ENGINEERING DESIGN SHOWCASE 2015

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A SPECIAL THANK YOU

I want to especially thank the judges who have taken time to be here today to evaluate our students’ projects. The College of Engineering appreciates the close relationships we enjoy with our guests from industry. Your feedback will enable our programs to improve our quality of instruction and experience of students. On behalf of the entire faculty in the College of Engineering, I am grateful that you have joined us today.

Sincerely,

Jean-Pierre Delplanque
Professor and Associate Dean, Undergraduate Studies
The UC Davis College of Engineering is pleased to share with the campus community the efforts of the senior design teams and engineering clubs. Together, these students and aspiring professionals have endured hours of drafting, modeling, prototyping, testing, and analysis to complete these projects – on top of an already rigorous curriculum. The senior year coursework is the culmination of years of meticulous and precise study and presents students with the opportunity to apply their skills and knowledge in order to engineer solutions to a variety of problems and needs. The faculty and the administration of the College are proud and thrilled to host this event so that members of the public and our partners in industry can see and experience the quality of a UC Davis engineering degree. We thank our guests for their time and attention, and we appreciate our students for their hard work. Please enjoy the showcase!
ENGINEERING DESIGN SHOWCASE 2015

TEAM #1: RFIELDS SYSTEMS: ASSET TRACKING SYSTEM
- Department: Electrical & Computer Engineering
- Team members: Brent Allen, Austin Bartholomaus, Michael Sticlaru, Eric Telles
- Advisers: Dr. Andre Knoesen, Nicholas Hosein

Designed for the Robert Mondavi Institute for Wine and Food Science, our system aids in automating the grape harvesting and wine-making processes. By tracking the location, weight, time, and type of grapes harvested, we have created a wireless tracking system that will automatically record your wine data for an efficient winery. Using state-of-the-art RFID technology, we ensure that our system performs optimally in any agricultural setting.

TEAM #2: SHAREDROBE MOBILE APPLICATION
- Department: Computer Science
- Team members: Dhawal Chandra, Ajit Ravisaravanan, Jessica Sheu, Megan Yee
- Adviser: Dr. Xin Liu

The goal of our application is to encourage sustainability in fashion through a sharing economy. Sharedrobe encompasses all aspects of one’s outfit that one may need: tops, bottoms, dresses, bags, shoes, and accessories, all of which are made available for any user of our application to rent. In our app, individuals may enroll as members of the app, upload their garment images, and edit their garments' descriptions and prices. They may also search other users’ garments by styles and geographical proximity. If a user decides to rent a piece of clothing, they may select the amount of days they need it, then pay rental cost and service accordingly. This is a fantastic way to obtain clothing specific to the occasion -- such as a wedding, prom, or any other event -- without needing to actually purchase expensive garments or accessories to complete your outfit.

TEAM #3: DINKY – AUTONOMOUS CAR PROJECT
- Department: Electrical & Computer Engineering
- Team members: Andrew Chung, Samuel Dawson, Justin Laguardia
- Adviser: Lance Halsted

The NATCAR and Freescale Cup competitions challenge participants to construct an autonomous race car. The NATCAR competition entails following a white line on a dark carpet, while the Freescale Cup has competitors attempt to stay within a white lane bordered by black edges. Our car won the Freescale Cup West Regional and National competitions and will represent the US at the Worldwide Finals in Germany. All cars are built with a 1/10-scale chassis and navigate a track using one or more cameras. Our design features a 2-D camera, custom PCB, and closed loop speed control.

TEAM #4: SYSTEM FOR TEMPERATURE AND EVAPOTRANSPIRATION MONITORING (STEM)
- Department: Electrical & Computer Engineering
- Team members: Robin Johnston, David Killeen, Jeffrey Kung, Chad Timmons, Erik Zhang
- Adviser: Dr. Andre Knoesen

Monitoring plant health and conserving water are two important considerations in regards to agriculture, especially given the current drought. Plants take in water through rainfall and regular watering and lose water through transpiration from the leaves. If growers can quantify the amount of water that is available to the plant and how much the plant loses through transpiration, they can water more efficiently. STEM accomplishes both of these goals by monitoring soil moisture and temperature at different depths in the ground around a plant and looking at the leaf temperature of the plant, which will correlate to whether or not the stomata are opened or closed and thus whether or not water is evaporating from the leaves.

TEAM #5: PROJECT ATLANTIS: SECURE MESSAGING WITH OTP
- Department: Computer Science
- Team members: Andrew Brandes, Ricardo Matsui, Daniel See, Jonathan Vronsky
- Adviser: Dr. Xin Liu

With recent events, security and privacy have become major topics globally, and new revelations on mass surveillance and the ever-increasing power of computers have shown how existing Internet traffic encrypted with SSL and VPN can be problematic if the communication is recorded, since that communication may be decrypted as more powerful computers become available. The Atlantis project solves this by providing private, end-to-end encryption using the one time pad technique which guarantees the message cannot be decrypted as long as the pad is not compromised. The app requires Atlantis users to start their conversation with an in-person meeting, allowing their devices to exchange a completely random pad outside of any network. This pad is then used to encrypt future messages for transfer across the Internet. Because the pad is random and is never reused, it is not possible to decrypt the messages without the pad, even with any amount of computational power. Atlantis therefore provides privacy-aware customers such as journalists and businesses, with a convenient platform for secure messaging.
TEAM #6: HANDWRITTEN DIGIT RECOGNITION USING FPGA BASED HARDWARE ACCELERATION

- Department: Electrical & Computer Engineering
- Team members: Amandeep Dhaliwal, Ajit Punj, Chenkai Tan
- Adviser: Dr. Soheil Ghiasi

Using an Altera FPGA development board with an built in ARM based processor and attached camera, handwritten digits shown in front of the camera were recognized and displayed using a trained neural network algorithm. To ensure quick digit recognition, we used the FPGA for hardware acceleration by allowing the FPGA to handle computations that were slow in C code.

TEAM #7: FPGA IMPLEMENTATION OF DIGIT RECOGNITION SOFTWARE

- Department: Electrical & Computer Engineering
- Team members: Kaila Balancio, Lillian Deas, James Ginley
- Adviser: Dr. Soheil Ghiasi

The goal of this project is to develop an FPGA based handwritten digit recognition system which is capable of reading, recognizing and displaying, via VGA, the values of the handwritten numbers rapidly. The digit recognition system is entirely implemented on the Altera DE1-SOC board in the form of an integrated hardware-software system.

TEAM #8: HARDWARE AND SOFTWARE DIGIT RECOGNITION SYSTEM DEMO

- Department: Electrical & Computer Engineering
- Team members: Eduard Alfonso, Jack Chen, Jimmy Yu
- Adviser: Dr. Soheil Ghiasi

This project consists of having an Altera DE1-SOC FPGA board capture an image from a projector screen using the camera on the board. The image is then processed by our software to determine what digit(s) it is at a fast rate and high accuracy. Our software for digit recognition utilizes a region of interest, segmentation, resizing algorithm, and finally a neural network as a classifier to determine the most probable digit for the recognized image.

TEAM #9: HUMMINGBIRD RFID READER

- Department: Computer Science
- Team members: Arjun Bharadwaj, Dustin Ellis, Huu Tan Nguyen, Scott Turner
- Adviser: Dr. Xin Liu

This project reads RFID tags implanted in hummingbirds to allow researchers to track where these birds travel in their migration patterns. The readers are placed on hummingbird feeders, and once the tag is read the data is sent to a database where researchers can look at the collected data. This data can be accessed on the web or via an android application on a Researcher’s phone.

