOSTRUCTURED ELECTRODES FOR CAPACITIVE DEIONIZATION OF WATER

MEM-13 CHARACTERIZATION OF A HYDRAULIC DRIVE SYSTEM FOR AN ELECTRIC MOTORCYCLE

MEM-14 DREXEL FORMULA HYBRID MECHANICAL

MEM-15 FSAE BRAKE AND SUSPENSION DESIGN AND OPTIMIZATION

MEM-16 MICROFLUIDIC DEVICE TO SIMULATE BLOOD VESSEL DEVELOPMENT

MEM-17 PLASMA TREATMENT OF WATER FOR HOSPITAL APPLICATION

MEM-18 DESIGN AND FABRICATION OF A SOLAR CELL TESTING

MEM-19 DESIGN OPTIMIZATION FOR WASTE HEAT RECOVERY SYSTEM

MEM-20 SOLAR PANEL DEPLOYMENT MECHANISM FOR CUBE SATELLITES

MEM-21 MINIATURE PONTOON BOAT FOR BASS FISHING

MEM-22 CRASHWORTHY COMPOSITE SUBFLOOR INTEGRATION FOR ROTORCRAFT

MEM-23 DESIGN FOR DEVELOPMENT IN THAILAND

MEM-24 ENHANCEMENT OF FLAPPING MICRO AERIAL VEHICLE

MEM-25 DETECTION OF LEAKY PIPES IN WATER DISTRIBUTION NETWORK AND METHOD TO REPAIR USING A TRAVELING ROBOT (C)

MEM-26 AUTOMATED NETWORKED TRANSPORT SWARM (ANTS) HARDWARE PROTOTYPE DEVELOPMENT

MEM-27 VIRTUAL WESTERN BLOT LABORATORY FOR PROTEIN DETECTION

MEM-28 Nd:YAG PULSED LASER SYSTEM ENCLOSURE

MEM-29 ENGINEERED FLAGELLAR FOREST FOR OPTOFLUIDIC SENSORS

MEM-30/MSE-04 NOVEL CLASSROOM MECHANICAL TESTING DEVICE USING DIGITAL IMAGE CORRELATION

MEM-32 AN IMPROVED GROWING ROD FOR THE TREATMENT OF EARLY ONSET SCOLIOSIS

MEM-101 DESIGN AND DEVELOPMENT OF WINDLESS 'WIND TUNNEL' FOR SPACE APPLICATION

MEM-102 POCKET DRIVER

MEM-103 THE CLEVER LEVER

MSE-01 AN ANALYTICAL STUDY OF THE PREFERENTIAL GRAIN ORIENTATION ATTACK OF SLIP BANDS IN ALUMINUM LITHIUM ALLOYS

MSE-02 TUNING THE BANDGAP OF LA1-X SRX FEO3 SEMICONDUCTORS

MSE-03 ANALYSIS OF THERMOMECHANICAL PROCESSING OF AA5083 FOR CORROSION RESISTANCE

MSE-04/MEM-30) NOVEL CLASSROOM MECHANICAL TESTING DEVICE USING DIGITAL IMAGE CORRELATION

MSE-05 COPPER AND LEAD DETECTION UTILIZING FURAN-MODIFIED CHITOSAN THIN FILMS

MSE-06 AFM STUDY OF MODEL SOLID OXIDE FUEL CELL CATHODES

MSE-07 PEROVSKITE OXIDE ETCHING CHARACTERISTICS

MSE-08 THIN FILM COLOR DETECTION OF GLUTARALDEHYDE

MSE-09 ALGINATE BASED FOAMS FOR THE PURPOSE OF CREATING SUSTAINABLE BUILDING MATERIALS

BME-01	DESIGN OF AN EEG HEADBAND FOR DAILY IN-HOME USE OF THE P300 BRAIN-COMPUTER INTERFACE
BME-02	EXPERIMENTAL MODEL OF HIGH IMPACT LOADING ON INTERVERTEBRAL DISC
BME-03	DISTRIBUTED PRESSURE INSERT DEVICE FOR RIGID CERVICAL COLLARS
BME-04	DESIGN OF IMPROVED SUCTION CATHETER FOR THE REMOVAL OF PARTICULATE MATTER AND LIQUID PRIOR TO EMERGENCY INTUBATION
BME-05	INSTRUMENT FOR EVALUATION OF AFFINITY CHROMATOGRAPHY SUBSTRATE FOR ANTIBODY PURIFICATION
BME-07	IN VITRO 3D MODEL OF TUMOR CELL COMPRESSION
BME-08	A SUPPORT DEVICE FOR PATIENTS WITH CLASS IV AND V CEREBRAL PALSY
BME-09	BIO-INSPIRED MUSSEL ADHESIVE ELECTRODE COATING FOR DRUG DELIVERY APPLICATIONS
BME-10	MICROFUIDIC DELIVERY SYSTEM FOR A BIOCHIP POINT OF CARE DIAGNOSTIC DEVICE
BME- 11	NON-VIRAL GENE THERAPY USING ZINC SELENIDE QUANTUM DOTS
BME-12	A B-TCP/RESORBABLE MESH BONE VOID FILLER WITH INCREASED STRENGTH FOR IRREGULAR BONE VOID DEFORMITIES
BME-13	EVALUATION OF CELL ADHERENCE/INFILTRATION OF CERAMIC BONE GRAFT SUBSTITUTES USING A MODIFIED DIRECT-PERFUSION BIOREACTOR
BME-14	APPLICATION OF QUANTUM DOT BASED ACTIVATABLE MOLECULAR PROBES FOR VISUALIZATION OF AREAS WITH MMP2 ACTIVITY
BME-15	3-D TISSUE ENDOMETRIUM MODEL FOR STUDYING BLASTOCYST IMPLANTATION MECHANICS

CAEE-01
SCHULYKILL RIVER TRAIL CROSSING AT GRAYS FERRY AVENUE

Advisor: Dr. Joseph P. Martin

Team:

Matthew Albracht	Civil Engineering
Robinson Eng	Civil Engineering
Connor Mueller	Civil Engineering
Richard Munns	Civil Engineering
Martin Williams	Civil Engineering

A pedestrian bridge crossing the Schuylkill River near the Grays Ferry Avenue Bridge is needed to connect two sections of the Schuylkill River Banks Trail. The target is to cross the Schuylkill to southwest Philadelphia and connect to the Bartram Gardens. The area has an abandoned railroad bridge in place. An assessment of the condition of the bridge has been performed. Permitting and acquisition of right-of-way will be a large part of the project.
The key engineering issue for this project is the production of a crossing over a navigable waterway. In order to meet vertical clearances for ships, the crossing must be raised to a minimum of 50 feet above the mean high tide of the river. The new design includes a new structure crossing the river while incorporating the old truss into the design. The trail connecting to Bartram Gardens will be finalized when the crossing is complete.
Sponsor: Schuylkill Banks

CAEE-02
DELAWARE RIVER INTEGRATED WATERFRONT LINE

Advisor: Dr. Joseph Martin

Team:

Bridget Botchwey	Civil Engineering
Gananath Chandratilleke	Civil Engineering
Kenny Chen	Civil and Architectural Engineering
Chelsey Weaver	Civil Engineering
Menelik Yilma	Civil Engineering

Philadelphia has several attractions that many residents and tourists are unfortunately unable to enjoy due to the lack of access by public transit. Some of these major attractions include the newly built Sugarhouse Casino, the Philadelphia Navy Yard, and Columbus Boulevard's big-box stores, bars, and restaurants. A transit line has been proposed to provide a public route to reach these locations. Furthermore, this proposed transit could create a more convenient public transit method to the Philadelphia stadiums and Philadelphia Navy Yard. A feasibility study of locations has been administered to examine several possible constraints. Variables such as an attraction market study and estimated ridership demographics have determined the best possible routes. Interchanges evaluated include the Market-Frankford line, Broad Street line, and PATCO line. Moreover, use of old rail utilities has been explored to determine workability, feasibility, and cost effectiveness.

CAEE-03
PILOT-SCALE SURFACE-POND BIO-REACTOR AT A MUNICIPAL SOLID WASTE LANDFILL

Advisor: Dr. Mira S. Olson

Team:

Carolyn Comer	Environmental Engineering
Erin Hughes	Environmental Engineering
Ashley Mundackal	Civil Engineering
Matthew Wenrick	Environmental Engineering

Excess liquid production from the compaction and decomposition of solid waste landfill must be collected and treated prior to release to natural waters. This liquid, known as leachate, contains not only significant amount of suspended solids, but also dissolved metals and high nutrient levels. The transportation and treatment of over 40,000 gallons incurs an expense of $2500 per day. The team's design evaluates the feasibility of pretreating the leachate with an open-pond algae bioreactor onsite to reduce nutrient levels. Rainfall collection and effluent recycling is used to dilute the leachate and also allows sunlight penetration for photosynthesis of the algae while gentle paddle-wheel mixing ensures gas diffusion and prevents settling. Once a maximum biomass is produced, the algae can be harvested to create a cost-offsetting biofuel. The final design is approximately a 1/1000th pilot-scale, oblong-shaped, versatile bioreactor capable of controlling environmental and hydraulic conditions to further the research of algae growth in a landfill leachate medium.
Sponsor: EPA P3 Award, Delaware Solid Waste Authority

CAEE-04
EXPANSION OF THE PROPOSED COLLEGE OF ENGINEERING DESIGN FACILITY

Advisors: Dr. Robert Brehm, Dr. Eugenia Ellis (ARCH)

Team:

Julius Campanella	Architectural Engineering
Samuel Cocchia	Civil Engineering
Klaus Horsch	Civil Engineering
Michael J. Whelan	Civil and Architectural Engineering
Alexander Yeganeh	Civil Engineering

In the original proposal, a building dedicated to the College of Engineering was created. When the previous proposal was presented to the Dean, he felt that the site was not fully utilized due to the elevation as well as the footprint of the building.
From this, the new proposal will be dedicated to the Department of Civil, Architectural and Environmental Engineering. The structural as well as the architectural aspects are the main focus of this project. This building will house offices, classrooms, laboratory spaces and auditoriums for the CAEE Department. Space for students will be maintained by creating an updated and larger Cad Lab area. A CAEE library will also be added for students to have better access to design standards and relevant information and will also contain a space to display previous models or projects like the Concrete Canoe and Steel Bridge competitions.

CAEE-05
THE INTEGRATED DESIGN OF A GOVERNMENT OFFICE BUILDING LOCATED IN OMAHA, NEBRASKA

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

Team:

Bilal Baqai	Civil Engineering
Sara Beg	Architectural Engineering
David Fratamico	Architectural Engineering
Adrian Lu	Architectural Engineering
Emily McNally	Architecture
Vaibhav Paritosh	Electrical Engineering
Dylan Short	Architectural Engineering

CAUTELA Engineering is comprised of seven individuals specializing in various disciplines of architectural engineering and building design working together to compete in the 2012 National ASCE/AEI Student Competition sponsored by the Charles Pankow Foundation. The name CAUTELA is derived from the Latin word for "security," an overarching concept in the firm's integrated design of the architectural, structural, mechanical, and electrical systems of the proposed LEED Gold government office building located on 601 Riverfront Drive in Omaha, Nebraska. The 66,000 square-foot building is rated with a high-asset value and a high Homeland Security Threat Condition. It is designed to house approximately 250 occupants. The building's most critical assets which are protected from terrorist attacks and local environmental hazards include its occupants, valuable archives, and essential building functions. In addition to a security design that provides both transparency and fortification, CAUTELA has developed a high-performance design of building systems that are redundant, sustainable, cost-effective, and innovative.

CAEE-06
ESTABLISHING WATER DISTRIBUTION SYSTEMS IN LÉOGÂNE, HAITI

Advisor: ***Dr. Franco Montalto***

Team:

Kristin O'Neill	Environmental Engineering
Brendan Quann	Environmental Engineering
Bethany Shumaker	Civil Engineering

On January 7th, 2010 a massive earthquake occurred in the Republic of Haiti. The epicenter of the earthquake occurred in the Léogâne Commune of Haiti, approximately 20 miles west of Port au Prince. In response to this tragedy, unprecedented amounts of international aid have been pledged to the rehabilitation of effected areas. The scope of this project is to establish a sustainable drinking water system that services the unmet needs of the Léogâne population through the investment of this pledged aid. The design incorporates an analysis of available hydraulic resources to most efficiently service the community and limit future vulnerability.

CAEE-07
SOUTH STREET – PENN'S LANDING PEDESTRIAN BRIDGE REDESIGN PROJECT

Advisor: Dr. Ivan Bartoli

Team:

Pat Callahan	Civil Engineering
Frank DiCianni	Civil and Architectural Engineering
Kyle Jurgelewicz	Civil Engineering
Ian McEwing	Civil Engineering

Within the past decade, the Delaware Valley Regional Planning Commission developed a comprehensive plan to rejuvenate Philadelphia's waterfront. The plan calls for development throughout the riverfront area, which incorporates convenient access points from the city grid directly to the waterfront. Since South Street is a heavily trafficked area of the city, its connection to the waterfront is essential for igniting Penn's Landing development.

Connecting two Philadelphia landmarks, South Street and Penn's Landing, requires a landmark bridge design. Therefore, the goal of this project is to engineer a pedestrian bridge that symbolizes the gateway from Philadelphia's grid to Penn's Landing. The bridge selected for this project is a cable-stay bridge. Designing the bridge was divided into two parts: defining the structural parameters, and designing the individual bridge components. A structural analysis model is also produced to analyze the bridge, as well as a construction schedule, sequence and cost estimate.

Sponsors: Chris Menna, City of Philadelphia Bridge Department; Chuck Davies, PennDOT

CAEE-08
REDEVELOPMENT OF BUILDING 624 AT THE PHILADELPHIA NAVY YARD

Advisor: Dr. Kurt Sjoblom

Team:

Steve Bartram	Civil Engineering
Daniel Culbert	Civil and Architectural Engineering
Kyle Earthman	Civil Engineering
Jeff Weinberger	Civil and Architectural Engineering
Anthony Wisniewski	Civil and Architectural Engineering

The Grünwald Adaptive Reuse proposal includes the transformation of existing Building 624 at the Philadelphia Navy Yard in to a dynamic mixed-use facility offering prime Class A retail, dining, and office spaces. The park will have a large retention basin, as well as outdoor seating to compliment various dining spaces proposed in The Grünwald. Within the building footprint, there will be a core out of a large section from grade level to roof level to create a large courtyard.

This proposal includes several significant environmentally sustainability features on the site. A green roof will be installed encompassing the building's footprint to manage storm water. The green roof will also contribute to the mitigation of the heat island effect and insulation within the building year round. Additionally, a retention basin will be installed at the adjacent park area to manage storm water from the parking lot. Some of the engineering solutions proposed include filling the basement with aerated concrete and installing a truss system in the lobby. It is estimated that the cost of this project will be $74 million.

CAEE-09
MIRIMAR WATER DISTRIBUTION

Advisor: Dr. Joseph Martin

Team:

Brandon Hinman	Architectural Engineering
Erik Mangan	Civil and Architectural Engineering
Jake McCarthy	Civil and Architectural Engineering
Anthony Nanfro	Civil and Architectural Engineering
Tejas Patel	Civil and Architectural Engineering

The town of Mirimar, El Salvador, does not have a sufficient system to provide clean water to its 150 residents. There are two public hand dug wells and ten private wells throughout the village, but they contain high levels of fecal coliform and are unusable for drinking. The lack of knowledge and skill to create a system to hydraulically pump water up to the elevation of the village is the limiting factor.
The water will be retrieved from the river via a settling pond. From there the water, which is now significantly cleaner due to the settlement of solids, will be transported to a high efficiency pump. The pump will then bring the water from an elevation of 375 feet to an elevation of 675 feet and empty it into a large storage tank which is connected to a nearby slow sand filtration system.

CAEE-10
GREEN REDEVELOPMENT OF DREXEL UNIVERSITY STUDENT RESIDENTIAL QUAD

Advisor: Dr. Paul Block

Team:

Mashal Ali	Civil Engineering
Scott Jeffers	Environmental Engineering
Matthew Ryan	Civil Engineering
Julian Safar	Architectural Engineering

In conjunction with Drexel University's Planning Department, we have prepared a plan for redevelopment of the residential square located between Drexel residential dormitories Calhoun and Towers Hall. The plan takes into account three major design criteria most important to the university. The first is the creation of a pathway system that connects to current pathways in the residential area. The second is to design an aesthetically pleasing environment that encourages the space to be utilized by students. The third is to manage stormwater runoff moving through the area. Using these design criteria, we have created a plan for future development in the area. Highlights of the plan include connective tree lined pathways linking together the dormitories of the area, both grassy and bench seating areas, and a bioretention basin to manage stormwater runoff.

CAEE-11
POMPESTON CREEK BRIDGE RENEWAL PROJECT

Advisor: Dr. Emin Aktan

Team:

Simbarashe Jhamba	Civil Engineering
Jeffin Lukose	Civil Engineering
Dan Seeberger	Civil Engineering

The Pompeston Creek Bridge, owned by the Burlington County Bridge Commission, is in very poor condition and beyond repair. Pennoni Associates has worked with T&M Associates on a preliminary design for the new bridge, and it has been brought to JDS Associates for analysis and design of alternative bridges. Obstacles in our design will include the railroad bridge that runs parallel to the bridge in question. The railroad bridge and Pompeston Creek Bridge are approximately 2 feet apart and share the same continuous abutment and foundation. Another issue is the pile foundation that will be used to save on costs.
After extensive research JDS has elected to go with the CON/SPAN design, which is a precast concrete arch system, due to not only its very simple and effective design, but also its cost savings. This type of bridge follows all AASHTO and NJDOT requirements, fits in well with the surrounding area and is very economical.