TEAM #10: BIODIGESTER EFFLUENT PROCESSING FOR USE AS ORGANIC FERTILIZER

- Department: Biological & Agricultural Engineering
- Team members: Ashwin Bala, Tanner Garrett, Brandon Roosenboom
- Adviser: Dr. Ruohong Zhang

To convert the effluent waste stream of a biodigester to a usable form of organic fertilizer. This is done through a multi-step process that incorporates various filtration and chemical methods. The project shows the improvements in economic viability of biodigesters that can be made via recycling the waste stream of these systems.

TEAM #11: INTELLIGENT AUTONOMOUS RACE CAR

- Department: Electrical & Computer Engineering
- Team members: Ronald Lai, Shawn Xiang, Patrick Yu
- Adviser: Lance Halsted

Designed and implemented using a KL25Z microcontroller, PCB, DC and servo motors, bluetooth, and 2D and linescan cameras, our autonomous vehicle operates using a 7.2V battery to traverse along Freescale and Natcar tracks in 6 ft/sec or faster.

TEAM #12: AMPEROMETRIC GLUCOSE BIOSENSOR

- Department: Biological & Agricultural Engineering
- Team members: Myles Donahue, Christopher Roberts, Christopher Stadick
- Adviser: Dr. Tina Jeoh, Dr. Michael Delwiche, Dr. Ruohong Zhang

Continued growth in the biofuels industry has created a need for a method of easily and continuously measuring the concentration of sugars, such as glucose, in a solution. Effectively monitoring glucose concentration throughout hydrolysis (saccharification) of a biomass is critical to advancing biofuel production technology. The amount of glucose produced by cellulase enzymes during this process indicates the extent of conversion and measurement of this change provides information that may be used to improve the hydrolysis reaction. The time intensive sampling methods typically used today for determining sugar concentration only produce discrete data points. Our proposed solution for improving the determination of glucose concentration is able to provide real-time measurements at a relatively low cost. The biosensor that we have produced uses an immobilized enzyme specific to glucose that can be easily replaced by a user when needed. While we focused on the measurement of glucose in solution, the system can be adapted for the detection of other substrates by changing the enzyme that is immobilized. This flexibility, reduced cost, and real-time measurement capability make this biosensor valuable for the biofuels industry as well as groups interested in tracking other substrates.
TEAM #13: BII-BOT – BLADE INTERIOR INSPECTION (RO)BOT

- Department: Mechanical & Aerospace Engineering
- Team members: Audrey Lee, Annabelle Li, Brent Marriott, Raleigh Moyher, Julie Wurzbach
- Adviser: Dr. Steven Velinsky

Bii-Bot’s purpose is to travel down the interior of wind turbine blades to look for fatigue indicators such as cracks. Wind turbine blades are about 50m long and can get smaller than 10cm by 20cm. Therefore, a person cannot visually inspect the inside of the blade. This robot was designed to fit into a space 10cm by 20cm and travel along slightly rough terrain. The robot is remotely controlled using a video-game style controller. Bii-bot uses a first person view camera to obtain live video feedback to the person controlling the robot. It has a modular gripper arm that can be used to re-glue cracks on the glue lines.

TEAM #14: PLANT SCHEMATIC & SPECIFICATIONS FOR PRODUCTION OF ON-PURPOSE PROPYLENE FROM METHANOL

- Department: Chemical Engineering & Materials Science
- Team members: Alice Rystov, Miguel Turcios, Anais Quintero, Akash Yadav
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

A plant design is being proposed for the large scale manufacture of on-purpose propylene. The plant is proposed to be located in Trinidad & Tobago and aims to produce 500 million lbs/year of propylene from methanol feed, utilizing a two-step catalytic mechanism.

TEAM #15: HYDROPONIC GROWTH CABINET

- Department: Biological & Agricultural Engineering
- Team members: Jorman Heflin, Timothy Tran
- Advisers: Dr. Ruihong Zhang, Heiner Lieth

A design and prototype of a hydroponic growth cabinet intended to grow multiple plants and crops. The cabinet includes developmental technology, such as sensors, specialized lights, and a micro-controller for monitoring and user interface.

TEAM #16: TRAVEL DIAGNOSTIC EYE PRESCRIPTION INSTRUMENT

- Department: Biomedical Engineering
- Team members: Jacquelyn Lim, Frank Mai, Natalya Shelby, Rose Hong Truong
- Adviser: Dr. Anthony Passerini

There are very few optometrists in developing countries, resulting in millions of people without proper vision to learn and work at their full potential. Vision Vanguard is minimizing this disparity in access to eye care by creating an instrument that provides a prescriptions without requiring the user to have any specialized skills.

TEAM #17: CAMERA-BASED ORCHARD NAVIGATION VIA TETHERED SUAV

- Department: Mechanical & Aerospace Engineering
- Team members: Bryce Anglin, Brian Broderick, Hunter Kepon
- Advisers: Dr. Stavros Vougioukas, Dr. Stephen Robinson, Dr. Cristina Davis

This project showcases an autonomous flight system that is capable of collecting and processing visual information to assist in the automated navigation of a utility vehicle. The flight system consists of a pair of stereoscopic cameras mounted on a tether-powered Small Unmanned Aerial Vehicle. The tether operates from a retractable reel housed beneath a landing platform, and provides power to the copter from the ground vehicle battery through a stepped power system. This system could allow the utility vehicle to autonomously traverse an orchard, which is an important step in fully automating harvesting. Being able to autonomously harvest an orchard would reduce labor costs and allow us to keep pace with our growing population’s growing food needs.

TEAM #18: DUALCOOL WATER MAINTENANCE SYSTEM DESIGN MODIFICATION

- Department: Mechanical & Aerospace Engineering
- Team members: Jacob Aman, Joseph Kohn, Joe Moquin, Stefano Skouritakis
- Advisers: Dick Bourne, Steve Short (Integrated Comfort Inc.), Dr. M. Sarigul-Klijn

DualCool is a retrofit system, designed and built by Integrated Comfort Inc., which mounts to existing rooftop air conditioners. These units use evaporative cooling to reduce the load on an AC unit. The DualCool system uses water to wet an evaporative media. Air is then blown across the wet media allowing for water to evaporate and the air to cool, which is used to cool the condenser. The evaporative cooling technique is an efficient process that helps reduce the load on the air conditioning system, especially in hot weather. A utility water supply is used by the DualCool unit to replenish water lost to evaporation. The utility water contains varying concentrations of minerals that can accumulate as the evaporation process occurs. If not monitored, these minerals can clog the small pipes in the system and can degrade the performance of the DualCool unit. Currently, Integrated Comfort uses a constant flow rate bleed valve to drain water from the system, and a float valve to replenish the system with new utility water. Although this method works for the system, the goal of this project is to improve the ability to control hard water buildup within the DualCool system while reducing water waste. To improve this process, there will be remote time monitoring of the mineral concentration within the supply water and flow rate of water into the system. By doing this, the timing of water leaving the system through a bleed valve can be controlled through a motorized valve.
TEAM #19: POINT OF CARE BLOOD ANALYSIS
- Department: Biomedical Engineering
- Team members: Dustin Hadley, Jun Quintos, Casey Trevino, Jacob Weersing, Lucy Wu
- Adviser: Dr. Anthony Passerini

Tuberculosis is one of the predominant infectious diseases worldwide that remains a public health concern. The Mycobacterium bovis that causes this infection can also infect humans. Currently, many tuberculosis testing methods require multiple doctor’s office visits, or rely on antibodies or PCR, which take time and cost money. There is no current assay that is designed to test multiple samples at the same time, while focusing on lowering costs and reducing testing time. Our objective is to develop a POC biosensor that uses aptamers developed by the Revzin lab, for the detection of IFN-γ—a biomarker commonly used for diagnosing TB. The goal of this device is to create an aptamer based assay that can process multiple samples on site, and be as specific as the tests using antibodies. To fill the above criteria of developing a TB diagnostic device that tests for the mycobacterium cheaply, quickly, and accurately, we will build an aptamer based biosensor that incorporates ergonomic incubation test chips to assay for IFN-γ in whole blood, with a software to run the necessary voltammetry and calculations needed to give a diagnosis.

TEAM #20: MOBILE APP DOGGY DOOR – THE PUPPY PORTAL
- Department: Biomedical Engineering
- Team members: Tyler Freitas, Daniel Kapulkin, Yiran Li, Richard Tong, Kuo Hao Tseng
- Adviser: Dr. Anthony Passerini

This design project revolutionizes the common doggy door, enhancing security and customization by implementing a wirelessly enabled microcontroller, wireless camera, and RFID scanner to allow pets controlled entry in and out of your home, while keeping stray animals and intruders out.

TEAM #21: WALKER OFFLOAD FORCE MEASUREMENT DEVICE FOR CEREBRAL PALSY PATIENTS
- Department: Biomedical Engineering
- Team members: Ben Bazor, Megan Howes, Shalini Majumdar, AnnaLisa Smullin
- Adviser: Dr. Anthony Passerini

Current methods of clinical gait analysis are limited for cerebral palsy (CP) patients who use assistive devices. Therefore, clinicians subjectively assess a patient’s reliance on his or her walker. Our device, InvisiForce, accurately measures the offload force a patient applies to their walker to aid clinicians in the evaluation of CP patients. It is a lightweight and reusable device that attaches to the walker handles and uses a force sensor to determine the weight placed on the walker. InvisiForce is compatible with multiple walkers, accommodates CP patient variability, and can quantify balance. The data generated from our device will be used by a multidisciplinary team to guide surgical planning, monitor recovery, assess treatment efficacy, and ultimately improve patient care.

TEAM #22: TEMPERATURE-CONTROLLED BIRD PERCH TO GAUGE AVIAN RESPONSE TO ANTINOCICEPTIVE DRUGS
- Department: Mechanical & Aerospace Engineering
- Team members: Carissa Beck, Darren Hentschel, Juan Martinez Aceves, Christopher Needham
- Advisers: Dr. Joanne Paul-Murphy, Dr. Vijay K. Raghunathan, Dr. Martinus M. Sarigul-Klijn

The goal of this project was to create a device to test birds’ reaction to thermal stimuli to understand the effects of avian antinociceptive drugs. A perch with a heatable and coolable foot plate and bird monitoring system was designed. This system will be used by Dr. Paul-Murphy in her research with small birds. The thermal system in the perch uses thermoelectric elements to heat and cool the foot plate. Coolant is pumped through the perch to stabilize the temperature of the thermoelectric elements. A pair of microcontrollers drive the thermoelectric elements at different intensity levels according to user inputs and set off an alarm in the event of a system fault. A consistent test environment is necessary to avoid alerting the bird of thermal changes prematurely. The operator’s controls are on a tethered remote distanced from the enclosure reducing noise audible to the bird. To avoid changes in tone or pitch the cooling loop runs at a constant speed. The temperature of the foot plate must respond to operator input with less than a second latency. To minimize latency the temperature control elements must be inside the perch. These elements must be small enough to fit into the body of the perch, and the perch itself must be small enough to be comfortably gripped by the birds. Thermoelectric elements were chosen because they are silent and small enough to fit into the perch.

TEAM #23: FORMULA SAE DRIVETRAIN
- Department: Mechanical & Aerospace Engineering
- Team members: Craig Asanuma, Lucas Bolster, Gordon Chen, Kyle Krueger, Hagop Parnoustsoukian
- Advisers: Dr. Jae Wan Park, Dr. Roland Williams, Dr. M. Sarigul-Klijn

The UC Davis Formula Racing team is a student design team challenged to design, build, and race a formula-style electric vehicle for the International FSAE competition. Competing universities are tasked with designing and fabricating a vehicle suited to the weekend autocross racer that can be sold to a manufacturing firm for mass production. This project focuses on the powertrain system for UC Davis’ 2015 electric vehicle. Like all components on the vehicle, the powertrain needs to respond to the rules and challenges set forth by the Formula SAE Electric competition. To respond to the
formidable acceleration, cornering, efficiency, and top speed requirements, the system consists of two major components: a front reduction drive and a limited-slip differential. The front reduction drive includes a co-axial planetary reduction (3:1) and a second sprocket-to-sprocket reduction (2:1) to provide the final 6:1 ratio, ideal for the track layout and size while keeping weight low. The second major component, a Torsen limited-slip differential, will help to get all of the power to the ground when accelerating out of a corner. The success of the vehicle’s design will be evaluated against 19 other universities in a number of static and dynamic competition segments at this year’s competition taking place June 17-20 in Lincoln, NE.

TEAM #24: FORMULA ELECTRIC RACECAR
BATTERY AND POWER MANAGEMENT
ELECTRONICS
- Department: Electrical & Computer Engineering
- Team members: Henry Herndon, Jonathan Tao, Hengjiu Kang, Yi Lu
- Adviser: Dr. Andre Knoesen

The Formula Racing team at UC Davis is currently designing its second all-electric open-wheel, single-seat racecar for the FSAE-Electric competition. We are building on our success from last year to create a new vehicle this year. Critically underpinning the ability of the vehicle to compete successfully is the battery monitoring and electronic networking system. This system is designed to automotive standards and includes cell voltage monitoring, temperature monitoring, current sensing, user controls, instrumentation, logging and telemetry systems.

TEAM #25: FORMULA SAE SUSPENSION

- Department: Mechanical & Aerospace Engineering
- Team members: Josh Aguilar, Julian Enis, Rocco Holloway, Yash Nagda, Sean Raley
- Adviser: Dr. Stephen Velinsky

This project involves designing, analyzing, building, and implementing a suspension for the Formula Racing 2014-2015 electric car. The front multilink and rear trailing link design packages well with the powertrain and chassis while allowing for the desired handling characteristics.

TEAM #26: FSAE ELECTRIC: CHASSIS

- Department: Mechanical & Aerospace Engineering
- Team members: Kimberly Barr, Diego Ugaz
- Advisers: Dr. Steven Velinsky, Roland Williams

The Formula Racing team at UC Davis competes in the annual FSAE Electric Competition in Lincoln, Nebraska. For the 2014-15 season, the team is designing a completely new suspension and powertrain. As such, it has been the chassis team’s goal to design a rigid, lightweight, and safe steel space frame to accommodate these subsystems. It is a highly collaborative process requiring careful design iterations while maintaining FSAE rules compliance. Using last year’s techniques, the chassis team hopes to minimize fabrication time and hone skills necessary for creating strong, clean joints for maximum rigidity.