CAEE-12
THE LIFE TOWER

Advisor: Prof. Louis DaSaro

Team:

Scott Macpherson	Civil Engineering
Peter Matthews	Architectural Engineering
Thomas McGrew	Civil Engineering
Monika Mickute	Architectural Engineering
Jennifer Shin	Architecture

Our senior design group is participating in the 2012 Chicago Mock Firm Competition. We have created a mock engineering firm, Vector Collaborative, and designed a 100-story multi-use high-rise building in Beijing, China, called the Life Tower, to compete in this competition. The Life Tower is designed to accommodate retail, residential, commercial, and hotel uses. We have used the International Building Code 2009 to design all aspects of the building, including the building envelope and structural, HVAC, electrical, fire protection and plumbing systems. Our building and site design incorporate sustainability, innovation, and the traditional Chinese philosophy of Feng Shui. We have achieved a certified LEED Platinum rating in our design, demonstrating our commitment to these principles. We have the backing of several sponsors to assist us with competition fees and traveling costs to Chicago in May in order to present our project.

CAEE-13
BIOGAS FACILITY – LEOGANE, HAITI

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

Team:

Tyler Buecher	Civil Engineering
Daniel Hegarty	Civil and Architectural Engineering
Ralph Hernandez	Mechanical Engineering
Martin Conor O'Toole	Mechanical Engineering
Chris Sokolowski	Civil and Architectural Engineering

This Senior Design Capstone Project aims to resolve several issues that Leogane, Haiti is currently experiencing after being stricken by a massive earthquake in 2010. The project's goals include finding a sanitary alternative to the short-term latrines and pits currently in place, providing an alternative fuel source to charcoal and wood, and reducing the spoilage rate of food by providing a refrigeration unit to the local market. The project focuses on building an anerobic biogas facility that will use waste matter to produce biogas from which a distribution system of usable fuel will be readily available for the Haitian people. The biogas fuel alternative will resolve the current problem of waste removal while providing a solution to the deforestation problem and providing a source of fuel. The proposed facility will be modular in design, allowing for future expansion.

CAEE-14
A FRAMEWORK FOR THE DESIGN AND IMPLEMENTATION OF ENVIRONMENTAL SENSOR NETWORKS IN COMMERCIAL BUILDINGS TO PROMOTE ENERGY EFFICIENCY AND IAQ

Advisor: ***Dr. Michael Waring***

Team:

Adams Rackes	Architectural Engineering

Environmental sensor networks (ESNs) for routine monitoring of indoor air quality (IAQ) have the potential to help reduce building energy use while protecting occupant health and comfort. The project focuses on development of a framework for ESN design and implementation in commercial buildings. The first stage of work included researching sensor characteristics, developing a method for quantifying network performance, and establishing a Monte Carlo simulation procedure for evaluating network designs. The second stage of work included building a complex, time- and spatially-resolved model of an office in the multi-zone airflow simulation program CONTAM, identifying initial possible sensor layouts and interpolation rules, and implementing the Monte Carlo evaluation procedure in the context of these network designs. The third stage of work included using empirical procedures, such as clustering and regression, to identify optimal number of sensors and interpolation rules, given perfect information (i.e., highly resolved concentration data), and then use similar techniques to predict or estimate the optimal network design parameters, given the information customarily available to designers (e.g., design airflow rates, spatial and HVAC zone topology).

CAEE-15
QUARTERS A" RETROFIT FOR SUSTAINABILITY

Advisor: Dr. Eugenia Ellis (ARCH)

Team:

Corey Griffiths	Architectural Engineering
Asrah Khadr	Environmental Engineering
Maria Sofia Sanguinetti	Environmental and Civil Engineering
Gozde Unkaya	Civil and Architectural Engineering
Malin Viberg	Environmental Engineering

Many residential houses and buildings in Philadelphia are very old and thus have many functional problems. Generally these problems include leaky building envelopes, wet basements and inefficient energy usage. This Senior Design Project is a framework on how to retrofit a characteristic Philadelphia historic building to meet today's energy-efficiency goals for sustainable architecture. To create this framework, a building was chosen as the pilot in order to work with actual data and parameters. "Quarters A" is an historic building situated at the Navy Yard that today is a high school called "The Sustainability Workshop" – a program in which high school students learn through project based learning. This design project was broken into four parts that are typical problem areas for an old building in Philadelphia: electrical lighting, HVAC, building envelope and stormwater management. In theory, this framework demonstrates reduced costs in utilities and a better indoor air quality.

CAEE-16
REDUCING THE ENVIRONMENTAL FOOTPRINT OF ALUMNI ENGINEERING LABS AT DREXEL

Advisors: Dr. Charles Haas, Dr. Eugenia Ellis (ARCH)

Team:

Thomas Bosc	Architectural Engineering
Christina Giannascoli	Environmental Engineering
Ryan Monkman	Civil and Architectural Engineering
Matthew Shinton	Civil Engineering

This project is an effort to reduce environmental impact of the Alumni Engineering Labs by using forefront green technologies in an effort to match Drexel University's sustainable movement and incorporation of these technologies to reduce the energy consumption for the facility. The incorporation of high performance fenestration, green roofing, storm water management, efficient lighting and redesigned HVAC system to improve efficiency highlight the numerous design improvements to the building. Consideration throughout the project has come from Philadelphia green building guidelines, Philadelphia Water Department Storm water guidelines and Department of Energy sustainable guidelines. Rather than perform a complete tear down and redesign of Alumni Engineering Labs; this project is produced to serve as a University model of sustainable renovations for use at Drexel University. As full demolition and redesign is costly to the environment and character of the University.

CAEE-17
FEASIBILITY STUDY TO INVESTIGATE THE NEED FOR A PUBLIC TRANSPORTATION CONNECTION ACROSS THE DELAWARE RIVER WITHIN BURLINGTON COUNTY, NEW JERSEY

Advisor: Dr. Franklin Moon

James Drogalis	Architectural Engineering
Brandon Glencross	Architectural Engineering
Neil Patel	Civil and Architectural Engineering
Brandon Weaver	Civil and Architectural Engineering
Charles Young	Civil and Architectural Engineering

Residents of Burlington County, New Jersey currently lack an efficient public transportation system. As a result, a significantly lower number of residents utilize public transportation than in surrounding counties. A major reason why people are not using public transportation is accessibility and convenience. In order for commuters to travel by rail from Burlington County to Pennsylvania, they must cross the Delaware River. A feasibility study was conducted to assess connecting the NJ Transit River LINE and the SEPTA Trenton line with a public transportation link over the Burlington Bristol Bridge.
The feasibly study consisted of constructing a finite element model of the Burlington Bristol Bridge to assess the loading carrying capacity and need for retrofit. This model allowed for the consideration of several rail alignments. The outcome of this project was a recommendation to the Burlington County Bridge Commission considering the recommended alignment and retrofits.

CAEE-18
DESIGN OF A CENTRALIZED WASTE TREATMENT FACILITY FOR HYDRAULIC FRACTURING WASTEWATER

Advisor: Dr. Charles Haas

Team:

Nathaniel Cain	Environmental Engineering
Matthew Fritch	Environmental Engineering
Edward Lennon	Environmental Engineering
Christopher Nase	Environmental Engineering

Hydraulic fracturing in the regions of Pennsylvania underlain by the Marcellus Shale poses a significant problem when it comes to treating or disposing of produced wastewater from drilling activities. The natural-gas industry must invest in a dedicated facility that can handle extremely brackish water (total dissolved solids greater than 50,000 mg/L) as well as radioactive byproducts that are naturally present in the flowback fluid. Our design choice is an elaboration on the MVR evaporation plant that includes chemical treatment in order to produce a marketable sodium chloride product by the addition of sodium hydroxide. Our goals are to design a facility that will effectively treat the contaminated water according to state and federal standards, provide a long-term, cost-efficient solution for natural gas companies, and reduce the environmental impact of drilling activities in the Marcellus Shale.

CAEE-19
REDESIGN AND RECONSTRUCTION OF THE DELAIR BRIDGE

Advisors: Dr. Kurt J. Sjoblom, Dr. Ivan Bartoli

Team:

Allyson Canestri	Environmental Engineering
Lauren Reiter	Civil Engineering
Samuel Steffes	Civil Engineering
Daniel Usher	Civil Engineering

The Delair Bridge, built in 1895, crosses the Delaware River just south of the Betsy Ross Bridge. At its completion, it was the first bridge connecting Philadelphia to southern New Jersey, and replaced ferries as the main source of freight transport between the two locations. Other than an addition of a movable lift span in the 1950's, the bridge has not been modified or updated since its initial construction. Currently, the Delair Bridge services New Jersey Transit (NJT) passenger trains and Conrail's freight service. Structural analysis completed by the New Jersey Department of Transportation has determined the severe need for both short and long-term investment in the bridge, and its approaches in order to ensure its continued functionality. Additionally, major structural work is needed to maintain the 286 kip freight capacity of the bridge necessary to transport freight. An environmental assessment has been done on the bridge and surrounding area. A redesign and reconstruction of this structure is being done with the following objectives: improve structural quality of bridge and employ preventative measures of deterioration, improve bridge reliability and functional flexibility, enhance capacity to meet current and future regional freight and passenger demands, implement procedures to reduce environmental impact.

CAEE-20
REPURPOSING OF THE MANAYUNK BRIDGE AS URBAN GREEN SPACE

Advisor: Dr. Sabrina Spatari

Team:

Colin Henner	Civil Engineering
Jonathan Hubler	Civil Engineering
Steven Squibb	Civil Engineering
Michael Thorley	Civil Engineering

The Manayunk Bridge was built in 1918 over the Schuylkill River to service the Pennsylvania Railroad before being purchased by SEPTA in 1976 to connect the Cynwyd and Ivy Ridge regional rail stations. However, the iconic arch bridge has not been used since 1986 due to concerns surrounding the structural integrity of the rail and bridge. In the 1990s, a rehabilitation of the bridge structure was performed, leaving the bridge underutilized and full of potential. With the increasing demand for urban public green spaces, this bridge offers an interesting project to repurpose an underutilized urban space for use as a public park. The redesigned bridge, which connects Manayunk and the Cynwyd Heritage Trail, will provide a much-desired park trail for cyclists, joggers, and walkers. The expected outcome of this project is to determine the most sustainable practices and designs for the renewal of this abandoned rail bridge.

CAEE-21
WARMINSTER COMMUNITY PARK - BASEBALL AND SOFTBALL COMPLEX

Advisor: Dr. Richard Weggel

Team:

Robert Hudson	Civil Engineering
Long Tran	Civil Engineering
Rebecca Small	Civil Engineering
Christopher Snavely	Architectural Engineering

The township of Warminster, PA has requested the design for a baseball complex comprising of five fields and a multipurpose building. The Warminster Baseball/Softball Association desires a central location to hold tournaments and regular practices. The township has an area about four acres in size that will be used for this complex. There will be one regulation size field, two little league fields, and two softball fields. The building will have restrooms, an area for selling concessions, and a second floor for announcing booths. This multipurpose building will be installed with electric, water, and sewer utilities. There will be a two lane roadway intersecting the complex and multiple parking lots to allow access to the fields. The complex will be equipped with proper runoff drainage that will be connected to a detention basin. This complex will be constructed with a three phase plan per the client's request.

CAEE-22
STORMWATER MANAGEMENT FOR UNITARIAN SOCIETY OF GERMANTOWN

Advisors: Dr. Patricia Gallagher, Dr. Charles Haas

Team:

Glenn Aller	Environmental Engineering
Matthew Carideo	Environmental Engineering
Wei Chen	Civil Engineering
John Jones	Civil Engineering

In recent years, the City of Philadelphia has changed their billing of stormwater runoff from meter based, to parcel-size based. The total area of impervious surfaces within the property is responsible for the majority of the billing. The Unitarian Society of Germantown is one property owner whose bill will be inflated by this new policy. The Philadelphia Water Department offers credits for property owners who implement runoff prevention methods and/or devices. Some such devices include porous pavement, green roofs, cisterns, stormwater basins, and rain barrels. In working with the church and considering their budget, an appropriate design system will be selected to minimize construction costs. With church approval, this design implemented on their property will minimize the monthly stormwater charge. The proposed design will be compared with Philadelphia Water Department's suggestions, to ultimately reduce the economic hardship burdening the church.

CAEE-23
KERR CLUB BOATHOUSE PROJECT

Advisor: Prof. James E. Mitchell

Team:

Kelly Downes	Architectural Engineering
Marty Khait	Architectural Engineering
Peter Schmidt	Architectural Engineering
Jake Sloan	Civil Engineering

Drexel University has an exclusive outlet in Fairmount Park that is leased from Bachelor's Barge Club for use by the University's Crew Team. Unfortunately, the rent for this boathouse is growing while the structure deteriorates. The crew team struggles to store eight 60 feet shells, four 40 feet shells and four 30 feet shells in just one 80'x18' bay. Drexel University is in search of a new permanent and sustainable facility for use as a recreational address, an intercollegiate competitive venue, and as a retreat to be used by those affiliated, to meet current standards among winning programs.
The team will investigate a few solutions for this problem. They range from a buy-out and renovation of the current location to building a brand new structure in several possible locations. Case studies of similar structures and projects will also be used to guide the group in the right direction.

CAEE-24
DREXEL PARK DORMITORY

Advisor: Dr. Joseph Mullin

Team:

Yun Bai	Architectural Engineering
Lemond Brown	Architectural Engineering
Dmitriy Gorbachik	Civil Engineering
Sierra Tilton	Civil Engineering
Qian Wang	Civil Engineering

The multi-story dormitory building will house graduate and undergraduate students. The proposed site for this new facility is located at 31st and Powelton St., which is currently known as Drexel Park. The new dormitory will provide housing to 408 students, and is intended to mitigate the overcrowding of the existing dorms. The dormitory will features suite style housing and takes advantage of the expansive view of downtown Philadelphia. The design includes provisions for a Wawa food market on the ground level and a green roof accessible for faculty, students, and staff.

CAEE-25
REDEVELOPMENT OF MOYERS LANDFILL AS A LAND IMPROVEMENT PROJECT

Advisor: Dr. Sabrina Spatari

Team:

Brian Conzentino	Civil and Architectural Engineering
Caroline Edwards-Mack	Civil and Architectural Engineering
Justin Johnson	Civil and Architectural Engineering
James Monahan	Civil and Architectural Engineering
Eric Rice	Civil Engineering

We evaluated the feasibility of redeveloping the vacant Moyers Landfill brownfield located in Montgomery County, Pennsylvania. As a former landfill, the site has been remediated by the EPA, and will be released for development in August of 2012. We finalized our design for a strip mall, comprising of one large warehouse store, 8 smaller storefronts, and a parking lot to be built on the site. Our group completed phase one and phase two geotechnical investigations and soil summaries, evaluated site and water management plans, computed structural load requirements for the buildings, designed a foundation system to support the structures, and created a detailed cost estimate for the project. Our submission also includes a brief history of the site conditions at the Moyers Landfill, and relevant parts of a 2007 progress report acquired through contacts as the US EPA office.

CAEE-26
RENOVATIONS AND IMPROVEMENTS TO THE ACADEMY OF NATURAL SCIENCES OF DREXEL UNIVERSITY

Advisor: Dr. Robert Brehm

Team:

Daniel Brown	Architectural Engineering
Bryan Gilliam	Architectural Engineering
Ryan Pinkowski	Civil Engineering
Adam Trosko	Architectural Engineering

The Academy of Natural Sciences of Philadelphia (ANS) was built in 1876, and has undergone many renovations and additions between then and the present day. Today, the ANS is faced with several challenges. First, many of the building's heating, ventilation, and air-conditioning (HVAC) systems are beyond their economic lifespan. Additionally, the ANS staff has expressed the desire for a new aesthetic scheme in the main exhibit area. Finally, the ANS wishes to create a new exhibit highlighting an emergent technology in the field of environmental sustainability. The group will attempt to solve these challenges by addressing each area. Supplementary air handling units will be placed on the roof to provide adequate air supply to meet the building's demand. The original building's atrium will be restored to create a more dramatic exhibit space. Finally, an exhibit demonstrating the process of converting biomass to usable biofuel will be designed to educate patrons.

CAEE-27
NORTHEAST EXTENSION OPTIMIZATION

Advisor: ***Dr. Anu Pradhan***

Team:

Erik Bagasevich	Civil Engineering
Patricia Bookh	Civil Engineering
Timothy Bratton	Civil Engineering
Matthew J. Schreffler	Civil Engineering

The 10.5-mile corridor of the Northeast Extension between the Schuylkill Expressway (I-76) and Rt. 63 is one of the most observable instances of traffic congestion in the area due to outdated and overloaded roadway designs. Recently, the Pennsylvania Turnpike Commission approved plans for a "Total Reconstruction and Widening Project" to begin construction in 2014 that would transform the existing four-lane roadway into a modern, six-lane highway with three 12' lanes dedicated to each direction.

In order to justify an alternative solution, a conceptual life-cycle design must prove more beneficial than the approved plans. The current design features innovative concepts and emerging technologies based on heavy research of traffic analysis and Intelligent Transportation Systems (ITS). The benefits incurred through the use of multidirectional lanes, traffic analysis methods, and ITS systems will prove a more adaptable, safe, and life-cycle cost effective design than the currently approved plans.

CBE-01
LIQUID FLUORIDE THORIUM REACTOR

Advisors: Prof. John Speidel, Dr. Christopher Peters

Team:

Peter Hunter	Chemical Engineering
Yakira Kirzner	Chemical Engineering
Edith Monino	Chemical Engineering
Khoa Van	Chemical Engineering

Team Thorriors has designed a Liquid Fluoride Thorium Reactor (LFTR) and surrounding operating systems as a potential nuclear energy source. Energy is created when the uranium-233, bred from thorium-232, fissions, releasing neutrons with large kinetic energies. Rather than using solid core fuel, the LFTR utilizes molten salt LiF-BeF¬¬2. This molten fuel salt is continuously purified in a salt purification system, and is additionally pumped to a heat exchanger system where water is converted to steam and used to generate power. The entire LFTR plant is designed to generate 100 MWe of power. The LFTR process includes a waste treatment system, as well as several active and passive safety controls to mitigate possible runaway reactions. The plant has an expected lifetime of 60 years. In the economic analysis, the plant was deemed to be profitable with a discounted cash flow rate of return of 10.63% and a payback period of 10.13 years.