TEAM #27: SK PORTABLE WATER DISTILLER

- Department: Mechanical & Aerospace Engineering
- Team members: Ronald Cortez, Richard Kanadi, Kai Lun Lee, Liwei Lu
- Advisers: Dr. Martinus M Sarigul-Klijn, Dr. Nesrin Sarigul-Klijn

According to the World Health Organization, 750 million people around the world lack access to safe water, approximately one in nine people alive (2014). Lack of access leads to poor hygiene and disease, causing an estimated 280,000 deaths yearly (Tropical Medicine and International Health 2014). Safe, clean water is critical to human prosperity. As one potential solution, this project demonstrates the transformation of water from a non-pure form into clean water that is safe to drink. The primary objective of this project is to design and produce a proof-of-concept portable water distiller that operates using a method called vapor compression evaporation. The design goal is to build a device which can generate pure drinking water from any dirty water source, while also being easy to transport, operate, and maintain. The system operates by generating a low pressure environment which allows water to evaporate at room temperature. A compressor and a novel heat exchanger design cause the pure water vapor to condense after being separated from the dirty source. The final device demonstrates a prototype that can be further developed into a refined product.

TEAM #28: RECONFIGURABLE DESKTOP GRINDING MACHINE – PROGRAMMABLE MOTOR MODULES

- Department: Mechanical & Aerospace Engineering
- Team members: Numair Ahmed, Erik Contreras, Hector Herrera, Alvin Lieu
- Advisers: Dr. Cristina Davis, Dr. Stephen Robinson, Michael Schirle

This motor-module prototype establishes the groundwork for a reconfigurable desktop machine that would allow users to adapt the machine to a workpiece. Potential uses of the machine include grinding, sanding, detailing and printing parts in a repeatable manner. Additionally, its small size and low cost make it ideal for hobby and educational purposes. The design of the project primarily focuses on accurate tracking and programmability of the machine’s end-effector (or tool), and robustness to withstand stresses during operation. As such, the modular linkages that comprise the machine feature high-torque motors to counteract vibrations and improve stability. The design utilizes the 211 compact
stepper motor joined with a custom-built 1:175 ratio gearbox, the Arduino Mini 05 microcontroller coupled with two stepper motor drivers, and a position sensor, all contained in a 3D-printed PLA housing module. Further developments include implementation of an efficient battery pack that will allow untethered operation, wireless communication via Bluetooth, faster speeds, and additional degrees of freedom (DOF).

TEAM #29: MACHINE LEARNING APPLICATIONS FOR NASA DROPLET IMAGE ANALYSIS
- Department: Computer Science
- Team members: Ramya Bhaskar, Rylan Schaeffer, Willie Huey, Amanda Ho
- Advisers: Dr. Ben Shaw, Dr. Xin Liu

Our project tackles the problem of analyzing images of fuel cell droplets with various machine learning techniques for purpose of image recognition. The goal is to determine the correct radius as a function of time of a moving combusting droplet, taking into account obscuration of the image due to sooting, and loss of resolution due to diffraction. Our final product is aimed to assist NASA research into efficient fuels, for the purpose of ground and space travel. We tackled the problem with two similarly related, but distinct algorithms, one implemented in Matlab and the other in C++. The programs both implement the Hough Circle Transformation in seeking and measuring the object’s size and diameter, but how each program executes and tackles different scenarios differs.

TEAM #30: DRY POWDER LOADING AND MEASUREMENT MECHANISM FOR INTRATRACHEAL DELIVERY
- Department: Mechanical & Aerospace Engineering
- Team members: Steven Biasca, Michelle Gonzalez, Walter Kemphaus, Alberto Luna
- Advisers: UC Davis Medical School CTSC, Dr. Jean-Pierre Delplanque, Carlos Ruvalcaba, Dr. Cristina Davis, Dr. Stephen Robinson

The dry powder, simvastatin, is injected into the trachea of laboratory mice to test the intratracheal administration of drugs. Currently, the simvastatin loading process requires a researcher to manually fill a syringe with 50 micrograms of dry powder, which can take a full day. This device would improve the efficiency of research involving small laboratory animals and different dry powders by increasing the rate at which samples can be prepared. The loading and measurement device uses inter-particle and electrostatic forces to accurately weigh out multiple instillations of dry powder in a repeatable fashion. Researchers will ideally be able to initiate the loading and measurement device by the use of a switch, allowing them to perform other duties as the shells are loaded with dry powder. The device is composed of three subsystems: the dry powder loading and charging compartment, the volumetric metering system, and the rotating shell holder tray. The simvastatin powder will be loaded directly into the opening of a hollow aluminum cylinder; the dry powder will then land on a vibrating metallic mesh that will charge the particles. Once positively charged, the dry powder continues through the equally charged cylinder, counteracting wall-to-particle forces with repulsive electrostatic forces. The simvastatin is then volumetrically metered through the revolving divot that separates approximately 50 micrograms of dry powder into seven equivalent rotations. Finally, the dry powder settles into the shells within the rotating tray, preparing it for transport to the injection mechanism.

TEAM #31: EXHAUST GAS VENT AUTONOMOUS CAP CLOSE-OFF SYSTEM FOR REDUCTION OF HVAC ENERGY LOSSES
- Department: Mechanical & Aerospace Engineering
- Team members: Daniel Foster, Trevor Silva, Carter Tong
- Advisers: Mr. Ryan Devine (M&G Duravent), Dr. M. Sarigul-Klijn

With the world trending towards energy savings, there is a constant desire to eliminate energy losses due to convection through furnace exhaust vents. Natural gas heaters in homes do not have a way of automatically opening and closing their vents which allows for leakage. The HVAC energy losses that are accompanied with the constant leak or influx of air add to the significant inefficiencies within a residential setting. The design and implementation of an exhaust vent cap can increase residential heating and air conditioning efficiency by blocking undesired air exchange. Minimization of HVAC losses through the vent is facilitated by a rotating cap driven by one of the following methods: electromagnetism or elastic nitinol memory wire. The electromagnet design includes a return spring as a fail-safe option to immediately open the vent should the electrical system fail in any way. The nitinol design makes use of the same return spring in order to close the vent during the nitinol cool-down process after the system has been shut off. Both designs will inhibit undesired airflow. Our sponsor M&G Duravent, Inc. has supported both designs, providing funding and equipment and allowing use of their state of the art testing equipment to determine which design is more successful.

TEAM #32: MOBILE CLOSED LOOP CONTROL VARIABLE GAS FLOW TEST BENCH
- Department: Mechanical & Aerospace Engineering
- Team members: Christian Hernandez, Dennis Kong, Mingfang Su, Chengyu Zheng
- Advisers: Brad Bon, Erin Mussoni, Mike Gherini, Dr. Stephen Robinson, Dr. Cristina Davis

The purpose of this project was to design a closed loop flow bench for testing and characterization experiments of single and mixed gases. It was built to handle steady and transient flows in a vacuum environment to retain gas purity.
In addition to this, the device also has the ability to control pressure and temperature values which can then be collected by a data acquisition system compatible with LabVIEW. Pressure, temperature and flow rate measurements were obtained at the downstream and upstream side of the Unit Under Test (UUT). In order to accurately adjust temperature, our team designed a temperature control subsystem using thermoelectrics modules and PID controllers to cool and heat the test gas to a specific temperature. To control pressure and flow rate values, we implemented numerous pumps, valves, mass flow controller, and tanks specifically made to meet design requirements. High pressure Stainless steel tubes and fittings were chosen to ensure that our system could withstand a pressure of 1000 psig during testing. An infinity tank was installed after the unit under testing to simulate atmospheric conditions for more reliable pressure readings. Additional design and control considerations have also been taken to ensure that there are no phase changes when adjusting thermodynamic properties of the gas. All of these requirements have been met while remaining compact enough for easy transportation. Finally, a 3D CAD assembly of the entire system was created to show the positions and routing of every single components.

**TEAM #33: CARBON NANOTUBE THIN FILM AUTOMATED SPRAY FABRICATION SYSTEM**

- Department: Mechanical & Aerospace Engineering
- Team members: Arick Jones, Ahmed Khan, Napang Kongsitthanakorn, Ronald Miranda, Simranjot Singh
- Advisers: Dr. Ken Loh, Dr. Cristina Davis, Dr. Stephen Robinson

Carbon nanotubes (CNT) exhibit superior mechanical, electrical, thermal, and other properties compared to conventional materials. The intrinsic piezoresistive properties of CNTs allow the fabrication of high-sensitivity thin film strain sensors that could be applied to any size and shape. The vision is to employ these sensors for structural health monitoring (SHM) of large aerospace, mechanical, and civil structures. As a step towards this motivation, Professor Ken Loh’s Nano-Engineering & Smart Structures Technologies (NESST) Laboratory has devised a novel CNT solution for spray applications by dispersing CNTs in polyelectrolyte solution and mixing with latex. This technique has been demonstrated in the past using a manual, hand-controlled spray procedure. Automation of the spray process allows for both scalability of substrate deposition area, as well as, enhancement of the electromechanical (sensing) properties of CNT by improving the coating quality. The objective of the project is to design and prototype a 3-axis automated CNT thin film spray fabrication system. The system’s 30”x24” base and 18” height is designed to fit into a standard fume hood. It allows precise control of film thickness, uniformity, and capability of coating surface areas as large as 9”x11”. Thickness and film uniformity is assessed via scanning electron microscopy (SEM) and profilometry. In addition, the morphologies and film formation of the yield is statistically investigated using the Taguchi method for the Design of Experiments.

**TEAM #34: SOLAR-PACK**

- Department: Electrical & Computer Engineering
- Team members: Jaspreet Buttar, Steven Dunbar, Zishan Huq, Ranesh Kumar
- Adviser: Dr. Charles Hunt

The Solar-Pack is a lightweight, flexible, portable solar panel with a built-in battery pack of 5500 mAh that charges electronics on the go. Its unique modular design allows it to be easily attached to any surface, ranging from a backpack to a bike. It can also be easily recharged through a USB port and when compared to some of the similar products on the market, this device was designed to be more user-friendly while keeping manufacturing costs low at $160. These features allow the user to charge their mobile devices with less cables and spend less time at home waiting.

**TEAM #35: HAND WRITTEN DIGIT RECOGNITION SYSTEM**

- Department: Electrical & Computer Engineering
- Team members: Julian Lin, Yudong Shen, Matthew Song
- Adviser: Dr. Soheil Ghiasi

Using an Altera DE1-SOC board and a 5 megapixel camera, our project performs digit recognition of various hand written digits projected on a wall. The camera captures images which are analyzed using a combination of FPGA hardware and SW algorithms. The system analyzes the images captured by the camera at speeds of at least 10 images per second.

**TEAM #36: MEDICAL MAKE-A-THON, HACKING BIOMEDICAL ENGINEERING IN 30 HOURS**

- Department: Biomedical Engineering
- Team members: Kenneth Chang, Gabriel Jagoe-Seidl, Janek Jobanputra, Aaron Kho, Anthony Leung, Htet Ma,
- Adviser: Dr. Anthony Passerini

BMES at UC Davis is proud to present the result of their first annual biomedical hackathon, the Medical Make-a-thon! The goal was to – in 30 hours – study, design, and finally create a medical device using the TEAM Design, Prototyping, and Fabrication Facilities. This Make-a-thon was a showcase of engineering students and their ability to shine in any given project, under a short amount of time.
TEAM #37: SUCTION-BASED PEDIATRIC LIVER RETRACTOR

- Department: Biomedical Engineering
- Team members: Manuel Cisneros, Gregory Del Rosario, Rocio Lozano, Gloria Shin
- Advisers: Dr. Benjamin Keller, Dr. Anthony Passerini

The current standards of liver retractors are designed with a fully-grown adult in mind; downsized versions for pediatric patients do not fully account for the difference in liver position and shape, rendering many retractors unsuitable. Even the slightest shear trauma can increase the level of fragility in pediatric livers due to the lack of a fully developed liver capsule. All of these factors indicate that the current status of liver retraction leaves much to be desired. Our aim is to design an effective liver retractor tailored to the unique hepatic anatomy of pediatric patients. We are designing the only suction-based retractor specifically for pediatric use. This design solution minimizes harm by utilizing an air vacuum to effectively distribute the force required for retraction. Its design and implications have been tuned to be simple and user friendly while also being safe for the patient.

TEAM #38: DIGIT RECOGNITION

- Department: Electrical & Computer Engineering
- Team members: Elly Chau, Maggie Lai
- Adviser: Dr. Soheil Ghiasi

A string of digits is displayed on a screen and captured by the camera. Programming the FPGA board, we use software and hardware to find out the string of digits.

TEAM #39: NUMBER RECOGNITION SYSTEM

- Department: Electrical & Computer Engineering
- Team members: Philip Chan, Chan Lu, Jessica Ma
- Adviser: Dr. Soheil Ghiasi

Developed an FPGA and ARM processor based handwritten digit recognition system, capable of reading, recognizing, and displaying handwritten numbers. The system digitizes a projection of the handwritten number with the camera and finds the region of interest. Once the region of interest is found, it separates and normalizes the digits. It then passes the digits through a neural network to determine the number that was most likely projected on the screen. The hardware consists of a DE1-SoC FPGA board and Terasic TRDB-D5M 5 megapixel digital camera. The firmware was developed in Verilog to convert the image to black and white and pre-process it for the ARM processor. The main software, developed in C, reads in the image, normalizes the digits, and sends the digits into a neural network to determine the number.

TEAM #40: 2-AXIS PRESSURE SCANNING SYSTEM FOR FLUID DYNAMIC RESEARCH AND EDUCATION

- Department: Mechanical & Aerospace Engineering
- Team members: Steven Lawrence, Jeffrey Lee, Alex Lerikos, Brian Orr
- Advisers: Dr. Stephen Robinson and Michael Schirle

Correctly measuring drag is crucial for the study of airflow over an aerodynamically intensive body. The 2-Axis Pressure Scanning system will use a pitot tube to scan the velocity profile in the wake of aerodynamic bodies and calculate the momentum deficit for drag analysis. Our scanning system consists of a pitot tube mounted on the end of a 2-axis carriage which is driven by stepper motors. This will measure pressure across a plane downstream of an aerodynamic body of interest. A microcontroller will handle user specifications, motion control, and computations on the collected pressure sensor data. The motor control and data acquisition will be programmed in the Beaglebone’s native Java, however users will interact with the system through an IPython Notebook environment. Pressure data will be acquired by a differential pressure sensor, which can be switched out depending on the requirements of the system. The final system is designed to fit with the dimensions of the client’s wind tunnel and be accurate for airspeeds ranging from 1-30 miles per hour. The 2-Axis Pitot Scanning system will greatly assist professors and students with aerodynamic research and education by demonstrating bernoulli’s law and finding drag of bodies for reference.