CBE-03
DRY-FRACTURING PROCESS

Advisor: Prof. Gennaro Maffia

Team:

James Dierkes	Chemical Engineering
Amanda Hoffman	Chemical Engineering
Amanda Love	Chemical Engineering
Morgan Tweed	Chemical Engineering

In efforts to reduce the contamination and water depletion threats that the current hydraulic fracturing process has on the environment, the FracKINGS Company provides an efficient alternative process. This process is the dry fracturing of a well using liquid CO2 captured from power plant flue gas. This fluid is mixed it with a proppant, sand, and injected into the well at high pressure. The sand proppant holds open the fractures and remains in the shale, allowing the release of the natural gas. The FracKINGS Company will make profit off the natural gas product after it has been treated at a central facility. Wells treated with the CO2/sand proppant mixture had an average cumulative gas production that was four times greater than the traditional hydraulic fracturing methods. Even though it has a high initial investment, the FracKINGS' process has proved to be worthy of consideration in today's natural gas exploration needs.

CBE-04
FEASIBILITY STUDY FOR LANDFILL GAS TO ELECTRICITY PLANT DESIGN -LMFGO-

Advisor: ***Prof. John Speidel***

Team:

Kaycee Watkins	Chemical Engineering
Marc Ragnauth	Chemical Engineering
Matthew Novatnack	Chemical Engineering
Mitchell Zelmanovich	Chemical Engineering

Proposed is a system that treats and processes landfill gas extracted from the Fresh Kills Landfill in Staten Island, New York and coverts it to electricity using a water-tube boiler and steam turbine system. The plant filters and treats 400,000 m3/day of landfill gas to remove corrosive compounds. The cleaned gas is then mixed with excess air and combusted in the shell of a water-tube boiler. The heat of this combustion reaction is used to convert preheated feed water into high pressure steam. Steam exiting the boiler powers turbines, producing approximately 20.9 MW of electricity. The plant's design includes optimization strategies to reduce capital and utility costs.
The bulk of raw material used will be methane, in the form of landfill gas, and is assumed to be provided at no cost. River water will be used for cooling. Electricity produced will be sold to the power grid.
The landfill gas to electricity plant proposed reduces the amount of hazardous greenhouse gases emitted by the landfill to the atmosphere. This sustainability aspect makes the plant's implementation desirable.

CBE-05
GAS-TO-LIQUID (GTL) PLANT

Advisor: ***Prof. Gennaro Maffia***

Team:

Lynda Bui	Chemical Engineering
Prina Chudasama	Chemical Engineering
Ziheng Li	Chemical Engineering
Chel'se Prejean	Chemical Engineering

This is a feasibility study of a gas to liquid (GTL) plant in Fairbanks, Alaska and is an alternative to the proposed Alaskan pipeline project, costing an estimated $26 billion, from Alaska to Canada for transporting natural gas. Due to the environmental concerns and high cost, U.S. and Canadian governments opposed the project. The aim of this project is to convert natural gas into valuable hydrocarbon liquids. A 400-mile natural gas pipeline will be built from Prudhoe Bay to Fairbanks. The refinery at Prudhoe Bay removes the impurities from the natural gas so that the feedstock to the GTL plant is pure methane. Octane, diesel, wax, hydrogen, and methane are produced using the steam methane reforming, Fischer-Tropsch and Sabatier processes. The process has been designed to minimize safety, sustainability, and environmental concerns and follows standards set by OSHA. The net present value of the plant is $510 million and the discounted rate of return is 15.28%. This rate of return shows that the project will be profitable after 5.3 years.

CBE-06
MANUFACTURING HMBA FROM MMP
SARSINE INC

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

Team:

Alexandra Bartolomeo	Chemical Engineering
Ronald Kayea	Chemical Engineering
Samuel MacLean	Chemical Engineering
Stephen Price	Chemical Engineering

DL-Methionine (DLM) is an essential amino acid most commonly used as a supplement in poultry feed stocks. The supplement is often added as the DLM hydroxyl analogue, or 2-hydroxy-4-(methylthio)butanoic acid (HMBA), and converted to DLM in vivo. By supplementing HMBA in feed stocks, poultry growth is expedited and time to slaughter is reduced significantly. Due to the recent rise in the standard of living throughout Asia, chicken has become a commodity that can be afforded by more of the Asian population. Designing an HMBA plant onto an existing MMP facility in Asia is desirable due to the developing market for poultry and limited supply of HMBA in the area. The current market for HMBA in Asia is approximately 1.5 billion pounds annually with a growth rate of 6.5% annually. The following proposal entails design specifications and the economics of a plant that produces HMBA from 3-(methylthio)propionaldehyde (MMP).

CBE-07
PRODUCTION OF ATACTIC POLYPROPYLENE THROUGH PROPYLENE-ETHYLENE COPOLYMERIZATION

Advisors: ***Prof. John Speidel, Dr. Giuseppe Palmese***

Team: Andrew Burns	Chemical Engineering
Caitlin Keane	Chemical Engineering
Tyler Perlenfein	Chemical Engineering
Karen Rothschild	Chemical Engineering

Atactic Polypropylene (APP) is a tacky substance most applicable for creating impermeable water sealants. Demand for APP has increased due to newly discovered applications in the roofing market. This project focuses on building an APP production plant to meet the rise in demand for APP in the domestic housing market.

APP is produced through copolymerization of propylene and ethylene in a loop reactor in the presence of a Ziegler-Natta catalyst. Ethylene is the copolymer to aid in strength and flexibility of the product. The APP is recovered through a flash system, separating APP from unreacted propylene. Special handling techniques must be used to package and ship APP due to its tacky nature.

The APP plant is located in Baton Rouge, LA. The production capacity is 230,000 tonnes/year, which will meet approximately 15% of the market demand projected through 2015. With the rise of new housing markets, roofing material will be in heightened demand, causing an anticipated increase in demand for APP.

CBE-08
OLEFIN/PARAFFIN SEPARATION USING REACTIVE DISTILLATION

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

Team:

Hang Kuen Lau	Chemical Engineering
Aye Aye Min	Chemical Engineering
Merlin Thomas	Chemical Engineering
Laura Wu	Chemical Engineering

This report details the conceptual design of a propylene/propane separation unit using reactive distillation as a potential replacement for a conventional C3 splitter.
This separation unit is composed of three columns, two reactive distillation columns, where the reversible esterification occurs, and a purification column to achieve the purity required for the polymer grade propylene. First, the C3 mixture feeds to the first reactive distillation for separation of propane with an esterification reaction. The bottom product of the first reactive distillation column feeds to the second reactive distillation column to separate the propylene utilizing a de-esterification reaction. The third purification column purifies the propylene from the second column to achieve the purity of 99.7% with recycle.
Economic analysis shows the optimized process is a favorable investment for both a grass-root plant and the replacement of an existing conventional C3 splitter. This reactive distillation design saves up to 24% energy compared to the conventional C3 splitter. The return on investment is 42% with a payback period of 2.52 years. The project with the optimized process is economically feasible. A patent is being applied for to cover this technology.

CBE-09
OLIGOMERIZATION OF OLEFINS TO MAKE POLYGASOLINE

Advisor: ***Dr. George Rowell***

Team:

Tram Nguyen	Chemical Engineering
Matthew Pennington	Chemical Engineering
Rodolfo Santelises	Chemical Engineering
Xiaomei Wei	Chemical Engineering

The project under consideration is the construction of an olefin oligomerization plant for the production of polygasoline. This process consumes olefin byproducts from the High Temperature Fischer-Tropsch (HTFT) process used at the Sasol II Coal Liquefaction plant located in Secunda, South Africa. The primary components of the olefin feedstock are propylene and butene, along with propane and butane, which do not participate in reaction. The feedstock olefins are run over a Solid Phosphoric Acid (SPA) catalyst where several oligomerization reactions occur simultaneously, producing a complex distribution of olefinic hydrocarbons. The polygasoline product contains mostly hydrocarbons in the range of C8-C12. The plant will consist of two trains (a 100 and 200 section) operating in parallel. The major equipment units of each train will consist of 4 reactors operating in parallel and a debutanizer column that separates its feed into a polygasoline product stream and a Liquefied Petroleum Gasoline (LPG) product stream. The production capacity of the plant is 43,374 kg/hr of polygasoline and 24,824 kg/hr of LPG. The annual capacity of the plant will be 351,000 metric tons per year of polygasoline and 200,300 metric tons per year of LPG.

CBE-10
THE REMOVAL OF NITROGEN- AND PHOSPHORUS-BASED COMPOUNDS FROM ANIMAL WASTE

Advisor: Dr. Richard Cairncross

Team:

Mekhana Abraham	Chemical Engineering
Rashidi Butcher	Chemical Engineering
Simi John	Chemical Engineering
Andrew McCaughan	Chemical Engineering

The removal of animal waste from farms and animal feeding operations is a major issue worldwide. Livestock manure is considered to be a valuable resource for fertilizer nutrients to increase crop production. Renu Manu, Inc. is a Waste and Energy Solutions Company that produces low-nutrient nitrogen-, phosphorus-, and potassium- (N-P-K) based fertilizer, and anhydrous ammonia from dairy cow manure.
Located in Nebraska, dairy cow manure from 5000 cows will be collected daily. The major steps in the process are the decomposition of manure, and separation and purification of the products. The manure is decomposed, producing a biogas and digested slurry in four identical horizontal plug flow anaerobic digesters. The biogas produced is used as a source of energy for various processes. The solids are separated from the slurry by rotary filtration and sold as low-nutrient N-P-K-based fertilizer. The filtrate is sent to an ammonia stripper to produce commercial anhydrous ammonia.

CBE-11
RENEWABLE DIESEL PRODUCTION FROM MICROALGAE

Advisor: Dr. Michael Grady, DuPont

Team:

Danielle Martin	Chemical Engineering
Jade Teekhasaenee	Chemical Engineering
Nigora Isamiddinova	Chemical Engineering
Omer Hashmi	Chemical Engineering

Algaenius, Inc. has conducted a feasibility study for the production of renewable diesel from algal oil. Renewable diesel has superior qualities comparable to those of traditional diesel fuel, and alleviates net greenhouse gas and particulate emissions. Microalgae are an attractive prospect for renewable fuels as they have high growth rates and higher energy yields per area than terrestrial crops, and they do not impact on food production demands. A full scale plant capable of producing 32 million gallons of renewable diesel per year – energy-equivalent to a 55 million gallon ethanol plant – was designed. The marine microalgae, Nannochloropsis sp. are cultivated in raceway ponds and harvested, and the oil is extracted and converted to renewable diesel via a hydrotreat process. Flue gas and wastewater usage is integrated into the process to offset environmental burdens. Based on our economic analysis, the project has an internal rate of return of 13 percent, thus presenting an economically viable sustainable energy design.

CBE-12
ALLYL ALCOHOL PRODUCTION VIA ISOMERIZATION OF PROPYLENE OXIDE

Advisor: Dr. George Rowell

Team:

Christopher Esucdero	Chemical Engineering
Harriet Henry	Chemical Engineering
Melat Mengistu	Chemical Engineering
Veronica Ndegwa	Chemical Engineering

Allyl alcohol is used as a chemical intermediate for specialty chemicals. It is mainly converted to glycidol, which is then used to manufacture glycerol. This chemical process design explores the production of allyl alcohol by isomerization of propylene oxide. The reaction occurs in a train of five fixed bed reactors in series using 40 wt. % silica based lithium phosphate catalyst, with an overall propylene oxide conversion of 80% and an allyl alcohol selectivity of 93%. This yields production of 6283 kg of allyl alcohol per hour. LyondellBasell currently dominates the production of allyl alcohol in America. 80% of the allyl alcohol they produce is for in-house use as a chemical intermediate for other processes. The other 20% is commercially sold. This new process plans to capture the remaining domestic market and 25% of the global market share by producing 50 million kilograms per year upon entry.

CBE-14
WASTE TRAP GREASE TO BIODIESEL

Advisor: Dr. Richard Cairncross

Team:

Alexander Gallagher	Chemical Engineering
Sean Mauk	Chemical Engineering
Shriram Raghu	Chemical Engineering
Andrea White	Chemical Engineering

A 10,000 gallon capacity transfer station collects, treats, and then disposes of trap grease. Approximately 10-40% by volume of the trap grease is Free Fatty Acid (FFA) which can be converted to Fatty Acid Methyl Ester (FAME) otherwise known as biodiesel. A feasibility study on a process design to convert FFA to FAME was performed using aspen simulation software. The design involves a pretreatment coalescer to separate FFA from trap grease. A bubble column reactor then reacts FFA with methanol (MeOH) to produce FAME. A MeOH recovery flash drum operating at 75.9°C recovers and recycles unreacted MeOH. The product FAME is purified in a standard vacuum Wiped Film Evaporator. The process generates an annual revenue of $2.8 million by producing 366 kg/hr of FAME and from picking up 1498 kg/hr of trap grease. The discounted Cash Flow Rate of Return is 53.49% and the discounted payback period is 1.5 years.

CBE-16
RECOVERY OF SULFURIC ACID FROM AMMONIUM BISULFATE

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

Team:

Adwoa Coleman	Chemical Engineering
Melissa Iwu	Chemical Engineering
Kelvin Stubblefield II	Chemical Engineering
Omasan Wyse	Chemical Engineering

This report details the design and operation of a sulfuric acid (H2SO4) recovery plant producing 6,998,000 kg/yr. of pure ammonia (NH3) gas and 196,345,000 kg/yr. of 50 wt.% H2SO4 via bipolar electrodialysis. Ammonium bisulfate (ABS) is a byproduct of hydroxymethylthiobutyric acid (HMBA) production. ABS hydrolyses to form H2SO4, a raw material in HMBA production. Conventional processes to recover H2SO4 and/or NH3 are often uneconomical. The goal of this project is to explore an alternative, economical process to recover H2SO4 and/or NH3 from ABS.
The NH3 and H2SO4 provide a total yearly revenue of only $7,800,000. The process requires a fixed capital investment of $22,600,000. Due to the high cost of utilities, the yearly cost of manufacturing is $7,140,438. Based on a 15-year project life and a 2-year construction period, the net present value of the project is a loss of $19,850,000 with no DCFROR. The plant was designed as an adjunct to an existing HMBA facility in Malaysia to reduce the utility costs and eliminate shipping costs. A sensitivity study on the cost of raw materials shows that the project may become favorable if the cost of the products increase as projected.

CBE-18
SUPPLY GAS SYNTHESIS FROM WASTE PLASTIC

Advisor: ***Prof. Gennaro Maffia***

Team:

Brian Acquaviva	Chemical Engineering
John Akerson	Chemical Engineering
Alex Klemp	Chemical Engineering
Steve Pribis	Chemical Engineering

NASA is planning deep space missions to Jupiter's moon Europa, to explore for possible life. Such a mission requires would take approximately 10 years, with no way to refuel or resupply the ship after launch. With all the required resources and such limited space, it is a necessity to create robust recycling systems to convert wastes into a more usable form.
This project will address methods to deal with recycling the low density polyethylene (LDPE) waste. This waste is from plastic bags and packaging used to preserve foods. With 262 g per person per day of waste over ten years, 6694.1 kg of LDPE are generated during the mission. This can be converted to a fuel source to power the ship and increase available space. With a hydrogen source, approximately 6 tonnes of methane fuel can be generated over the course of the mission.

CBE-19
REDUCTION OF BENZENE IN CATALYTIC REFORMING PROCESS

Advisor: ***Dr. George Rowell***

Team:

Adam Daniels	Chemical Engineering
Daniel Domin	Chemical Engineering
Tyler Frazier	Chemical Engineering
Taylor Myer	Chemical Engineering

More gasoline capacity is required at the Balero refinery in Texas City, Texas. A study was done to propose reforming FCC naphtha in a continuous catalytic regeneration (CCR) reformer to provide more gasoline capacity. The catalytic reforming process restructures the naphtha hydrocarbons into more complex aromatic molecules with higher octane ratings that can be blended with gasoline. One of the aromatics produced is benzene. The focus of the study was to design a reforming process that minimizes or eliminates benzene production. The project cost for installing the new reformer is $17,770,000 and the projected discounted cash flow rate of return is 14.64%. A CCR reformer processing 15,355 kg/hr of naphtha was modeled using ASPEN Plus. A benzene recycle stream was added to return 90% of the benzene produced back to the reforming section to drive the chemical equilibrium towards other aromatic components. This reduced the overall benzene production by 28%.

CS-01
VisAssist

Advisor: ***Prof. Jeff Salvage***

Team:

Trevor Adams	Computer Science
Nate Bomberger	Computer Science
Tom Burdak	Computer Science
Shawn Busolits	Computer Science
Andrew Scott	Computer Science
Matt Stankiewicz	Computer Science
Nate Vecchiarelli	Computer Science

There are many tasks that visually impaired individuals struggle with on a daily basis. Mobile applications can aid these individuals and enhance their quality of life.

The VisAssist software suite is targeted at individuals with visual impairment ranging from legally blind to fully impaired. We worked closely with the Overbrook School for the Blind to develop requirements in order to create a suite of mobile application to solve these problems. VisAssist helps a visually impaired individual with accessibility of the device, navigation, color matching and getting information about their environment. The targeted platforms are Android, iOS, and Windows Mobile.

CS-02
TEAM ANACONDA

Advisor: ***Dr. Yuanfang Cai***

Team:

Nii Ashikwei	Computer Sciencse
Matt Bilyeu	Computer Science
Jordan Checkman	Computer Science
Michael Evans	Computer Science
William Luong	Computer Science
Aashish Vats	Computer Science

PowerPitch runs on Android devices, and communicates with a presentions Windows 7 computer via Bluetooth or a local Wi-Fi network. This mobile application allows presenters using Microsoft PowerPoint software to see low-resolution renderings of their slides, presentation notes, or both. Improved navigation during presentations will be achieved by showing a grid-layout of all the slides in a presentation. PowerPitch controls the slideshow remotely while also displaying pertinent information, thereby freeing the presenter to move about and to deliver a more natural and engaging presentation.