TEAM #41: FAST, INEXPENSIVE AND REPRODUCIBLE QUALITY CONTROL OF OLIVE OIL THROUGH ENZYME-MEDIATED ALDEHYDE PROFILING

- Department: Biomedical Engineering
- Team member: Lucas Murray
- Adviser: Dr. Marc Facciotti

Olive oil is one of the most common, healthiest and yet widely mislabeled every day diet products. Recent studies found that more than 69% of the extra virgin oil sold in US supermarkets is rancid, while no inexpensive testing method is currently available to consumers. Our team has developed a rapid, inexpensive and accurate technique to measure oil quality. We have built an electrochemical sensor that incorporates engineered enzymes to detect a spectrum of aldehydes that serve as a proxy of rancidity. Computational analysis and custom hardware that includes signal filtering, processing and optimization of chemical kinetics allows us to perform multi-compound detection and hence olive oil quality control in a highly reproducible manner. Current and future collaboration with olive oil producers and distributors will pave the way for a widely-applicable platform with far-fetching consumer applications.
**TEAM #42: WEINBOT: A ROBOTIC FLOOR CLEANER FOR REDUCING WINERY WATER USE**

- Department: Mechanical & Aerospace Engineering
- Team members: Ardalan Moazeni, Egan McComb, Kyle Turner, Natalie Pueyo Svoboda
- Advisers: Dr. Martinus Sarigul-Klijn, Ken Fry, Michael LaVasseur

The Water-Efficient Industrial Navigating Robot (WEINBot) is a proof-of-concept automated industrial floor care vehicle that can effectively dislodge and collect solid grape waste from typical concrete winery flooring with minimal water use. Successful collection of solid waste before manual hose-down greatly reduces the labor and water requirements during crush season, when typical cleanings are a tedious chore that can use hundreds of gallons of water. While the device does not have the full array of sensors and software algorithms to robustly navigate the uncontrolled winery environment, basic control and sensor technologies are included so that limited demonstrations of those functionalities required for full autonomy may be accomplished. In this way, our device will serve as a good foundation for potential further robotics research to develop the automation techniques required to navigate the bustling winery environment.

**TEAM #43: COMS: CARBON DIOXIDE AND OXYGEN MONITORING SYSTEM**

- Department: Electrical & Computer Engineering
- Team members: Zibran Chaus, Carlos Flores, Fulbert Jong, Alejandra Perez, Giuliana Pistone
- Advisers: Dr. Andre Knoesen

COMS is a low power and low cost device that detects and monitors the Carbon Dioxide and Oxygen levels in the surrounding environment. Using standards set by OSHA, the device will alert the user with an audible cue when the unsafe thresholds are reached giving the user ample time to remove themselves from the toxic environment.

**TEAM #45: FLY ANESTHESIA PAD**

- Department: Mechanical & Aerospace Engineering
- Team members: Po-Hao Chen, Duan Harrion, Denise Nguyen, Keisuke Sasaki
- Advisers: Dr. Martinus Sarigul-Klijn, Ken Fry, Michael LaVasseur

In the biomedical industry, the drosophila melanogaster—the common fruit fly—is normally used for drug and genetic testing. The fruit fly has a high reproduction rate and a central nervous system that strongly resembles that of humans, making them a valuable resource in research. In order to observe and test on the fruit flies, researchers use carbon dioxide as an anesthetic. The current standard tool for this process is the fly pad, a flat surface that slowly releases carbon dioxide. Once the fruit flies are anesthetized, scientists sort the flies for observation using brushes, dragging them across the surface of the fly pad. Currently, the most popular fly pad designs allow for even carbon dioxide distribution through a fibrous surface, but the material causes damage to the flies and requires constant replacement due to clogging. Our objective is to re-engineer a fly pad with optimal carbon dioxide distribution and the ability to efficiently remove flies. To achieve this, our redesigned fly pad uses an aluminum frame with glass laid over the base. Channels that have been cut into the walls of the frame allow carbon dioxide to flow along the two long sides of the pad and into the central work area. The flies are then sorted into two pits in two corners of the fly pad, sent through tubes powered by material conveying pumps, and filtered into collection vials or a disposal site.

**TEAM #46: HUMAN-ROBOT INTERFACE**

- Department: Computer Science
- Team members: Daniel Chen, Laura Demesa, Steven Rodriguez, Justin Salanga
- Adviser: Dr. Xin Liu

Interfacing a quadcopter with Google Glass for an effective and intuitive way to control and utilize the quadcopter. Quadcopter camera gimbal is controlled by head gestures on Google Glass, with aerial live-feed relayed back. Controls are included for the capture of video and pictures, and all media is stored and posted to a server when Glass has internet connectivity.

**TEAM #47: AUTOMATED SENSOR FOR COUNTING PEACH TREE SEEDLINGS**

- Department: Biological & Agricultural Engineering
- Team members: Andrew Barber, Amy Freitas, Daniel Robles, Erin Whelan
- Adviser: Dr. David Slaughter

Each year, disease resistant peach tree rootstock is planted from seed in Sierra Gold’s nursery. Variability in germination rate, and consumption by birds create uncertainty in the number of marketable seedlings available for sale each year. Currently, workers are used to count the seedlings which is time intensive and costly. We’ve designed a moving platform with an imaging system that will take photos of the peach seedlings while traveling though the furrows. A created counting algorithm will process the photos and come out with a count of how many seedlings there are through use of imaging software.
**TEAM #48: PRE-LOAD FIXTURE FOR THE INTRODUCTION OF BENDING STRESS**

- Department: Mechanical & Aerospace Engineering
- Team members: Ian Boilard, Ty Kennedy, Joe Marsh, Scott Rice
- Advisers: Mr. Mitchell Olsen (Hill Engineering), Dr. M. Sarigul-Klijn

Residual stresses are present in many materials and are caused by manufacturing processes. The introduction of these residual stresses influences material properties. That is not to say that all residual stresses are unfavorable. Hill Engineering specializes in measuring residual stresses. They note that residual stresses can be particularly effective in slowing and stopping crack growth that is caused by fatigue or stress corrosion. Essentially, residual stresses can strengthen materials and make them less likely to fail when introduced carefully. However, quantifying the residual stress in a material can be very difficult. One way to validate measurement techniques is to introduce a known stress within a test specimen as a standard for comparison. The fixture built for this project was designed to exert a known stress on a test specimen to a high precision which can then be tested using existing residual stress measurement techniques. The fixture was designed to integrate smoothly with Hill Engineering’s test and optical measurement equipment at its facility. Precision instruments and materials were selected to ensure accurate repeatability for which existing residual stress measurement techniques could be validated.

**TEAM #49: SAFETY SYRINGE FOR SENIOR ARTHRITIS PATIENTS**

- Department: Biological & Agricultural Engineering
- Team members: Tyler Hunter, Luis Mercado, Mike Perlic
- Adviser: Dr. Ruihong Zhang

Individuals who require frequent injections of medication are often forced to self-inject, usually at home with no supervision. The introduction of safety syringes stemmed from the need to provide a method of injection to these individuals that reduces the risk of needle-stick injury or incorrect dosing. However, most existing safety syringes have not been designed for the highly variable hand, finger, and wrist strength and dexterity of their users. This is particularly problematic for seniors with arthritis, who must frequently self-inject but have reduced strength and dexterity due to both age and the symptoms of arthritis. Our goal is to collect hand strength data to develop a sizing chart for syringe users based on age, gender, and physical health in order to make the self-injection process as comfortable and safe as possible. We plan to present our completed sizing chart, modified syringes used for testing and validation, and our safety syringe prototype design in SolidWorks at the Design Showcase.

**TEAM #50: DAM-FREE HYDROKINETIC TURBINE**

- Department: Biological & Agricultural Engineering
- Team members: Melissa Cartwright, Petra Eberspacher, Emily Iskin
- Advisers: Dr. Ruithong Zhang, Dr. Kurt Kornbluth

Our client in Kafue, Zambia has designed and built a working power-generating turbine system. The electricity produced will be used by local fishermen to run refrigerators for fish storage. The system consists of a turbine submerged in the Kafue River, followed by a gearbox connected to a 3 kW generator, both on a barge. The gearbox transfers the mechanical energy from the low-speed, high-torque turbine shaft to the high-speed, low-torque generator shaft. The gearbox is not performing at maximum efficiency. Our project focuses on designing, modeling, building, and testing an improved gearbox with a gear ratio of over 1:100. We designed a sprocket and chain system consisting of three pairs of sprockets. We built a prototype of the gearbox that we then tested against certain design constraints. The design will be accessible to and reproducible by other local fishermen.