CS-03
INHERITREE

Advisor: ***Dr. Werner Krandick***

Team:

Firoze Abdur Rakib	Computer Science
William Fisher	Computer Science
Jeff Gelman	Computer Science
John Moran	Computer Science
Dave Ramirez	Computer Science

Inheritree is a learning tool allowing nursing students to create family health pedigrees that are a standardized way to illustrate relevant genetic information in the medical field. Students are able to generate professional quality pedigree charts that adhere to standards defined by the Pedigree Standardization Work Group.
These charts are generated, through the use of a desktop application, allow students to save their work and export their diagrams to a PDF document. They are also be able to submit their work to their professors, who use a specialized version of the Inheritree software in order to view and grade the students' work.
The focus of development is a rich, intuitive user interface that integrates into existing distance learning systems used by the College of Nursing. Inheritree uses Microsoft Silverlight to provide a polished, responsive interface.

CS-04
AUTONOMIC COMPUTING: SENSORS AND DETECTORS FOR APPLICATIONS, VMS, AND HOST OSes

Advisor: ***Dr. Spiros Mancoridis***

Team:

Joe Brightbill	Computer Science
John Greco	Computer Science
Ethan Mullins	Computer Science
John Troy	Computer Science

Modern fault detection software suffers from high incidence of false positivity and false negativity. This project will improve the fault tolerance and security posture of software systems. The project will utilize software sensors implemented at multiple levels: hardware, host OS, virtual machine, middleware, and application. The applications run on VMs, and the VMs run on Unix OS hosts. Simple geometric models will be used to capture normal system behavior. By creating and injecting faults and security attacks into the system, we will monitor whether the system state exceeds the boundaries of the normal model of the system.

CS-05
DEPLOYMENT OF LARGE-SCALE DATABASE FOR CROSS-FUNCTIONAL MATERIALS RESEARCH

Advisor: ***Dr. Spiros Mancoridis***

Team:

Tejprakash Gill	Computer Science
Evan Haas	Computer Science
Patrick Lockner	Computer Science
Phil Maconi	Software Engineering
Jonathan Monteiro	Computer Science
Alexander Rybak	Computer Science

Hephaestus will be a project focused on storing, searching, and sharing data pertaining to materials engineering research. It will allow users to upload information about their various material samples and then specify how that data will be shared. The system will contain both an API and a web front-end to facilitate storing, searching, and retrieving the data. Hephaestus will expose a data model that will enable researchers to convert their various material samples to a universal format. In addition, the API will include a set of commonly used tools to aid users in analyzing the data. The web interface will contain social networking features for researchers to discover each other and form collaborative teams. Finally, the web interface will provide access to common API functionality, as well as visualization tools for exploring the data.

CS-06
DISTRO KON

Advisor: ***Dr. Jeffrey Popyack***

Team:

Klaidi Dhamo	Computer Science
Yen-Duyen Duong	Computer Science
Esin Gokgoz	Computer Science
Daniel Harbuz	Computer Science
Preston Hults	Computer Engineering
Daniel Van Pham	Computer Science

DistroKon is an evolution of the last year's Computer Science Senior Design Final Four contest winning project, DistroWhale. By expanding the core functionality of providing convention organizers features to run their conventions on iOS and Android mobile platforms, we create a more socially dynamic experience for both convention organizers and attendees.
DistroKon's additional modules include: Interactive chat rooms (emulating & fostering the NDS pictochat craze); User accounts expansion including friends lists and event sharing, alerts, and ratings systems; Facebook, Twitter, and Google+ integration; Virtual "passport" system which allows users to check into convention booths and events.
DistroKon also adds additional statistics tracking utilities for event organizers.

CS-07
ASTRAEUS

Advisor: ***Dr. Jeremy Johnson***

Team:

Daniel Iannuzzi	Computer Science
Alex Karagodov	Computer Science
Matt Marron	Computer Science
Mariyan Stoyanov	Computer Science
Dan Zollers	Computer Science

Computationally expensive scientific simulations are performed most cost-effectively on Graphical Processing Units (GPUs). However, setup and management of experiments on a GPU cluster are difficult to perform. Astraeus is a cross-platform framework to setup, monitor, visualize, and analyze computationally expensive experiments on remote GPU clusters. Astraeus is designed to be flexible. Through plugin interfaces, multiple job management systems and simulation libraries may be used, although the Astrophysical Multipurpose Software Environment (AMUSE) is targeted in this implementation. Features include fault tolerance, secure authenticated connections, experiment permissions, and simulation result exportation.

CS-08
OPTIC RM

Advisor: ***Prof. Jeff Salvage***

Team:

John Klein	Computer Science
Garry Ledford	Computer Science
Roberto Vieras	Computer Science

The requirement to track business expenses is a burden to individuals as well as corporations. Individuals must retain and organize their receipts in order to get reimbursed, while businesses must collect, aggregate, and report expenses with proof of the transactions. With the current fiscal hardship, the IRS is watching closer than ever before, making complete expense tracking essential. Currently, most individuals collect paper receipts stuffed in wallets or purses and report their expenses upon returning to the office, hoping they haven't lost anything. The OpticRM Receipt Management Application acts as the catalyst in transforming antiquated manual expense tracking to the new wave of digital organization. OpticRM solves the problem of keeping paper copies of receipts by gathering, analyzing with OCR, storing, categorizing and transmitting essential data and imagery through a standard camera-enabled smart phone on the Android and Windows Mobile platforms.

CS-09
UNICONF

Advisor: ***Prof. Michael Kain***

Team:

Ross Bower	Computer Science
Sajal Desai	Computer Science
MeiZhi Li	Computer Science
Phil Trinh	Computer Science
Jedi Weller	Computer Science

The popularity of mobile devices creates a unique opportunity for collaboration at conferences and in the classroom. However, the wide variety of device platforms causes fragmentation issues that make such collaboration difficult or impossible. Existing systems are limited to specific platforms, isolating users from one another or contain very few features useful to conference attendees. Powered by Unisys ePortal technology, UniConf provides a unified interface for scheduling, collaboration and sharing across all devices. UniConf allows students or attendees to actively participate.

CS-10
MATHDASH

Advisor: ***Dr. Frank Lee***

Team:

Keith Ayers	Computer Science
Matt Lesnak	Computer Science
Nicholas Taylor Mullen	Computer Science

Traditionally students learning to solve math problems in school are forced to sit down and memorize common solutions. This approach has a fatal flaw, it unintentionally teaches our children that there's only one right answer. MathDash is a game that aims to remove this boundary by allowing a player to explore all possible solutions, by giving the player a continually changing, limited selection of numbers. A user quickly learns that by trying to solve any problem with only a single solution in mind won't always work.

MathDash provides a fast-paced, rewarding gameplay experience that reinforces math skills taught to elementary aged students. It encourages players to approach problems from a different perspective, giving them an intellectual advantage by teaching them to think outside the box. At the same time, players of any age can enjoy the simple, engaging gameplay while competing for the highest scores.

ECE-01
ROBUST SECRET KEY GENERATION USING A RECONFIGURABLE ANTENNA

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

Team:

Eugin Cherkansky	Electrical Engineering
Alyssa DeMent	Electrical Engineering
Josh Lawrence	Computer Engineering
Kevin Pietsch	Electrical Engineering

Security is one of the most critical factors to consider in modern wireless networks. A wireless exchange of information possesses a large number of vulnerabilities to security threats due to the unbound nature of the wireless medium. This project develops a physical-layer based scheme for improving the security of a wireless link by exploiting the capabilities of a reconfigurable antenna. An algorithm was developed to ensure the security of a wireless link by generating a secret key between two communicating parties. The multiple configurations of the reconfigurable antenna provided channel diversity which supplied means for the collection of more channel data, thus leading to the creation of a longer key and greater encryption strength. Several test scenarios were designed to ensure the robustness of the algorithm against third party intruders, and to prove that the algorithm was essentially unsusceptible to security breaches. The strength of the was determined by a high entropy value.

ECE-03
FORMULA HYBRID ELECTRIC CAR

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

Team:

Nathalie Capati	Electrical Engineering
Norman Chan	Electrical Engineering
Ian Gallagher	Electrical Engineering
Adam Hollock	Electrical Engineering
Vionna Lo	Computer Engineering

The Formula Hybrid International Competition is an annual automotive racing and design event for students hosted in Loudon, NH by the IEEE and SAE. The competition challenges students to design high-performance hybrid and all-electric vehicles, with an emphasis on fuel efficiency. The Drexel 2012 team reused the 2011 chassis, but has designed entirely new electrical drive and safety systems. Working directly with an MEM senior design team and the Formula Hybrid club, the drivetrain has been redesigned to better utilize the frame space, and now includes regenerative braking. All key systems have been designed to ensure high voltage isolation and weatherproofing for driver safety. A new driver interface features a simple but optimized dashboard and new pedal design. This interface will use data collected by the monitoring system to provide speed and motor current to the driver. The vehicle also features new suspension, braking and aerodynamics. In May 2012, Drexel Racing successfully competed in the Formula Hybrid competition.

ECE-04
DREXEL WIRELESS SYSTEMS LAB WiMAX APPLICATIONS TEAM

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

Team:

Ankur Arora	Electrical Engineering
Omar Kabeer	Computer Engineering
Nathan Lee	Computer Engineering
Ishita Singh	Computer Engineering

Wireless data communications have become an important part in today's mobile communication landscape. WiMAX (Worldwide Interoperability for Microwave Access) is one of several 4G wireless technologies which provides high data rates with a wider coverage area than the 802.11 WiFi standard. Working in conjunction with the Drexel Wireless Systems Lab, we have performed detailed analysis of existing commercial WiMAX networks (e.g., CLEAR), collecting network statistic measures such as throughput and signal strength. We visualize the data and form a predictive model of the interference behavior caused by a future WiMAX base station installation. Our analysis also draws theoretical correlations between signal strength and throughput, developing experiments which will aid in characterization and troubleshooting of the new installation.

ECE-06
POWER AGILE COMPUTER

Advisor: ***Dr. Mark Hempstead***

Team:

Andrew Cebulski	Computer Engineering
Justine Miller	Computer Engineering
Thomas Ozalas	Electrical Engineering
Lloyd Ricks	Computer Engineering

The design of this project was to incorp-orate hardware and software to create a more energy efficient computing device. With the push towards more mobile computing battery life plays a key role in the development of new computing devices. Current solutions only allow for basic software control like dimming a screen.

Our design incorporates a performance management system that can determine run-ning applications and make power adjust-ments based on a compilation of past perfor-mance measurements. The power data is obtained from a power management system that uses DC power lines to take measure-ments and send measurements to the perfor-mance control software through a micro-controller. The performance control soft-ware contains a user interface that allows the program to get user input to determine the best power management for that specific user. This combination of hardware and software management lets the user maintain performance while saving battery life.

ECE-07
DESIGN OF FREE-SPACE OPTICAL TRANSMITTER AND RECEIVER MODULES FOR HELMET MOUNTED BROADBAND fNIR SYSTEM

Advisor: ***Dr. Afshin Daryoush***

Team:

Li Hao Jian	Electrical Engineering
Brandon Lally	Electrical and Computer Engineering
Peter Tran	Electrical Engineering

Broadband and low power consuming optical transmitter (Tx) and optical receiver (Rx) modules were designed and implemented for a custom designed helmet and headband mounted free-space functional near-infrared (fNIR) brain imagining system, a low cost imaging replacement to MRI. Many design innovations are made, such as functionality integration of integrated circuit (IC) in TO-5 and TO-39 cans for a very small individual optical transmitter (Tx) and receiver (Rx) that are placed in key positions in contact with head. The proposed system fNIR system will perform spectroscopic measurements of solid brain phantoms by switching among tri-wavelength vertical cavity surface emitting laser (VCSEL) sources of 680nm, 785nm, and 850nm that are modulated from 30MHz to 1000MHz. The diffused and scattered modulated photons are collected using 0.49 pitch graded index lens (GRIN) mounted on the optical Rx modules. The optical Rx is based on PIN photodiode(s) integrated with single or differential trans-impedance amplifier (TZA) IC. Our team was successful in improving the size and performance of the previous generation of optical Tx and Rx modules.

Sponsored by: National Institute of Health

ECE-08
DIGITAL PHILADELPHIA CONNECTIVITY TEAM

Advisors: ***Dr. Kapil R. Dandekar, Prof. Richard Primerano, Mr. Kevin Wanuga***

Abhinandan Bhunia	Computer Engineering
Nisarg Patel	Computer Engineering
Dennis Tran	Computer Engineering

An innovative way for researchingnew networking technologies (like WiMAX) is to use a virtual test bed. We used ORBIT Management Framework (OMF) along with the ORBIT Measurement Library (OML) architecture for designing test beds for the WiMAX network that will be deployed at Millennium Hall on Drexel Campus in the near future. The main motivation to use OMF/OML is that they provide for a unified and standard way of performing network experiments and collecting data. We described our tests in a domain specific high-level language OEDL (like Ruby) and passed them on to OMF. The OMF's job is to allocate resources, deploy and execute the tests, and store the results in the OML in real time. Thereafter, we extracted the results from the database using data manipulation tools. We designed bittorrent tests to calculate link utilization, RSSI, CINR; iperf tests etc to judge the performance of the WiMAX deployment at Millennium Hall.

ECE-10
CELLULAR PHONE RADIATION EMISSION EXPOSURE MONITOR

Advisor: Dr. Thomas Chmielewski

Team:

Carl Charlicomb	Electrical Engineering
Philip Livecchi	Electrical Engineering
Edward Thomas	Computer Engineering
Alan Yates	Electrical Engineering

We have designed a low-cost and portable device for displaying received cell phone emissions as a tool for those concerned with excessive phone usage. Monitored values are presented in common terms via an LED display, thus aiding the user in metering their phone use. The device is branded as the Cellular Emission Monitor (CEM).
The project goals were to design and build (3) CEM units to demonstrate functionality and repeatability. The CEM receives and displays the accumulated RF emissions from a cellular phone over time. The CEM needed to easily mount on a cellular phone and be inexpensive enough to attract the consumer. Thus, the two most important criteria in our design were size and cost.
During phone calls, the CEM will monitor and record the energy received. The user at any time may press a button to view the collective energy received by the CEM. Thus, the user can make an informed choice to curb usage, utilize hands-free devices or substitute calls with emails or text messages

ECE-11
WIRELESS SERVO CONTROLLER

Advisor: Dr. Thomas Chmielewski, Mr. Daniel M. Lofaro

Team:

Allison Heisler	Computer Engineering
Xin Li	Electrical Engineering
Brian Mizner	Electrical Engineering
Phuc Nguyen	Computer Engineering

This project replaced wired, low power, quadrature encoder connections on a servo motor system supplied by Siemens, with a wireless connection in such a way that performance of the system was maintained. While the power cables for the motor and encoder remain in-tact, the encoder signals (Channels A, B, and Index) are transmitted wirelessly in order to reduce the size of cable bundles and noise in runs over 50 feet. The encoder signals are 5V TTL pulses which were converted to 3V logic in order to interface to the wireless I/O of the Texas Instrument target boards. The signal interface to the wireless devices was accomplished through our designed printed circuit boards while software was coded to implement the wireless link between each encoder and the controller. Funding for the project has come from the team members and Drexel, and equipment was donated by Siemens Medical
Sponsor: Siemens Medical

ECE-12
AIR QUALITY MONITORING SENSOR NETWORK

Advisor: Dr. Kapil Dandekar, Prof. Richard Primerano

Team:

Aakash Gautam	Computer Engineering
Alvin Ocloo	Civil and Architectural Engineering
Lakshay Puniani	Computer Engineering
James Sebastian	Computer Engineering

We have designed an air quality monitoring wireless sensor network that records and analyzes harmful gas concentrations in ambient air. In a request from the Clean Air Council and in partnership with the Drexel EPICS program, we have designed a deployable network of low cost, low profile sensors that are easily accessible through a simple web user interface.
As our final product, we have developed a software that wirelessly collects gas concentrations on a base station. The data collected is stored both on the base station and an online database for greater data redundancy. The data is then analyzed locally on a Graphical User Interface (GUI) in real time and can be accessed via a web interface as well.
Sponsors: The Drexel EPICS program and Clean Air Council

ECE-13
DYNAMIC TRAFFIC CONTROL

Advisors: Prof. William Mongan (CS), Dr. Iman Salama

Team:

Steven M. August	Mechanical Engineering
Robert S. Calsamilia	Electrical Engineering
Damien D. Duckrey	Electrical Engineering
Richard J. Morrell	Electrical Engineering

We have proposed a Traffic Control system based off of RF technology, along with a complex algorithm to determine the most efficient traffic timing. The system will use long range RF sensors that will detect cars, and transmit a signal to the receiver at the intersection. The sensors are solar powered, and are mounted on poles along the side of the road. The wireless signal transmitted will be used to send real time traffic data to the traffic light control box at the intersection.
We have developed an algorithm that uses the real time sensor inputs to dynamically alter the timing of the traffic light. This algorithm stores and uses historical data to establish a base light timing for the intersection. This base light timing is then altered by the real time sensor data.
The Dynamic Traffic Control System is cost effective over its competitors because it does not require expensive hardware or costly labor. The benefit of the DTC system will be improved intersection efficiency which will lessen travel times and save fuel.

ECE-14
LOAD FLOW STUDIES

Advisor: ***Dr. Dagmar Niebur***

Team:

Ahamed Masdook Saheed	Electrical Engineering
Pavan Sajja	Electrical Engineering
Rajat Singh	Computer Engineering
Mahesh Talampally	Electrical Engineering

Power flow analysis is used by many electric utilities to analyze steady state behavior of the power grid. The analysis requires solving electric power flow equations for bus voltage magnitudes and angles. These non-linear equations are solved using iterative numerical methods such as Newton-Raphson or Gauss-Seidel. Power system monitoring and analysis tools such as state estimation, contingency analysis and optimal power flow rely on efficient computation of the power flows. Therefore, a minor improvement of power flow computation time will have a significant impact on many real-time power system tools.
This project investigates the inherent parallel processing capabilities of Graphical Processing Units (GPU) that enhances computation time of linear solvers integrated in Newton-Raphson algorithm for power system steady state analysis. The proposed linear solvers, Conjugate Gradient and Gauss Elimination, were implemented on the CPU and the GPU for power systems of different sizes and their respective computation speedups were then compared.

ECE-15
MAZE TRAVERSING ROBOT WITH EDUCATIONAL INTERFACE

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

Team:

Katherine Desmet	Computer Engineering
Greg Felber	Computer Engineering
James Goerke	Computer Engineering
Nicholas Vaccaro	Computer Engineering

We have designed a software suite to teach middle-school students logical thought through the use of flowcharts. This is done by providing a maze simulator that allows the students to construct a flowchart of instructions to control a simulated robot. The flowchart includes basic commands such as move forward, turn left, and turn right as well as conditional “if” statements and while loops.
With the use of this tool, students are tasked with guiding the simulated robot through a variety of mazes. The students can then create their own maze-solving algorithms after learning the basics. Students can reference several preset algorithms to assist with their own design. The suite includes a lesson on how to create and understand flowcharts as well as a tutorial on how to use the software. We will be testing our product on middle-schools to gain feedback on how it can be further improved.

ECE-17
NUCLEAR REACTOR SIMULATION UTILIZING MICROSOFT KINECT

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

Team:

Michael Lui	Computer Engineering
Paul Martin	Electrical and Computer Engineering
Paul Rua	Electrical Engineering
Joshua Waldman	Electrical Engineering

We have produced a stand-alone computer program that simulates a nuclear reactor, utilizing Microsoft Kinect-based motion gestures for input. The program is intended as a first exposure into the theory and operation of a nuclear reactor to help garner interest and encourage students to pursue a nuclear engineering degree. The system is designed to be affordable and portable, so that it can easily be purchased and used in classrooms or at home.
The Microsoft Kinect is an affordable sensor suite capable of motion tracking. By implementing the Kinect within the simulation, the user performs natural gestures in order to interact with the control panel providing a more immersive and intuitive experience.
While running the simulation, the user has several visual feedback gauges, similar to what would be found in a real reactor, to indicate the status of the reactor. In addition, the output power can be graphed in real-time for analysis.
Acknowledgements: Exelon

ECE-18
INTELLIGENT POWER STRIP

Advisor: ***Dr. Richard Primerano***

Team:

Calvin Au	Electrical Engineering
Prativa Kharel	Electrical Engineering
Mark Musser	Electrical Engineering
Jatish Patel	Electrical Engineering

In the United States alone, more than $10 billion a year is spent on generating electricity, only to be squandered via standby power. The amount of electricity being wasted can cause excess gas emissions into the atmosphere with the burning of excess fossil fuels. Our project goal is to design an “Intelligent Power Strip” that can measure power consumption, cost calculations and automated master/slave control outlets. Data measured by this power strip is recorded and stored to a PC for consumer convenience. Cost-effective is the most important constraint in this project. Our controller utilizes the PSOC programmable board, which includes excess components that is contributing to the cost of our device. If these smart power strips can be universally implemented, not only will the awareness of standby power spread but also the world can be a greener place with less electricity being generated. This can result in less air pollution and less utility costs for both businesses and residential homes.

ECE-19
POOL-SPECTRE

Advisor: ***Dr. Vasileios Nasis***

Team:

Ryan Hall	Electrical Engineering
Victor Martino	Mechanical Engineering
Scott Thiewes	Mechanical Engineering
John Zoltowski	Electrical Engineering

We have designed an innovative way to relieve the hassle of general pool maintenance.
The Pool-Spectre was designed to cater to a new demographic of residential automatic chemical balancing. Currently, pool owners must manually check their chemical levels themselves or call a pool company. The Pool-Spectre was designed to create an easy solution
for users to keep their pools balanced.
Unlike current systems on the market today, the Pool-Spectre was constructed as an all-in-one component. The chemicals and sensors are stored inside the housing along with the plumbing and chemical pumps. A detailed description of the construction of the Pool-Spectre can be found in our report.
Two sensors are used, ORP and a pH, which read the chemical levels. Then information is sent to the microcontroller. A detailed logic algorithm determines the amount of chemicals to be added into the system. Based on the information the pumps will be activated for a time period to disperse the proper amount of chemicals; saving all owners' time and money.

ECE-20
CHARACTERIZING DISTURBANCES IN SMART POWER DISTRIBUTION NETWORKS AND LOADS

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

Team:

David Andrews	Electrical Engineering
Eric Endress	Electrical Engineering
Thomas Regino	Electrical Engineering
Jonathan Segarra	Electrical Engineering
Vincent Zaccone	Electrical Engineering

In an ideal world, power distribution systems should contain voltage and current waveforms resembling a pure sinusoidal wave. However, various elements, like power electronic devices, distort these waveforms. These distortions can de-rate and reduce the life of electric equipment as well as cause nuisance tripping and lower reliability.
This project aimed to simulate such disturbances caused by power electronic devices, such as plug-in electric vehicle charging stations (PEVCS) and solar power inverters (SPI) and to study the effect of their increased usage on the distribution system. Simulink was first used to model several distribution circuits. Hardware experiments were then set up to establish baselines for systems with and without distortions. In our project, uninterruptible power supplies were interconnected to mimic PEVCS and SPI. The finalized procedure was published in manuals that will be used for

student learning as well as to help answer questions regarding the increased usage of power electronics.

ECE-22
DROP-IN LED REPLACEMENT FOR INCANDESCENT VISUAL LANDING AIDS

Advisors: Dr. Leonid Hrebien, Mr. Dave Peters (NAVAIR)

Team:

Joshua Edelman	Electrical Engineering
Roberto Salomé	Computer Engineering
Nicholas Silva	Electrical Engineering

The product delivered is a replacement lighting unit that will be used on NAVAIR Lakehurst's aircraft carriers. Every time a light bulb burns out, missions must be stopped or delayed until it is replaced. A flight deck crew member immediately goes out to change it, putting himself at high risk.
The new design is a longer lasting, LED light bulb that can match the legacy light bulb's light intensity and spatial output.
Increasing the lifespan and durability of the bulb is the primary objective for this design. The current, incandescent lighting units are cheaper to make, but only last up to 300 hours. The new landing aids use LEDs to provide similar illumination for up to 50,000 hours.
These visual landing aids will decrease the number of times that the bulbs will need to be replaced. This will further decrease the amount of times that the ship is operating with suboptimal illumination. While the LED bulb will cost more than the incandescent bulb, the extended lifespan of the LEDs will lower the long-term costs and thus save the NAVY and the US taxpayers' money as well.
Sponsor: NAVAIR Lakehurst

ECE-23
AUTOMATIC TENNIS ASSISTANT TRAINER

Advisor: Dr. Paul Kalata

Team:

Nicholas Andrew	Electrical Engineering
Kyle Dooley	Electrical Engineering
Alex Gruber	Electrical Engineering
Tim James	Mechanical Engineering
Colin Masterson	Electrical Engineering

We created a tennis trainer system that can track a tennis player and relay the player's position to a ball launcher. The intent is to use the system in conjunction with a ball launcher as a training aid for tennis players of any level. By taking into account the position of the player, the system will be able to provide more challenging play that simulates an actual tennis player.
The tracking component is a very important part of this project. We used computer vision to track the player on the court. Instead of using a tennis ball launcher, we tested the effectiveness of our tracking system using a Nerf gun mounted on a pan/tilt unit that allows us to adjust the position of the gun.
To demonstrate the system, we created 2 programs: one that will launch at the player and one that will launch somewhere on the court depending on where the player is.

ECE-25
AIR QUALITY MONITORING NETWORK - HARDWARE TEAM

Advisors: ***Dr. Kapil R. Dandekar, Prof. Richard Primanero, Mr. Kevin Wanuga***

Team:

Hartej Arora	Electrical Engineering
Abizer Nayeem	Computer Engineering
Sanyukt Sekhri	Computer Engineering

The high costs associated with current methods of monitoring particulate matter and harmful chemical gases, as well as the difficulty in monitoring targeted locations, have resulted in a request from the Clean Air Council (CAC) to design a deployable network of low-cost, low-profile sensors that are easily accessible through a simple GUI on the base station.
From the hardware team, we will deliver a set of three fully-constructed nodes capable of sensing harmful gases and particulate matter to detect natural gas leakage (default state). This is a 'plug-and-play' network wherein the sensors could be replaceable according to desired needs and functionalities.
Each node will consist of a processor, sensors, battery pack and radios for transmission of data to the base station.

ECE-26
CHARACTERISTIC CURVE TRACER WITH LabVIEW™

Advisor: ***Dr. Edwin Gerber***

Team:

Michael (Jorge) Peifer	Computer Engineering
Jacob Goldstein	Computer Engineering

Programs utilizing software LabVIEW™ have been designed to help students engage in an active learning environment for quick data collection of current and voltage characteristics of semiconductor devices. The devices we are concerned with specifically are diodes, JFET's, and NPN-PNP BJT's.
The curve tracer software has been designed to revolve around the student havin the best user experience possible for studying the characteristics of these devices. Our idea will ultimately serve the students well in the Drexel's ECE laboratories. For different labs the program can be altered to accommodate for these lab setups. The curve tracing unit will be designed to easily be used and understood in a laboratory environment.
The software itself cost Drexel nothing and uses lab equipment already in place in all of the ECE laboratories.

ECE-28
DESIGNING AND TESTING OF AN ENERGY STORAGE SYSTEM

Advisor: Dr. Karen Miu

Team:

Abhishek Garg	Electrical Engineering
William DePasquale	Electrical Engineering
Juxhin Jupi	Electrical Engineering
Michael Francois	Electrical Engineering
Sarabjit Singh	Electrical Engineering

We have incorporated a Lithium-ion battery system in addition to the existing Lead Acid battery system at Drexel's Center for Electric Power Engineering lab. This was to conduct charge and discharge tests on both battery types. Data collected during battery charging tests as well as data obtained during discharge tests for fixed and variable loads was used to evaluate the performance of each battery type. Data collected included voltage and current through the system and charge level of the batteries at regular time intervals. For this project we used SimPowerSystems and Simulink to build software simulation models to run simulations before assembling the hardware and performing tests on the batteries. AutoCAD program was used to design the layout of the hardware. The results of this project can be used to optimize the combination of existing energy storage technology for various uses.

ECE-29
ELECTRIC SOLAR CAR

Advisor: Dr. Adam Fontecchio

Team:

Ogedi Agoruah	Electrical Engineering
Joe Forrest	Electrical Engineering
Sean Fosmire	Electrical Engineering
Chris Jao	Electrical Engineering

Drexel University took part in the 2011 Shell-Eco marathon solar car competition. The Green Dragon was only able to generate 25 percent of the energy that the vehicle used on the course. Although Drexel emerged as the only prototype solar car to turn in a valid run, using 240 kilojoules to traverse the six-mile course from the produced 305 kilojoules of energy, none of the cars including other competing Universities could break the barrier of producing more solar power than it used.

This project was aimed to not only serve as a power source for the solar car but also one that is able to utilize the generated solar energy to its peak. Thorough investigation on the combination of solar panels, photovoltaic cells, energy storage and distribution were carried out and implemented. The project aimed to achieve not only regulating the speed for the solar car using the generated solar energy, but also maintaining the speed when solar input drops.

The project encompassed designing a charging, storage, and injection system into the circuitry and drive of the car and testing the photovoltaic system for generating the power for the car.

ECE-30
MAXIMUM POWER POINT TRACKING FOR SOLAR APPLICATIONS

Advisors: ***Dr. Allon Guez, Oleg Fishman, Ulrich Schwabe***

Team:

Joseph Dales	Electrical Engineering
Dzmitry Ilyuk	Electrical Engineering
Dan Shick	Computer Engineering

The goal is to implement maximum power point tracking for a solar cell string and dynamically load it to ensure that maximum power is produced. Alencon Systems developed a design for efficient solar farm that involves transmitting high voltage power to reduce loss. DC-to-DC converter is used for solar cell loading.

The device takes current and voltage measurements from an array and maximizes the power by changing the load. The converter is the H-Bridge with RLC string as a loading element. It is operated at different frequencies to dynamically change the load.

A solar panel, H-Bridge, and perturb and observe tracking algorithm were simulated. A small scale model of the system was constructed. Measurements and switching are handled by Cypress microcontroller. The measurements are used to determine the change in power over time and dynamically adjust the switching frequency. The model demonstrates the principle of MPPT, resulting in optimized power generation.

Sponsor: Alencon Systems, Inc

MEM-01
SMALL-SCALE THREE-DIMENSIONAL CELL PRINTING FOR POTENTIAL SPACE APPLICATION

Advisors: ***Dr. Wei Sun, Qudus Hamid***

Team:

Adrian Ambruş	Mechanical Engineering
Darko Blažić	Mechanical Engineering
Ashan Senaratne	Mechanical Engineering
Mickey Whitzer	Mechanical Engineering

Advances in additive manufacturing allow today's printers to print three-dimensional cell structures for use in drug delivery testing and organ growth. The current cell printing systems are large, expensive and require a degree of technical knowledge to operate. In order to increase the availability of these systems, their size, weight and cost must be reduced. Additionally, several entities expressed interest in a system that is capable of printing in a microgravity environment, providing the avenue for research of cell viability and proliferation under such conditions. The team has designed and fabricated a cell printer that costs under $2000, weighs less than 45 lbs, is easy to operate, and has a gravity independent material delivery system. The cell printer is 12"x12"x12" in size, fits inside a custom designed casing unit, operates with a cell viability greater than 70% and is capable of printing in a 3.5"x5" area.

MEM-02
AERODYNAMIC PACKAGE FOR LOW ALTITUDE ORBIT CUBESAT

Advisor: ***Dr. Jin Kang***

Team:

Frank Arute	Mechanical Engineering
Jasen Carroll	Mechanical Engineering
Kelly Meighan	Mechanical Engineering
Daniel Zettler	Mechanical Engineering

Among military and academia there exists a desire to launch CubeSats into very low altitude orbits for extended periods of time. This would make CubeSats more economical and attractive solutions for optical data collection and low power signal transmission. Currently, CubeSats at altitudes of approximately 250 km will remain in orbit relatively ten days. As launches are extremely expensive, extending the mission of a spacecraft from ten days to upwards of three weeks would yield a much higher return on that investment. To accomplish this feat, a simple solution was contrived; add a deployable aerodynamic package to an existing CubeSat. The package is comprised of a nose cone for the front of the satellite in the shape of a double wedge. The resulting package, fabricated out of aluminum and steel, will increase the lifespan of a CubeSat to an estimated 34 days (4.7 weeks), which exceeds the desired threshold for this project.

MEM-03
LEAK DETECTION IN WATER MAINS – NAVIGATION

Advisor: ***Dr. Young I. Cho***

Team:

Gary Auer	Mechanical Engineering
Joseph Colman	Mechanical Engineering
Michelle Neese	Mechanical Engineering
Brian Wickersham	Mechanical Engineering

This project is focused on creating an autonomous leak detection device for a water distribution system. We propose that an autonomous leak detection method can mitigate water and financial losses more efficiently than the non-autonomous leak detection methods currently used in the water industry. The project will be divided into 3 focus areas; with this team developing the subsystem to continuously determine and record the device's position in the water system. Deliverables for this project include the subsystem's working code in the Arduino programming language, examples and analysis of the code's recorded position data with and without filters, and a prototype of the subsystem hardware; consisting of 3 positioning sensors an Arduino Duemilanove microcontroller, and a MicroSD storage device. The accuracy of the subsystem's localization data is reliable up to the maximum speed of the transport device, and has a leak positioning error at least equal to the accuracy of the leak detection subsystem.

MEM-04
MEMS SHEAR STRESS SENSOR

Advisor: ***Dr. Mathew McCarthy***

Team:

Katie Brown	Mechanical Engineering
Adam Ryan	Mechanical Engineering
Evan Sauder	Mechanical Engineering
Marcin Szafran	Mechanical Engineering
Nick Tromba	Mechanical Engineering

As a fluid flows over a surface, the interaction between the fluid and the surface causes the fluid particles to slow down. This phenomenon is known as shear stress and is dependent upon the viscosity, velocity, and the cross sectional area it is flowing through. The ability to minimize shear stress (also known as drag) is necessary in many applications, e.g. ground and air vehicle design or blood flow through arteries. A MEMS (Micro-electromechanical System) sensor allows for a local reading to be taken at an exact point. The sensor was modeled and optimized using COMSOL Multiphysics and fabricated by using micro-fabrication techniques. To calibrate the sensor, a parallel plate chamber was designed to create a known value of shear stress along the walls of the chamber. The MEMS shear stress sensor was able to read desired shear stress values in the range of 1-2 Pascals.

MEM-05
FORMULA SAE: ANALYSIS AND DESIGN OF AERODYNAMICS

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

Team:

Evan Dimmerling	Mechanical Engineering
Thaddeus Fidura	Mechanical Engineering
Christine Gallagher	Mechanical Engineering
Joseph Gruber	Mechanical Engineering
Erik Smith	Mechanical Engineering

Formula SAE is an annual student design competition run by the Society of Automotive Engineers (SAE) where universities from around the world engineer three-quarter scale, combustion engine race vehicles. In order for the Drexel University FSAE team to remain competitive, the aerodynamic package was completely redesigned and manufactured for the 2012 competition in Lincoln, Nebraska. This included exploring recently discovered tubercle technology in an automotive application and utilizing analysis software for more comprehensive designs. The objective was not only to improve vehicle performance, but to provide the Drexel FSAE team with research for future designs as well. The final package includes a nose cone, side pods, undertray, front wing, and multi-element rear wing. Simulations and testing show a total vehicle downforce of over 100 ft-lbs at 35 mph, results that indicate significant improvement over vehicles designed by the Drexel FSAE team in years past.