**TEAM #51: AREION – 4 SEAT ELECTRIC GENERAL AVIATION AIRCRAFT**

- Department: Mechanical & Aerospace Engineering
- Team members: Calvin Davis, Louis Edelman, Benjamin Holmquist, Catherine Mamon, Alejandro Pensado, Dillan Thung
- Adviser: Dr. Cornelius van Dam

Areion is a modern aircraft designed to compete in the 2020 Electric General Aviation NASA ARMD Design Challenge. The RFP challenge asks the team to consider the difficulties of deploying battery or fuel cell systems due to underdeveloped technologies and infrastructure. The aircraft must meet the threshold (goal) requirements of 4 passengers, 500 (800) nautical mile range, 400 (800) pound usable payload, 130 (175) knots cruise speed, and a 30 minute reserve flight time. In order to meet the requirements, Areion utilizes a unique configuration with advancements in aerodynamics, materials, and energy storage. It is configured with a single electrically driven pusher propeller, wake control system, twisted trapezoidal wing, lifting canard, and retractable landing gear. Natural laminar flow technology on the lifting surfaces and fuselage and the unique Prandtl-Horten-Jones lift distribution providing for significant drag reductions over contemporary aircraft as well as controlled tail-less flight. Areion makes use of strong and lightweight carbon fiber construction. Gaseous hydrogen fuel cells power its propulsion system with an independent battery reserve.
**TEAM #52: D-VOLT 474 AIRCRAFT**
- Department: Mechanical & Aerospace Engineering
- Team members: Douglas Fox, Kirk Kelly, Alexander Lee, Christopher McDaniel
- Adviser: Dr. Cornelius van Dam

One of the most exciting and promising developments in travel, aviation included, is the burgeoning interest in electric vehicles. Electric motors offer a number of advantages over conventional engines powered by petroleum-based fuel, generally including reliability (as they contain fewer moving parts), efficiency, diminished environmental repercussion (electric motors have the potential to be powered entirely by renewable energy sources), greater torque at low shaft angular velocities, and lower noise emission. Unfortunately, large-scale implementation of electric vehicles remains hindered by the current limitations of electrical energy storage technology (which includes batteries, capacitors, and fuel cells, although we will limit our discussion to batteries) as well as the inadequacy of existing infrastructure, which extends to both the scarcity of commercial charging stations and the additional load on the power grid. Besides its usually prohibitive cost, one of the chief drawbacks of contemporary battery technology is its inherent weight. The low specific energy of batteries or other electrical energy storage devices reduces the range of any vehicle powered by electrical energy relative to that of a similar vector motivated by conventional fuel. This limitation has the greatest impact on electric aircraft, which have especially strong dependencies of required energy and power on the vehicle’s weight compared to those of automobiles or watercraft. Designing an aircraft that successfully avoids restrictively low values for range, cruise velocity, cabin dimensions, rate of climb, payload, and other performance parameters while ensuring safe, comfortable travel for its passengers has become the central challenge of electric aviation.

**TEAM #53: MAKING AETHER A REALITY**
- Department: Mechanical & Aerospace Engineering
- Team members: Gursevak Badesha, Max Danilevsky, Danny Nguyen, David Stanley, Paul Suarez, Derrick Yabut
- Advisers: Dr. Cornelius van Dam, Nathan Blaesser

Electric power has been an increasingly important avenue of an alternate energy source to fossil fuels for vehicles. Electric fuel has already shown promise in cars today. The logical step is electric aircraft. A design of an all electric general aviation aircraft is presented, entitled “Aether,” that proves to be a worthy design to fly by 2020.

**TEAM #54: ELECTRIC AIRCRAFT DESIGN – ZAPDOS BY TEAM FLY-N-CHARGE**
- Department: Mechanical & Aerospace Engineering
- Team members: Roberto Alvarez, Hung Dong, Nicole Foust, Luis Hernandez, Alvaro Ponce, Zuhair Shaikh
- Advisers: Dr. Cornelius van Dam, Nathan Blaesser

With the call for more eco-friendly aircrafts, Team Charge-N-Fly present Zapdos, the legendary creature of the sky. Possessing contra-rotating propellers to use as much of the airflow as possible and an H-Tail to improve handling and stability, Zapdos will incorporate both tried and tested as well as state of the art technologies, such as lithium-sulfate batteries, in order to provide a renewable and cost-effective mode of air transportation to enthusiasts and flight trainers alike.

**TEAM #55: SOL TERRA**
- Department: Mechanical & Aerospace Engineering
- Team members: Punit Pandit, Matt Stevens, Joey Waters, Jeffrey Won, Stephanie Zhu
- Adviser: Dr. Cornelius van Dam

The Sol Terra is an fully electric general aviation aircraft that is designed to meet the wants and needs of future air travel.

**TEAM #56: BATTERY OPERATED AIRCRAFT 140A (BOA 140A)**
- Department: Mechanical & Aerospace Engineering
- Team members: Kevin Arcalas, Hwang Rak Choi, Andrew Chung, Gino Estantino, Eric Wong
- Advisers: Dr. Cornelius van Dam, Nathan Blaesser

Batteries are becoming the new standard to power aircrafts, due to its higher mode of efficiency than traditional gas powered aircrafts, in addition to leaving a negligible carbon footprint. Therefore, the BOA 140A was designed to meet the criteria of a four seated aircraft powered solely through batteries. This craft was designed to have a range distance of 750 nautical miles, a total payload of 700 pounds, a cruise speed of 140 knots, and a power reserve for emergencies to last 30 minutes. Because this aircraft can be improved with a more efficient battery technology, it was designed with future capabilities in mind, which is in five years, where we predict the mass of batteries to decrease and its energy density to increase.
TEAM #57: ALL-ELECTRIC GENERAL AVIATION AIRCRAFT DESIGN
- Department: Mechanical & Aerospace Engineering
- Team members: Geoffrey Christensen, Junette Hsin, Ethan Kellogg, Keshavan Kope, Ben Schellenberg, Michael Starr
- Adviser: Dr. Cornelius van Dam

For years electrically-powered aircraft have struggled to reach beyond the experimental stages and enthusiast markets and enter the general aviation world, primarily due to limitations in battery technology. Our team has developed a conceptual design for NASA's ARMD challenge: a highly efficient, all-electric aircraft using technology allowing the aircraft be to production ready by 2020. This twin-prop aircraft features a low-drag fuselage, composite materials, and seating for 1 pilot and 3 passengers to travel a maximum range of 520 nautical miles in just under 4 hours. Additionally, our design considers necessary advancement in energy-storage systems to realize the design by 2020, as well as required changes in airport infrastructure to support this type of aircraft.

TEAM #58: J.E.F.F. – JUST ELECTRIC FRIENDLY FLIER
- Department: Mechanical & Aerospace Engineering
- Team members: Jer-Yen Hsu, Richard Lau, Richard Wilson, Steven Wong, Kewen Wu
- Advisers: Dr. Cornelius van Dam, Nathan Blaesser

The Just Electric Friendly Flier is a design submitted in response to NASA's 2014-2015 Aeronautics Research Mission Directorate Design Challenge RFP. J.E.F.F. is an all-electric general aviation aircraft ready for service in 2020 and is designed to keep up with the projected advances in energy storage technology in mind. It is a low wing, high-tail aircraft powered by two 150 horsepower electric motors mounted in its wing. It accommodates up to 4 passengers and a maximum of 800 pounds of payload. It has a range of 800 nautical miles and cruises at 140 knots.