Sponsors:

CD-adapco, Mastercam, SolidWorks, Boeing, Owens Corning

MEM-06
SLOWEST MOTORCYCLE LAND SPEED RECORD

Advisor: ***Dr. John Lacontora, Ryan Miller***

Team:

Erik Argueta	Mechanical Engineering
Bernard Callahan	Mechanical Engineering
Tyler Douglas	Mechanical Engineering
Johann Schlager	Mechanical Engineering
David Sharp	Mechanical Engineering

The Southern California Timing Association hosts an event every August, “Speedweek”, at the Bonneville Salt Flats during which individuals and teams bring their purpose-built vehicles to compete with hopes of setting a new world land speed record. This project consists of the design, fabrication, and testing of a motorcycle qualifying for the class A-F-100. The objectives of this project are to design and fabricate a 100cc motorcycle consisting of a nitrous oxide system and a custom frame, an optimized drive train, a cooling system, and a shifting system enabling gear selection from different riding positions. During testing, the engine did not overheat during a five-minute trial, and the rider was able to shift the motorcycle from an aerodynamic riding position.

The completed motorcycle showed a power increase of over 15% and a drag force reduction of over 30% compared to the stock configuration, with estimated top speed over 100 mph.

MEM-07
DETECTION OF LEAKY PIPES IN WATER DISTRIBUTION NETWORK AND METHOD TO REPAIR USING A TRAVELING ROBOT (B)

Advisor: ***Dr. Young Cho***

Team:

Brandon Burkey	Mechanical Engineering
Vincent Greco	Mechanical Engineering
Michael Lanza	Mechanical Engineering
Sean McDonald	Mechanical Engineering
Kevin Wiley	Mechanical Engineering

Millions of dollars in lost water are accrued annually across the globe thanks in large part to an aging and degrading water distribution infrastructure. City budgets are drained constantly and are fiscally unable to respond to the growing need for new systems, inspections, and replacements or repairs. Repairs seem viable, but are often too late as there is little advancement in the detection of leaks before a pipe bursts. This design solution proposes a mechanical device that can travel through live water mains while detecting cracks and leaks within the piping. The pipe rover has been designed, manufactured and now tested in a dry six inch pipe. In the future, the prototype must be modified to be water tight in order to maintain effectiveness when submerged. In conjunction with the two other groups and through the direction of Dr. Cho, the three designs will be combined into a singular detection mechanism.

MEM-08
KHR-4 HUBO FLEXIBLE TORSO

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

Team:

Roy Gross	Mechanical Engineering
Brittany Nutt	Mechanical Engineering
Richard Vallett	Mechanical Engineering

The articulation and flexibility of humanoid robots is an essential consideration in the development of robust platforms with human-like ranges of motion capable of operating within human environments. Crucial human tasks, such as balancing, require full body coordination through spinal bending; a feature lacking in modern humanoid robots like the KHR-4 Hubo. The project design objective involves designing and manufacturing an analogous spinal joint to insert at the waist of the Hubo between the upper and lower torso without altering existing components. A skewed-plane rotary joint design was chosen, which makes use of the existing waist yaw joint and allows additional pitch and roll of the upper body independent of the lower body. A virtual joint model was created in the OpenRAVE simulation environment and controlled using MATLAB to solve joint trajectories, showing the increased flexibility of the new design. A physical model was created and tested to verify the results of the virtual testing.

Sponsor: Drexel Autonomous Systems Lab (DASL) in conjunction with the National Science Foundation (NSF) federal grant number 0730206.

MEM-10
FEASIBILITY STUDY FOR THE USE OF PIEZOELECTRIC MATERIALS IN TRICKLE-CHARGING ONBOARD SMALL SATELLITE POWER SYSTEMS

Advisor: ***Dr. Jin Kang***

Team:
Kelly Collett Mechanical Engineering
Christopher Elko Mechanical Engineering
Danielle Jacobson Mechanical Engineering

Battery health of small satellites is a concern due to requirements for systems to be completely powered down during launch. There is also the possibility of a 2-3 month gap between handoff and launch, during which battery power may trickle out and render systems useless upon delivery into orbit. This project, coordinated with the RockSat-C Cansisterized Satellite Program, tests the feasibility of using piezoelectric materials to convert the mechanical vibration energy of a launch vehicle into usable electric potential and mitigate this concern. The experimental payload tests four configurations of piezoelectric cantilevers to determine the optimal orientation for power generation. Workbench level tests included vibration tests to prove the generation of electrical current and structural stability. Flight level tests, conducted at NASA Wallops Flight Facility, proved function and stability under the combined effects of sustained G-loads and spinning. All incorporated payload systems meet constraints outlined in the RockSat-C User's Guide.

MEM-11
DESIGN AND CONSTRUCTION OF A LINEAR MOTOR DRIVEN PULSE TUBE CRYOCOOLER FOR INFRARED CAMERAS

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

Team:
Michael Kapp Mechanical Engineering
Yash Nagarsheth Mechanical Engineering
Keola Williams Mechanical Engineering

Cryocoolers are the devices used to reach cryogenic temperatures (<120 K) by cycling gases like helium and nitrogen. The pulse tube cryocooler is a developing technology that emerged largely in the early 1980s. The pulse tube cryocooler can be made without moving parts in the low temperature part of the device, making the cooler suitable for many applications including the cooling of infrared camera sensors. The design construction and operation of coaxial type pulse tube cryocooler (for possible use in infrared cameras) is presented. Scaling the pulse tube cryocooler to the low temperatures and cooling power required while still fulfilling the geometrical specifications for infrared cameras is a challenge. The coaxial pulse tube cryocooler was designed using DELTAEC, a thermoacoustic apparatus design tool. The cryocooler components are being built at the time of writing this abstract. The results of initial testing and performance of the assembled cryocooler will be presented.

MEM-12
BIO-TEMPLATED NANOSTRUCTURED ELECTRODES FOR CAPACITIVE DEIONIZATION OF WATER

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

Team:

Charlie Garmel	Mechanical Engineering
Craig Hollish	Mechanical Engineering
Kevin Knehr	Mechanical Engineering
Liam O'Neill	Mechanical Engineering
Alexander Rinaldi	Mechanical Engineering

A large limiting factor of capacitive deionization (CDI) for water purification is the lack of high surface area, low cost, electrodes. Recently, electrodes coated with the tobacco mosaic virus (TMV) (to increase surface area) have produced promising results for use as low cost alternatives to synthetic electrode architectures for batteries. The project objective is to demonstrate the viability of TMV coated electrodes for capacitive deionization of brackish water. To accomplish this, the design team has i) developed a set of electrodes whose surface area has been enhanced with TMV, ii) designed and constructed a static test cell for electrode characterization, and iii) designed and constructed a functioning CDI system that is used to test electrode performance in a flowable configuration. Electrode performance yields data such as electrode capacitance, degradation, and water purity. This CDI system also required the design of a conductivity sensor, used to measure and record water purity.

MEM-13
CHARACTERIZATION OF A HYDRAULIC DRIVE SYSTEM FOR AN ELECTRIC MOTORCYCLE

Advisors: ***Dr. Jack Zhou, Dr. John Lacontora***

Team:

Erica Feldscher	Mechanical Engineering
Brian Garvey	Mechanical Engineering
Daniel Ku	Mechanical Engineering
Nijel Manatharyil	Electrical Engineering
Michael Petruzzo	Mechanical Engineering

Within motorcycle racing, there are many unexplored options, as many racers opt to take a tried-and-true track that will definitely work within competitive racing guidelines. Innovative Motorcycle Research, however, was founded to think outside the box and come up with new variations on a motorcycle aiming to increase speed and efficiency at the same time. One method of research chosen was to partner with a Drexel senior design team to design and build a hydraulic circuit to power a dirtbike to determine if it is a worthwhile design to pursue. The team designed and built a prototype to be powered by a continuous-duty motor to determine if the

utilization of a hydraulics system could increase the performance and efficiency of a dirtbike and eventually a motorcycle.
*Sponsor: Innovative Motorcycle Researc*h

MEM-14
DREXEL FORMULA HYBRID MECHANICAL

Advisors: Dr. Tein-Min Tan, Dr. Kevin Scoles (ECE)

Team:

Ryan Garis	Mechanical Engineering
Nik Heid	Mechanical Engineering
Ahmad Hijazi	Mechanical Engineering
John Lang	Mechanical Engineering
Marwan Mahfooz	Mechanical Engineering

Student interest in renewable technology is key to solving one of the twenty-first century's great engineering problems: sustainable transportation. The Formula Hybrid SAE competition challenges college students to design, innovate, build, and race a hybrid-electric or all-electric vehicle. This year's club, composed of one mechanical team, one electrical team, and several undergraduates, worked together to design and build a functional all-electric racecar with a lower weight compared to years past. The mechanical team, specifically, redesigned most of the components on the vehicle using 3D modeling software to draft parts and analyze stress distribution under racing conditions. Attention was paid to lowering the vehicle weight without compromising driver and crew safety. Certain tasks required a joint effort to make sure sensitive components were both mechanically and electrically reliable. The project culminates in a four-day competition in New Hampshire where teams are judged on design, marketability, and dynamic performance.

MEM-15
FSAE BRAKE AND SUSPENSION DESIGN AND OPTIMIZATION

Advisor: Dr. Tein-Min Tan

Team:

Tyler Buono	Mechanical Engineering
Steve Pierson	Mechanical Engineering
Pradeesh Shivaji	Mechanical Engineering
Bradley Wasson	Mechanical Engineering
Wenyu Zheng	Mechanical Engineering

The Drexel FSAE race car over the past few years, has had a very sturdy suspension and braking system which has not yet failed during competition. For this reason, the team was convinced that these components could be redesigned by performing a thorough analysis on the braking and suspension components and present an optimized design solution which primarily focused on weight reduction. The 2011 race car was equipped with strain gauges on the suspension arms and pressure gauges in the break lines. Dynamic tests were conducted on the track to record the forces and pressures during different driving scenarios. These results were analyzed in conjunction with

theoretical models for validation and also to determine failure modes. From these results, it was concluded that the wall thickness of the suspension members could be cut down to 0.028 inches and the brake rotor thickness reduced to 0.125 inches. This resulted in an overall weight reduction of 15%.

MEM-16
MICROFLUIDIC DEVICE TO SIMULATE BLOOD VESSEL DEVELOPMENT

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

Team:

Don Reed	Mechanical Engineering

Blood vessels develop in a dynamic environment in the body, yet most biological experiments for blood vessel development take place in static tissue culture. Blood flow has been shown to play an important role in blood vessel growth for 50 years. Capillary growth increased in vessels with high blood flow, whereas capillaries regressed when flow blood ceased in a frog model. In limited laboratory studies, pre-exposure of cells to shear stress enhanced markers of blood vessel development in both 2D and 3D models. However, very few studies have tested blood vessel development at the same time cells are exposed to shear stress, and the mechanism by which fluid flow initiates blood vessel development is unknown.

MEM-17
PLASMA TREATMENT OF WATER FOR HOSPITAL APPLICATION

Advisors: ***Dr. Danil Dobrynin, Dr. Gregory Fridman (BMES)***

Team:

Ray Eveland	Mechanical Engineering
Ryan Lally	Electrical and Computer Engineering
Marlin Miller III	Mechanical Engineering
Zach Mohn, MEM	Mechanical Engineering
Charles Schafer	Mechanical Engineering

Hospital faucet systems—especially some automatic systems originally intended to reduce the spread of bacteria— provide an excellent environment for the incubation of bacteria, including L. pneumophila. The objective of this project was to neutralize the bacteria as close to the faucet outlet as possible, thus minimizing the potential for infecting patients with weakened immune systems. The goal was to create a device which would attach to a faucet spout and use plasma energy discharges to inactivate the harmful bacteria. Various bacteria concentrations were tested until ideal power requirements were realized for sufficient inactivation. Test results showed one- to two-log reductions in concentration from initial bacterial concentrations of 101 CFU/mL to 104 CFU/mL. These results proved that plasma generation can occur in flowing water, revealed the optimal power requirements, and culminated in the creation of the necessary power supply.

MEM-18
DESIGN AND FABRICATION OF A SOLAR CELL TESTING

Advisor: ***Dr. Ying Sun***

Team:

Jared Harbin	Mechanical Engineering
Zekai He	Mechanical Engineering
Christopher Mannion	Mechanical Engineering
Kunal Shah	Mechanical Engineering
Neer Shah	Mechanical Engineering

The solar cell fabrication process undergoes multiple stages before finally being fabricated and utilized. This project is aimed at aiding two steps of this procedure. The first area of our interest is to manufacture a machine that will dip a small glass substrate into various solutions, with humidity control capabilities and adjustable dip and dwell times. The second stage of interest comes in the last step of the process, where we will fabricate an apparatus to effectively test a finished solar cell. This setup must have lateral movement capabilities and should be able to produce accurate results of a current versus voltage graph In order to analyze the efficiency of the cell.

MEM-19
DESIGN OPTIMIZATION FOR WASTE HEAT RECOVERY SYSTEM

Advisor: ***Dr. M. Ani Hsieh, Caglan Kumbur***

Team:

Satyam Satyam	Mechanical Engineering
Nidhi Sinha	Mechanical Engineering
Derya Teoman	Mechanical Engineering

As the fuel prices rise, there is a high demand to find new ways to improve fuel economy. One of the approaches taken towards increasing the fuel economy is the Waste Heat Recovery (WHR) system. It is analogous to a power plant. However, the size, weight and cost of developing and installing this system along with the duty cycle of the engine itself limit its applicability to heavy duty engines. The goal of the project is to increase the overall efficiency of an existing WHR system. A detailed thermodynamic and heat transfer analysis is performed to select the working fluid and generate trade-offs for different design modifications. The performance of the system is evaluated for three different driving cycles of a heavy-duty diesel engine. The results show an approximate of 2% increase in the thermodynamic efficiency of the cycle in steady state condition, assuming 85% efficiency of the individual components.

MEM-20
SOLAR PANEL DEPLOYMENT MECHANISM FOR CUBE SATELLITES

Advisor: ***Dr. Jin Kang, Dr. Jack Zhou***

Team:

Christian DeCastro	Mechanical Engineering
Benjamin Smith	Mechanical Engineering
Timothy Wilwert	Mechanical Engineering

Since the initial CubeSats that were launched nearly one decade ago, the design specifications for a standard picosatellite have not progressed. Namely, CubeSat solar panel systems have hardly advanced. Photovoltaics are undoubtedly ideal for powering a satellite; but current systems rely on fragile, wafer-like, rigid solar panels that monopolize the structure's surface area and limit power generation. Recent developments in thin-film solar cells have made it possible to manufacture affordable, versatile flexible photovoltaic panels. Flexible panels can generate the same power as their more costly rigid competitors. In order to implement thin-film systems in CubeSats, it was necessary to develop a mechanism that deploys a flexible solar array. Our design safely stores a furled flexible array within the CubeSat frame, while consuming only 32% volume, and then successfully deploys it once in orbit. It is both cost and volumetrically competitive with other university and industry designs.

MEM-21
MINIATURE PONTOON BOAT FOR BASS FISHING

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

Team:

Chad Espenshade	Mechanical Engineering
Derek Graham	Mechanical Engineering
Christian Heaps	Mechanical Engineering
Thomas Ziman	Mechanical Engineering

Due to an increased awareness of humans' environmental impact, specifically in aquatic areas, and the need for human safety, state regulators have placed new restrictive legislation how watercraft are built and operated. These new regulations often restrict the usability of the craft. The goal of this design project was to build a water craft to meet all state regulations within the Mid-Atlantic region of the United States and maintain a high level of usability for operators. Using a pontoon boat design, the team calculated all necessary equations for the buoyancy and functionality of the craft, and then rendered the design with multiple CAD software packages. Using this design the team constructed a prototype from the materials selected in the design process. The prototype was tested using both computer modeling and live tests. Testing of the prototype verified that the design met all regulations and user demands.

MEM-22
CRASHWORTHY COMPOSITE SUBFLOOR INTEGRATION FOR ROTORCRAFT

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

Team:

Joshua Fairley	Mechanical Engineering
Donald Fehlinger	Mechanical Engineering
Pavel Parfenov	Mechanical Engineering
Zachary Schwartz	Mechanical Engineering

The subfloor structure of rotorcraft is a critical component in protecting occupants in the event of a crash. To reduce the energy transmitted to the occupants, the subfloor can be reinforced with lightweight composites. Studies have been done on optimizing the structures that yield the highest energy absorption, but none have been done on integrating these structures into the rotorcraft. The purpose of this project is therefore to investigate the effects of different rivet configurations on the failure behavior of composite stanchions in compression. Three layup configurations were used in this investigation. Failure mechanisms and specific energy absorption were used to quantify the performance of each configuration. Results show that varying the rivet configuration and specimen layup can cause significant changes to the behavior of the stanchion. A validated computational model was developed in LS-DYNA which can be used to further investigate the behavior of various layups and rivet configurations.
Sponsor: The Boeing Company

MEM-23
DESIGN FOR DEVELOPMENT IN THAILAND

Advisor: ***Dr. Alexander Moseson***

Team:

Magid Bdeir	Mechanical Engineering
Emmanuel Georganas	Mechanical Engineering
Jorye Gross	Mechanical Engineering
Mande Keita	Mechanical Engineering
Hannah Olin	Graphic Design
Nicholas Padovani	Biomedical Engineering

For 700 years, the 30,000 people of Bo Klua Thailand have subsisted on rice grown by hand on steep, rocky slopes. Growing enough rice is challenging and traditional methods of farming often lead to chronic musculoskeletal pain. The 2011-2012 Drexel Thai Harvest team addressed these issues by developing a sustainable ergonomic weeding tool. Through a rigorous Technology Seeding product design process, farmer participation was integral to creating a functioning tool and an open-source pictorial manual and poster. The tool, similar in form to a planter earlier

developed by the program, reduces pain by at least 50% while maintaining traditional efficiency levels. The design relies on affordable materials and capabilities available in northeast Thailand. More importantly, the manual and poster empower farmers to design, adapt, build, and control the technology.

MEM-24
ENHANCEMENT OF FLAPPING MICRO AERIAL VEHICLE

Advisor: ***Dr. Min Jun Kim***

Team:

Woo Jin Bak	Mechanical Engineering
Timothy Garbarino	Mechanical Engineering
Thomas Hayden	Mechanical Engineering
Joseph Parente	Mechanical Engineering
Mark Zebley	Mechanical Engineering

The goal of this project was to redesign and enhance a biologically inspired flapping-wing micro aerial vehicle created by previous senior design teams. The inspiration for the design comes from the Allomyrina Dichotoma, a beetle typically found in Eastern Asia. This insect was chosen for its ability to hover as well as fly forward; it is also beneficial since it is approximately the same size as a typical micro aerial vehicle, thus no scaling is necessary. The final design is a dual motor platform to allow for the control of the wings independently of one another. The motors are attached to a crank mechanism for the wings. 100% of the requirements for a "micro" classification were met, and 50% of the requirements for a "nano" classification were met. Flapper performance was analyzed using particle image velocimetry and high speed video. Controlled flight was beyond the scope of this project.

MEM-25
DETECTION OF LEAKY PIPES IN WATER DISTRIBUTION NETWORK AND METHOD TO REPAIR USING A TRAVELING ROBOT (C)

Advisor: ***Dr. Young Cho***

Team:

Michael Dougherty	Mechanical Engineering
Bryan Jenkins	Computer Engineering
Ryan Jones	Mechanical Engineering
Michael Loftus	Mechanical Engineering
William Rasmussen	Mechanical Engineering

Water loss is a huge issue in major cities all over the world. Of all the treated drinking water that enters the distribution pipes, 20-40% of it is lost due to leaks. In order to help remedy this problem we have designed a means to locate the leaks within a threshold of 6 inches. The average leak in a water main with a pressure of 60 psi emits sound frequencies between 50 and 200 hertz. Using this information we set the high and low pass filters to remove all ambient noises simulated by the frequencies outside this range. With the use of a hydrophone and high and low pass filters, we can find the source of a sound within the desired threshold.

MEM-26
AUTOMATED NETWORKED TRANSPORT SWARM (ANTS) HARDWARE PROTOTYPE DEVELOPMENT

Advisor: Dr. John Lacontora

Team:

Jeffrey Stabb	Mechanical Engineering
Evan Rosen	Mechanical Engineering
Darrin Scardelli	Mechanical Engineering
Cheng-hua Wang	Mechanical Engineering

Aboard Aircraft Carriers a significant portion of the crew is utilized to transport weapons throughout the ship. The objective of the Automated Networked Transport Swarm (ANTS) Hardware Capstone is to design and build a prototype to assist in the transport of weapons within an Aircraft Carrier, focusing on an inexpensive and modular design. The ANT must be capable of transporting assembled weapons through the physical obstructions within the ship. Through numerous design iterations, with input from the end users and stakeholders, this project has resulted in a conversion kit for the existing weapons mover, the MHU-191 skid with the kit containing everything needed to transform the MHU-191 into a self-motorized, human steered skid. The project has culminated in a prototype that demonstrates the core requirements of this project; namely, weapons payload, locomotion, safe operation, and a modular inexpensive design to assist the sailors in weapons movement.

Sponsor: NAVAIR
Acknowledgments: NAVSEA Code 972; Baldor; Precision Systems

MEM-27
VIRTUAL WESTERN BLOT LABORATORY FOR PROTEIN DETECTION

Advisor: Dr. Alisa Morss Clyne

Team:

Sezin Alagoz	Mechanical Engineering
Christopher Chin	Mechanical Engineering
Michael Heffner	Mechanical Engineering
Sean Lavery	Mechanical Engineering
Christopher McManus	Mechanical Engineering

The Western Blot experiment is a useful tool in a variety of tests which include HIV identification. The experiment's educational value in the classroom and laboratory is significant as it demonstrates several important processes including the separation of cell proteins by gel electrophoresis. The objective of this project is to focus on the development of a virtual lab for a Western Blot experiment while reducing cost, time, and maintaining education value. A

mechanical system was designed that incorporates band formation, separation, transfer, analysis, and detection similarly to an actual Western Blot while eliminating the high cost and lengthy time associated with performing an experiment. A series of experiments and calculations that test various properties of ferrofluids and magnets were performed to identify critical components of the virtual lab. Utilizing the collected experimental data, the analyzed results, and the critical components, a mechanical device was designed, fabricated, and tested.

MEM-28
Nd:YAG PULSED LASER SYSTEM ENCLOSURE

Advisor: Dr. David Miller

Team:

Joshua Gonzalez	Mechanical Engineering
Patrick Nolan	Mechanical Engineering
Vincent Pappert	Mechanical Engineering
Timothy Schlindwein	Mechanical Engineering

The Nd:YAG Pulsed Laser System Enclosure senior design team will design a solid structure capable of containing and controlling the temperature and humidity of the Pulsar Laser System equipment in the Hess building lab. The modular structure will be conceptualized utilizing computer automated design programming. After load and structural testing has been successfully completed, final drawings will be used to build the physical unit. Once the unit has been completed, a thermal analysis with an integrated HVAC unit will determine that the environmental goals of the equipment have been met. Deliverables for the project include the fully functional structure and data backed proposals for HVAC unit selection.

MEM-29
ENGINEERED FLAGELLAR FOREST FOR OPTOFLUIDIC SENSORS

Advisor: Dr. Min Jun Kim

Team:

Gabriel Graves	Mechanical Engineering
Rory LaRocca	Mechanical Engineering
Joshua Lehman	Mechanical Engineering
Setu Saxena	Mechanical Engineering

This project involves the harvesting and culturing of flagella from the bacteria Salmonella to use as a biomechanical sensor. Flagella are biological proteins that aid in cellular movement and can sense and detect differences in a chemical environment. We observed and gauged how the flagella structure responds to changing environments by arranging the flagella in a highly concentrated 'forest' array upon a silicon surface. Results were obtained using a fluorescent microscope, which detects the difference in light intensity before and after the environment has changed. We have developed a fully functional flagella forest that is able to sense and react to changes in its chemical environment. With this prototype, we hope to advance the field of biomechanics by introducing a new class of biological sensor. Since these sensors are meant be calibrated to each respective medium that they are designed to detect, the possibilities of its applications are virtually endless.

MEM-30
NOVEL CLASSROOM MECHANICAL TESTING DEVICE USING DIGITAL IMAGE CORRELATION

Advisors: Dr. Antonios Kontsos, Dr. Richard Knight, (MSE)

Team:

Hashir Ahmad	Electrical Engineering
Venkat Iyer	Materials Science & Engineering
John O'Driscoll	Materials Science & Engineering
Mary Potvin	Mechanical Engineering

The objective of this Senior Design Project is to design an educational lab product that would be able to perform uniaxial mechanical tests incorporating Digital Image Correlation (DIC) technology. DIC provides continuous in-situ strain measurements, as well as information about crack propagation, identification of high strain areas, and allows for a real time strain map of the material's surface. We propose to use DIC to provide visual data of changes associated with deformation and damage progression (i.e. necking, crack growth), as well as in-plane measurements of axial and shear strains. In addition to a prototype of such a product, the team will design the educational material needed to demonstrate the theory, use and post-processing of the results of such an innovative design, which is further expected to create an academic standard for educational and training purposes. The deliverable will be a working prototype of the proposed device.

MEM-32
AN IMPROVED GROWING ROD FOR THE TREATMENT OF EARLY ONSET SCOLIOSIS

Advisor: Dr. Sorin Siegler

Team:

Claudia Hill	Mechanical Engineering
Christopher Judd	Mechanical Engineering
Thomas Mayer	Mechanical Engineering

Early-onset scoliosis is a rare and progressive spine deformity that presents with abnormal sagittal-plane curvature of the spine and is generally diagnosed by age five. If left untreated, it can result in a variety of painful disorders, severe deformities, and in some cases, morbidity. Most existing treatments are not applicable to young patients as their spines are still growing. While there are growing rod systems available, they require semiannual surgeries in which the rods are manually elongated. The objective of this project is to design a growing rod system that drastically reduces the number of surgical procedures required relative to comparable systems. While other implant systems have limitations regarding patient ambulation and preservation of spinal anatomy, our design aims to solve these problems while offering similar deformity

correction. The new system was designed, validated, and manufactured based on extensive research and finite element analysis.
Acknowledgements: Sawbones, Dr. John Caggiano

MEM-101
DESIGN AND DEVELOPMENT OF WINDLESS 'WIND TUNNEL' FOR SPACE APPLICATION

Advisor: Dr. Suk Jin Kang

Team:

Will Burns	Mechanical Engineering
Scott Edwards	Mechanical Engineering
Scott Holden	Mechanical Engineering
Steve Rehn	Mechanical Engineering

Satellites have been around for decades and have been providing very useful information about earth and beyond. As technology advanced, satellites have been getting smaller and more efficient at collecting data. They have been also playing an ever increasing role at lower altitudes. However, at very low earth orbit, the atmosphere behaves more like individual particles than like a fluid. Due to these conditions, regular wind tunnels cannot be used to test the aerodynamics of the satellite.
The objective of this project was to design, build, and test a 'windless wind' tunnel for the use of testing very low earth orbit satellites. Its design is based on conservation of momentum and shoots small plastic balls at the satellite to deliver an equivalent amount of momentum transfer. The resulting drag coefficient values were compared to ones determined from computer simulations and were found to be true. Final verification will occur when Drexel's Dragon-Sat 2 satellite is launched and compared against other satellites in space.

MEM-102
POCKET DRIVER

Advisors: Dr. Roger Marino, Dr. Jin Kang

Team:

Brett Mainor	Mechanical Engineering
Markand Patel	Mechanical Engineering
Timothy Perry	Mechanical Engineering
Xavier Santos	Mechanical Engineering

The Pocket Driver is a modified version of the normal screwdriver. It features multiple screwdriver bits that are easily accessible. The simple design of the Driver allows for one-handed operation, portability, and ease of use for a wide range of potential customers- from craftsmen to hobbyists. Our group will be involved in every aspect of the design process, including sketching, prototype fabrication, testing, manufacturing, environmental impacts, and patent approval. We plan to design the Driver using fracture analysis, based on CAD drawings and detailed sketches,

for optimal performance. It will be fabricated using inexpensive metals and plastic to allow for a low production cost, but will be sturdy enough to endure consistent use.
Sponsor - James Tarmin – Engineer

MEM-103
THE CLEVER LEVER

Advisor: Dr. Roger Marino

Team:
Valerie Cavanaugh
Kris Karbach
Scott Reithmeier
Joe Scafisi

The main objective of The Clever Lever was to develop a creative solution to help people clear their properties of the snow during the winter season. Advantages of the design allow the user to move more snow per shovel pass and require much less physical work and stress to perform the task. The Clever Lever design allows the user to move the shovel in all normal degrees needed to pick up the snow and drop it where desired. Through testing and research this device was proven strong enough to move even the heaviest snow in a convenient manner for the user as well as be easy for users of all ages and sizes. The design was altered, improved, and evolved to provide all of the desired advantages and capabilities and is easy to use and durable.

MSE-01
AN ANALYTICAL STUDY OF THE PREFERENTIAL GRAIN ORIENTATION ATTACK OF SLIP BANDS IN ALUMINUM LITHIUM ALLOYS

Advisor: ***Dr. Mitra Taheri***

Team:
Grady Bentzel Materials Science and Engineering

A form of stress corrosion cracking (SCC) in aluminum lithium alloys, termed slip band corrosion by Alcoa, has been observed to lead to preferential attack of certain grains. Samples were provided by Alcoa, and corrosion was induced using a solution of 5.7 % sodium chloride in water with an added 1% hydrogen peroxide, according to ASTM G110. A study was conducted by taking scanning electron microscope (SEM) and electron backscatter detection (EBSD) images of the corroded areas within Al-Li samples with varying aging treatments. By using orientation imaging microscopy (OIM) analysis software, the orientations of the attacked grains was determined. Transmission electron microscope images were captured of precipitates forming on the slip bands. Through a thorough analysis of these images, the cause of the corrosion was determined.

MSE-02
TUNING THE BANDGAP OF LA1-X SRX FEO3 SEMICONDUCTORS

Advisor: ***Dr. Steven May***

Team:
Spencer L Dustin Materials Science and Engineering

Lanthanum ferrite (LFO) is an orthorhombic perovskite oxide semiconductor; strontium ferrite (SFO) is a metallic conductive perovskite. Substituting strontium in LFO directly changes the optical properties, primarily the bandgap. Because LSFO does not have any “rare” or toxic elements and the bandgap can be tuned to the ideal 1.1-1.3 eV, it may be a photovoltaic candidate. LSFO films were grown using molecular beam epitaxy (MBE) with varying compositions and growth parameters. The films’ optical properties were determined using ellipsometry. To extract the optical properties and bandgap, FilmWizardTM was used to fit the ellipsometry data. An annealing study was performed on doped samples; each sample was oxygen annealed for 4 hours at 650 °C. It was found that the growth pressure and annealing of LFO did not affect the optical properties in as-grown films. The addition of strontium did not change the bandgap of as-grown films, however, annealing significantly decreased the bandgap.

MSE-03
ANALYSIS OF THERMOMECHANICAL PROCESSING OF AA5083 FOR CORROSION RESISTANCE

Advisor: Dr. Mitra Taheri

Team:
Joseph Hsieh Materials Science and Engineering

The 5xxx series of aluminum alloys are widely used in the marine industry because they are weldable, have moderate strength, light weight, and offer good corrosion resistance. It is known, however, that a sensitization effect can occur in 5xxx series Al, resulting in the formation of β-phase precipitates (Al3Mg2) at the grain boundaries. These precipitates are susceptible to corrosion, which can ultimately lead to stress corrosion cracking. Thermomechanical processing has been shown to play a role in reducing the degree of sensitization in marine applications for AA5083-H116, which could extend the material's service life. AA5083 is an aluminum-magnesium alloy containing 4-4.9 % Mg, as well as other insoluble elements and is non-heat treatable, with its strength resulting from solid solution hardening, dispersion hardening, and work hardening. Because thermal mechanical processing affects these attributes, it is important to understand the role that strain reduction and annealing have upon AA5083 to maximize the benefit of the thermomechanical processing.

MSE-04 (listed as well as MEM-30)
NOVEL CLASSROOM MECHANICAL TESTING DEVICE USING DIGITAL IMAGE CORRELATION

Advisors: Dr. Antonios Kontsos (MEM); Dr. Antonios Zavaliangos; Dr. Vasileios Nasis

Team:
Hashir Ahmad Electrical Engineering
Venkat Iyer Materials Science and Engineering
John O'Driscoll Materials Science and Engineering
Mary Potvin Mechanical Engineering

The objective was to design an educational laboratory product able to perform uniaxial mechanical tests while incorporating Digital Image Correlation (DIC) technology. DIC provides continuous in-situ strain measurements, as well as information about crack propagation, identification of high strain areas, and allows for a real-time strain map of the material surface. It was proposed to use DIC to provide visual data of changes associated with deformation and damage progression (e.g. necking, crack growth), as well as in-plane measurements of axial and shear strains. In addition to a prototype product, the educational materials needed to demonstrate the theory are also being designed, including use and post-processing of the results, which is further expected to create an academic standard for educational and training purposes.

Sponsor: Trilion Optical Test Systems

MSE-05
COPPER AND LEAD DETECTION UTILIZING FURAN-MODIFIED CHITOSAN THIN FILMS

Advisor: Dr. Caroline Schauer

Team:
Kristoffer Jones Materials Science and Engineering

The ability to detect heavy metal ions such as lead and copper is of particular importance due to their well-documented environmental hazards and detrimental health effects. Metal pollutants often find their way into the surrounding environment due to improper disposal of materials and are unfortunate remnants of industrialization. While detection does not directly reduce what is already present, it provides a way to monitor the current status. Chitosan, the de-acetylated derivative of chitin, is a naturally occurring polysaccharide that has been utilized to create thin films. Chitosan is an attractive polymer due to its selectivity and sensitivity to heavy metal ions in solution. Chitosan was selected for modification and investigation because of its abundance and renewability. Furthermore, chitosan has been proven in various experiments to be a known chelator of metal ions and exhibits thickness changes and color changes (frequency shifts) when exposed to metal ions. The viability of a furan-modified chitosan and its potential sensitivity and selectivity is being assessed.

MSE-06
AFM STUDY OF MODEL SOLID OXIDE FUEL CELL CATHODES

Advisor: Dr. Steven May

Team:
Drew Konrady Materials Science and Engineering

Solid oxide fuel cells (SOFCs) have been studied for decades and have finally started to be used commercially. They are very stable, more efficient than combustion engines, and emit less harmful by-products. One aspect being focused on is the degradation occurring at the cathode/ electrolyte interface. Due to the size of normal cells it is difficult to determine the cause of the degradation or where the reactions begin. The interface has thus been scaled down to the nanometer scale to gain greater control over the environment and to pinpoint what causes the degradation and determine what might be done to slow or prevent it. Films of Lanthanum Manganate, a common cathode material, were grown on Yttria-Stabilized Zirconia (YSZ) substrates of three different orientations, a common electrolyte material. Operating conditions were modeled and each sample was analyzed using atomic force microscopy (AFM) at different time points to characterize the extent of the degradation.

MSE-07
PEROVSKITE OXIDE ETCHING CHARACTERISTICS

Advisor: ***Dr. Steven May***

Team:
Max Levy Materials Science and Engineering

It is expected that various nano-devices will be fabricated from perovskite oxides. A fundamental step in the processing of nano-devices is patterning and etching. The etching process for perovskite oxides must thus be developed in order to realize commercial production of these new nano-devices. Smooth substrate surfaces terminated with a single atomic plane are essential for perfecting the epitaxial growth of transition metal oxide films. In order to determine the processing procedures required to develop perovskite devices this work investigated the etching characteristics of various wet etch processes on perovskite films. Additionally the combination of chemical etching and thermal annealing was investigated to achieve single termination. Samples produced to investigate these goals have been examined via atomic force microscopy (AFM) to determine etch rates and roughness, respectively, and to define the required procedures.

MSE-08
THIN FILM COLOR DETECTION OF GLUTARALDEHYDE

Advisor: ***Dr. Caroline Schauer***
Team:
Daniel Stewart Materials Science and Engineering

Glutaraldehyde is the leading cause of occupational asthma. However, there are no current techniques to detect glutaraldehyde in real-time without the use of expensive laboratory equipment. In this work, a colorimetric polymer thin film sensor has been designed to change color in the presence of glutaraldehyde vapors. Using poly(allyl amine) as the colorimetric base of the sensor, thin films were tested at different glutaraldehyde concentrations and time points.
Sponsor: MetPro

MSE-09
ALGINATE BASED FOAMS FOR THE PURPOSE OF CREATING SUSTAINABLE BUILDING MATERIALS

Advisor: ***Dr. Caroline Schauer***

Team:
Ebony Thompson Materials Science and Engineering

Polystyrene foam, commonly referred to as StyrofoamTM, has negative health and environmental effects. Studies have shown that polystyrene can take up to 70 years to biodegrade in a landfill and has been "reasonably anticipated to be a human carcinogen". These problems would be eliminated by creating a foam from alginate, a non-toxic natural polymer.
The goal of this project was to successfully design and create sodium alginate based foam building materials, with compression strengths and insulation properties comparable to those of polystyrene, in order to functionally replace polystyrene building materials.
The project seeks to create a comparable alginate foam by optimizing the alginate concentration in solution and type of crosslinker used. These factors have been explored via a series of experiments.

BME-01
DESIGN OF AN EEG HEADBAND FOR DAILY IN-HOME USE OF THE P300 BRAIN-COMPUTER INTERFACE

Advisors: ***Dr. Hasan Ayaz, Dr. Terry Heiman-Patterson, DUCOM***

Team:

Sean Dowd	Biomedical Engineering
Lauren Scull	Biomedical Engineering
Sherri Swayne	Biomedical Engineering
Laura Toth	Biomedical Engineering

ALS is a neurodegenerative disease that causes progressive paralysis, locked-in state, and death from respiratory failure within 2-5 years. The P300 Brain Computer Interface (BCI) was developed in order to enable patients in a locked-in state to communicate via EEG waves. However, the current EEG cap of the P300 BCI system is difficult to setup, use, and maintain, causing distress for both the caregiver and ALS patient. Here we present a newly designed three component system for use with the P300 BCI, which includes a two-tiered flexible thermoplastic headband allowing for accurate electrode placement and maintenance of contact pressure, an updated electrode montage, and an adapter to a biosignal amplifier. The newly designed system has a predicted EEG recording accuracy of 94%, which is within 1% of the accuracy range of the current cap. We anticipate that the P300 headband will greatly ease the use of this system while still maintaining acceptable P300 recording accuracy and overall patient comfort.

BME-02
EXPERIMENTAL MODEL OF HIGH IMPACT LOADING ON INTERVERTEBRAL DISC

Advisor: ***Dr. Michele Marcolongo, MSE; David Jamison IV***

Team:

James Havrilla	Biomedical Engineering
Mir Hussain	Biomedical Engineering
Sneha Patel	Biomedical Engineering
Daniel Visco	Biomedical Engineering

Low back pain in U.S. Navy high speed boat (HSB) operators is more prevalent than in the general population. This is a result of the harsh loading conditions that are experienced in these boats. Previous experimental models have been unable to replicate high impact loads in a laboratory setting, which would allow a better understanding of the effects of these loads on the intervertebral disc and begin to provide a connection to the high incidence of low back pain amongst HSB operators. There are three main aims of the solution. First, signal processing of the

collected accelerometer data in HSB which is required for data input into the available servohydraulic testing machine. This will mimic the HSB impact loads on the spine. The other objectives allow measurements during the loads and therefore allow observation of biomechanical changes. The measurements are intradiscal pressure and displacement of the disc. This will be done using a pressure transducer and an extensometer placed at the last disc.

BME-03
DISTRIBUTED PRESSURE INSERT DEVICE FOR RIGID CERVICAL COLLARS

Advisor: ***Dr. Fred Allen***

Team:

Maureen Campbell	Biomedical Engineering
Peter Gallo	Biomedical Engineering
Bianca Pulido	Biomedical Engineering
Kelly Sanger	Biomedical Engineering
Olga Zielinska	Biomedical Engineering

The current method of treatment for neck pathologies is wearing a rigid cervical collar, which causes pressure sores in 55% of patients. Pressure sores result in varying degrees of skin breakdown costing up to $30,000 in additional medical care. Pressure applied by the collars can be 107 mmHg in the peak pressure "hot" spots around the chin and occipital bones. In order to reduce the pressure in these areas, a soft insert was designed that allows for the contact force on the skin to be more widely distributed along the area of the collar. The goal is to reduce the pressure on the contact area to 21mmHg, a threshold for skin irritation, in order to decrease the risk of pressure sores. The insert accommodates the most commonly utilized cervical collars, the Miami J and Philadelphia Collar. Customized fit to the collars with the largest sales will reach the broadest target market for the product. Introducing the device to the cervical collar community projects to lower the frequency of pressure sores and its associated health care costs.

BME-04
DESIGN OF IMPROVED SUCTION CATHETER FOR THE REMOVAL OF PARTICULATE MATTER AND LIQUID PRIOR TO EMERGENCY INTUBATION

Advisor: ***Dr. Kenneth A Barbee***

Team:

Zahra Ahmed	Biomedical Engineering
Peter D'Antonio	Biomedical Engineering
Elise Krogman	Biomedical Engineering
Katelynn Montgomery	Biomedical Engineering

In emergency airway management, fast and effective intubations are critical in preventing serious complications. Patients receiving emergency intubations often lack neurological reflexes putting them at risk for aspiration, mucosal damage and even hypoxemia. Aspiration occurs in 4% to 20% of emergency intubations and can result in mortality rates as high as 70%. Clogging of the suction catheter by particulate matter is the major cause of suction failure, leading to increased

evacuation times. Therefore, there is a need for a device that can fully remove obstructing materials and accompanying liquid in an appropriate amount of time while counteracting clogging. The improved design should be able to clear the oropharyngeal cavity of particles up to 0.25 inches in diameter and fluid with viscosity ranging from 1-14 centipoise, in less than 15 seconds. Our prototype outperforms the current clinical standard of the Yankauer in terms of clearance times. In addition, the increased ability of the device to suction larger particulate matter addresses a recognized need in the current clinical setting.

BME-05
INSTRUMENT FOR EVALUATION OF AFFINITY CHROMATOGRAPHY SUBSTRATE FOR ANTIBODY PURIFICATION

Advisor: Dr. Dianne Rothstein

Team:

Sean Eyler	Biomedical Engineering
Adam Kozakov	Biomedical Engineering
Bhanu Trehan	Biomedical Engineering
Colin Valentis	Biomedical Engineering

Monoclonal Antibody (mab) Purification is a crucial process in the production of several drugs that are currently available on the commercial market. This process allows for the separation of antibodies from a stock solution in which it is grown, thus allowing them to be purified for the production of pharmaceuticals. It is estimated that the purification process accounts for 80% of the manufacturing costs. In addition, it is projected that there will be a significant increase in the number of antibody based therapies in the coming years. The purpose of this project was to create a low-cost purification method which will allow for comparison between the performances of different Protein A infused substrates. The performance metrics taken into account are the flow rate at which the substrate performs optimally and the Dynamic Binding Capacity (DBC) of the substrate. Using these metrics, different substrates were compared to determine the efficiency of each along with its ability to be “scaled up” for manufacturing purposes.
Sponsor: Prime Synthesis Inc

BME-07
IN VITRO 3D MODEL OF TUMOR CELL COMPRESSION

Advisor: Dr. Adrian Shieh

Team:

Dmytro Kyryliouk	Biomedical Engineering
Alicia Morgano	Biomedical Engineering
Poonam Sharma	Biomedical Engineering
Phillip Tomezsko	Biomedical Engineering

The effect of compressive strain on the tumor microenvironment is a growing area of cancer research that merits more study. There is a need for a cost-effective, live cell microscopy in vitro research tool that applies compressive deformation to a 3D gel containing cancer cells. The device must apply a range (0-50%) of deformation to a 3D gel in a chambered cover glass slide. The design must be biocompatible and maintain cell culture pH. It must fit within the Leica DMI6000B microscope stage area without obstructing the light path, allow for 200µl of gel and cell volume,

and for controls and experimental samples. The prototype is manufactured from stainless steel 316 and aluminum. It interfaces with the slide by fitting on the side of the well, and includes a platen moved by turning a marked thimble that applies deformation to the gel. The design includes a custom aluminum microscope stage adaptor and an acrylic lid to maintain the culture environment over a 48 hour testing period.

BME-08
A SUPPORT DEVICE FOR PATIENTS WITH CLASS IV AND V CEREBRAL PALSY

Advisors: ***Dr. Sri Balasubramanian, Megan Schaefer (CHOP)***

Team:

Vanessa Lin	Biomedical Engineering
Sneha Narasimhan	Biomedical Engineering
Tara Stebelski	Biomedical Engineering
Jacqueline White	Biomedical Engineering

Class IV and V cerebral palsy (CP) patients exhibit a decreased ability in head and neck control which hinders daily activities. For instance, classroom learning and wheelchair-assisted mobility becomes difficult when a patient's head is in an anatomically neutral position. Currently, the commonly used tilt-in-space wheelchair modifications are primarily used to keep the patient's airways open, and less so to address the line of vision issue. Neck braces used to treat CP patients have static designs which prevent any form of rotational and flexion-extension movement. The goal of this design is to restore the CP patient's head to an anatomically neutral position and allow for rotational movement of 120 degrees. The prototype is constructed primarily of ABS plastic material and weighs less than 3 lbs. Other features of the design include spring-loaded pistons and a roller bearing assisted track.

BME-09
BIO-INSPIRED MUSSEL ADHESIVE ELECTRODE COATING FOR DRUG DELIVERY APPLICATIONS

Advisors: ***Dr. Yinghui Zhong***

Team:

Paul Chialastri	Biomedical Engineering
Marko Dimiskovski	Biomedical Engineering
Yogin Dixit	Biomedical Engineering
Dave Forney	Biomedical Engineering

The insertion of chronic neural electrodes can lead to the activation of the immune system, which is characterized by the formation of nonconconductive glial scars. This negatively impacts the functionality of the electrode and eventually necessitates replacement. Neural electrodes are made of many types of different surface materials. Furthermore, layer-by-layer techniques can be applied, which release anti-inflammatory drugs to extend the life of the implanted electrode.

Current layer-by-layer techniques are unable to attach to the majority of modern neural electrode surface materials. For this reason, there is a demand for a layer-by-layer design capable of adhering to multiple electrode surfaces.
Our group aims to implement an additional layer that can adhere to multiple electrode surfaces as well as the layer-by-layer, anti-inflammatory release system.

BME-10
MICROFUIDIC DELIVERY SYSTEM FOR A BIOCHIP POINT OF CARE DIAGNOSTIC DEVICE

Advisors: ***Dr. Ryszard Lec, Dr. Johann deSa, Dr. Qiliang Zhang***

Team:

Jeremy Bauknight	Biomedical Engineering
Joshua Ho	Biomedical Engineering
Lea Landsmann	Biomedical Engineering
Chris Zachariah	Biomedical Engineering

Incorporating lab-on-a-chip into point of care devices has become increasingly prevalent in medical diagnosis. These systems provide the possibility of rapid test time, inexpensive production, low sample volume requirements, automation and consistent reproducibility. The team aimed to incorporate a previously designed biochip into a two part reusable microfluidic delivery system that will pump a sample over the biochip to promote antigen-antibody binding. To make a lab-on-a-chip diagnostic system viable in patient settings, the permanent pumping system must be separated from the disposable cartridge which contains the sample and the biochip. This disposable cartridge system will utilize a diaphragm pump check valve system to flow appropriate solutions or solvents across machined channels. The system will be able to pump from two different reservoirs individually.

BME- 11
NON-VIRAL GENE THERAPY USING ZINC SELENIDE QUANTUM DOTS

Advisors: ***Dr. Wan Shih, Dr. Wei-Heng Shih (MSE)***

Team:

Neenu Baby	Biomedical Engineering
Arpit Gandhi	Biomedical Engineering
Shruti Karambelkar	Biomedical Engineering
Ashley Twitty	Biomedical Engineering

Researchers are currently investigating various non-viral approaches for gene therapy transfections that could deliver the potential benefits of gene therapy without its side effects and risks associated in using viral vectors. While some of the current research mechanisms deal with use of lipoparticles, gene gun, cationic polymers such as Polyethyl eneimine(PEI)s as non-viral methods of gene delivery, most of them face the challenge of low transfection efficiencies compared to the viral methods or possess cytotoxicity issues preventing them from being applied

in living tissues. The team focused on developing a non-viral gene carrier using non-cytotoxic complex of Zinc- Selenide quantum dots capped with 3- mercapto-trimethoxy silane (MPS) attached to Polyethyleneimine (PEI)s vectors. The overall size of the carrier designed is less than 30 nm in order to pass through the nuclear pores successfully.

BME-12
A B-TCP/RESORBABLE MESH BONE VOID FILLER WITH INCREASED STRENGTH FOR IRREGULAR BONE VOID DEFORMITIES

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

Team:

Kenny Furdella	Biomedical Engineering
Jordan Gorczynski	Biomedical Engineering
Cathleen Kerr	Biomedical Engineering
Erica Louie	Biomedical Engineering

Abnormally shaped bone voids caused by bone cysts cannot be treated with current pre-shaped bone void fillers (BVF). BVFs with the ability to fill abnormal shapes have no strength. The team aimed to design a fully synthetic BVF to fill abnormal bone defects with adequate strength to avoid dissociation and fill the needs of sponsor, Kensey Nash Corporation. The device is composed of B-TCP, a variety of polymers, and a resorbable mesh. It must have tensile strength of 312Newtons to mimic the pull out strength of the hand and 80% porosity to allow the filler to be compressed during implantation. The device is manufactured in a long rectangular mold in order to allow the BVF to be coiled into abnormal defects. It will be validated using tensile testing procedures as well as reinsertion procedures. The new BVF will allow for a stronger product and better healing for bone void patients.

BME-13
EVALUATION OF CELL ADHERENCE/INFILTRATION OF CERAMIC BONE GRAFT SUBSTITUTES USING A MODIFIED DIRECT-PERFUSION BIOREACTOR

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

Team:

Joseph Bilikiewicz	Biomedical Engineering
Drew Clearfield	Biomedical Engineering
Dmitry Dymarsky	Biomedical Engineering
Sonny Sheth	Biomedical Engineering

Annually, many orthopedic device companies develop numerous formulations of synthetic bone graft substitutes. These grafts are tested in vitro, for cell response, using static conditions or dynamic culture systems, particularly direct perfusion bioreactors, which are more accurate. However, commercially available bioreactors are only able to deliver one media flow rate,

preventing the simultaneous evaluation of grafts with different physical properties, e.g., porosity and pore size. The team sought to develop a direct perfusion bioreactor that is able to deliver two different flow rates to samples with varying pore sizes. This will induce similar shear stresses on the cells within the scaffold, thereby improving accuracy of the observed cell response. A dual-pump system was designed to provide two different flow rates to 6 scaffolds in series. Ideally, this prototype will show greater cell infiltration of the scaffolds and greater osteoblast activity than static three-dimensional culture. Once perfected, this design could improve the accuracy and efficiency of in vitro evaluation of orthopedic materials.
Sponsor: Stryker Orthobiologics; Ted Clineff, Marissa Darmoc, Stephen McIhenny, Kristi Reuss, Jordan Sangerman

BME-14
APPLICATION OF QUANTUM DOT BASED ACTIVATABLE MOLECULAR PROBES FOR VISUALIZATION OF AREAS WITH MMP2 ACTIVITY

Advisor: ***Dr. Wan Y. Shih***

Team:

Gaelle Hector	Biomedical Engineering
Regina Lee	Biomedical Engineering
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Max Shestov	Biomedical Engineering
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Cancer is an overgrowing problem and current detection and visualization methods are slow and often have trouble distinguishing the boundary between healthy and cancerous tissue. As such surgical intervention can leave in cancerous tissue or remove healthy tissue. We propose a proof of concept for a quantum dot (QD) based activatable molecular probe that will enable better visualization of tissue areas with specific cancer markers. In our design the targeted cancer marker is Matrix Metalloproteinase-II (MMP2). The criteria for this proof of concept is a fluorescence contrast ratio of 2:1 between normal and cancerous tissue, and an intensity of 500,000 1/s for high visibility. The prototype will consist of 3 major elements which are the quantum dots, the Dark Quencher and the cleavable peptide. The QD and the quencher are held in close proximity by the uncleaved peptide, thus blocking the the QD emissions. When the cleavable peptide is cleaved by MMP2, QD is free to fluoresce thus providing live visualization of the cancerous tissue. The functionality of the probe will be measured by the analysis of fluorescence and the quenching efficiency.

BME-15
3-D TISSUE ENDOMETRIUM MODEL FOR STUDYING BLASTOCYST IMPLANTATION MECHANICS

Advisors: ***Dr. Michele Marcolongo (MSE), Rob Yucha***

Team:

Paige M. Bailey	Biomedical Engineering
Kritika Katiyar	Biomedical Engineering
Weili Ma	Biomedical Engineering
Joseph Mathew	Biomedical Engineering
Helly Shah	Biomedical Engineering

In vitro fertilization (IVF) is a medical treatment for women who are considered infertile or have trouble conceiving. Although it is a common procedure today, the rate of successful attachment of the blastocyst to the endometrium remains below 50%. The cause of low success rates has been pinpointed to problems in the attachment of the blastocyst to the uterine wall. Initial attachment of the blastocyst depends on the binding between the L-selectin protein on the blastocyst and its sialyl lewis x (sLex) sulfated ligand on the endometrial layer of the uterine wall. An in-vitro 3D model of the endometrium that mimics both physical and biochemical properties of the natural tissue is proposed. The primary objective is to develop a model in which sLex expression levels on the surface of Ishikawa human endometrial carcinoma cells can be modulated in order to study binding mechanics. This was done by culturing Ishikawa cells with RL-929 fibroblast cells to mimic the bilayer structure of the endometrium and produce a 3D model to allow for future blastocyst attachment studies.

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