TEAM #59: SCUBA STINGRAY – TAKING ELECTRIC TRANSPORTATION TO NEW HEIGHTS
- Department: Mechanical & Aerospace Engineering
- Team members: Camille Binter, Brandon Lee, Ujit Satyarthi, Andres Zuniga, Samuel Zuniga
- Adviser: Dr. Cornelius van Dam

The goal of the SCUBA (Specialized Craft Using Battery Advancements) Stingray is to revolutionize the electric general aviation industry. Prior to the formation of SCUBA, the potential for electric aircraft was limited to only small, single passenger craft capable of short flights ranges. The low performance of these existing aircraft has resulted in the need for more efficient and reliable battery packs. SCUBA plans to tackle these issues by utilizing experimental battery technologies in order to make electric aircraft more relevant and affordable. SCUBA's first electric vehicle, the Stingray, is a four-seater, general aviation electric aircraft that consists of a hybrid battery pack system utilizing advanced Lithium Ion batteries as well as the experimental, yet proven, Aluminum Air battery system. In addition, the plane will employ the most advanced engineering technologies available, such as composite materials, to maintain high efficiency and performance. It is intended that the Stingray be a multipurpose aircraft, taking part in fields ranging from flight training to reconnaissance to leisure. The Stingray is designed to be a strong competitor against combustion engine GA Aircraft. This aircraft is a major step towards making more affordable and sustainable modes of aerial transportation. SCUBA's potential success will certainly bring the potential of electric transportation to new heights as well as inspire others to undertake the challenges of this industry.

TEAM #60: MOBILE ANIMAL MONITOR
- Department: Electrical & Computer Engineering
- Team members: Anuj Bhardwaj, Brad Harris, John Meeker, James Nguyen, Kunihisa Tamura
- Adviser: Dr. Andre Knoesen

The team designed a wireless sensor network to monitor domesticated animals and aspects of their environment, public shelters specifically. As caretakers are not always present, issues like cold nights and bad air quality go unnoticed. Our device solves this by reading long-term environmental data, then giving cloud access to shelter employees.

TEAM #61: NATCAR CHUCKSGON
- Department: Electrical & Computer Engineering
- Team members: Zheng Zheng Jiang, Lejin Lin, Zixin Lu
- Adviser: Lance Halsted

This project presents the design of an autonomous race car that utilizes the FRDM-KL25Z microcontroller to compete in the Freescale Cup and NATCAR competition. This car features an adjustable camera stand design that allows the dual linescan cameras to face the racecourse in different angles and heights. In addition to the innovative hardware design, this car also features the algorithms to make sharp turns, accelerate in straight lines, and maintain smooth transitions in the track. We designed the car to be competitive against other cars. It performed very well in both class competitions.
ENGINEERING DESIGN SHOWCASE 2015

TEAM #62: UCD FLIGHT TRACKER
- Department: Computer Science
- Team members: Kirsten Cahoon, Nina Kaushik, Nick Layton, Rupali Saiya
- Adviser: Dr. Xin Liu

We have developed a web based application, where users can easily input their travel information. Our search engine will output the best priced flight option during the time range specified by the user. The search bot will continuously check in the background for random variations in the prices, and will notify a user if there is a flash sale, or a drop in price, on a particular flight during their time range. In addition to the standard inputs of source, destination, and dates, we have fields where users can named their own price, preferred airlines, and preferred route. The option for all of these extra user inputs is something that pre-existing search engines lack today.

TEAM #63: DELTA (DELAY-TOLERANCE APPLICATION)
- Department: Computer Science
- Team members: Tiffany Chan, AJ De Las Alas, Stephanie Tran, Viet Tran
- Advisers: Dr. Xin Liu, Dr. Prasant Mohapatra

DELTA is an Android-based application designed to run on tablet computers. This application wants to address self-control in preschool children with high rates of impulsivity. Schweitzer and Sulzer-Azaroff had done a study that demonstrated that self-control in these children can be increased by using the “shaping” procedure, which is that the longer the delay to receive the award means the rewards are increased. Therefore, the goal of this project is to replicate the study and to see whether the group of preschool children are able to obtain or increase their self control with this type of delay gratification.

TEAM #64: CHEMICAL PLANT DESIGN PROJECT: THE PRODUCTION OF ACROLEIN FROM THE CATALYTIC OXIDATION OF PROPYLENE
- Department: Chemical Engineering & Materials Science
- Team members: Oscar Granados, Yong Lee, Andres Soohoo, Raymond Wang
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

Acrolein is used as a chemical intermediate for methionine (an essential amino acid used in animal feed), gluteraldehyde, and cycloaliphatic epoxides. Direct uses include fuel additive to prevent microbial degradation and industrial water-treatment applications. Acrolein is produced by the catalytic oxidation of propylene then followed by phase separation and fractional distillation. There is a strong demand for this chemical and we want to plan a chemical plant that produces acrolein with processes that will maximize our profit. Also we planned our chemical plant so that it follows all the existing regulations on the chemical that are involved in our production and makes as small negative environment impact as possible.

TEAM #65: PRODUCTION OF ETHANOLAMINES FROM ETHYLENE OXIDE AND AMMONIA
- Department: Chemical Engineering & Materials Science
- Team members: Tony Ting Li, Christina Lum, Travis Ludlum, Christopher O’Connor
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

Ethanolamine production is currently of great interest in several industrial fields, ranging from energy to detergents and even to surfactants. Current ethanolamine production includes three chemical products: monoethanolamine, diethanolamine and triethanolamine. These products are produced from three separate reactions, beginning with the reactants of ethylene oxide (EO) and ammonia (NH3). There is particular interest in monoethanolamine production due to the rising demand for its ability to capture carbon dioxide emissions. Our objective is to design and analyze the development, engineering, and construction of a chemical plant that will produce ethanolamines in Beaumont, Texas, along the Gulf Coast. The final deliverables of the project will be a conceptual design package in AspenTech for the plant, along with a complete economic and environmental evaluation. Overall, there will be two major design paths that will be analyzed. The first path will attempt to generate the maximum profit product distribution, and the second path will operate such that 60% of the product will be MEA, or monoethanolamine. Major variables that will be analyzed and changed are the feed concentrations and rations of the EO and NH3, as well as reactor temperature and pressure.
**TEAM #66: GRASS ROOT PRODUCTION OF ACROLEIN THROUGH PROPYLENE OXIDATION**

- Department: Chemical Engineering & Materials Science
- Team members: Faizan Ali, Ryan Cohn, Bradley Costa, Javier Mares
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

This grass-root design will be able to produce 60 million pounds of acrolein per operating year using a method of propylene oxidation. Besides acrolein, acrylic acid will also be produced as a side product of this plant. The intended purity for this plant design is 99.0 wt% or greater for both acrolein and acrylic acid, which will allow both chemicals to be sold on the market. The planned operating conditions for the intended plant design is between 600 and 800 °F and pressure between 20 and 80 psia. All operating conditions were determined by maximizing the production of acrolein while minimizing the operating costs of the plant. The catalyst will have to be replaced yearly during the schedule downtime of the reactor so as to prevent deactivation of catalyst and loss of conversion in the reactors. Also both oxygen and nitrogen will be obtained from the atmosphere so as to minimize the operating cost of the reactors.

**TEAM #67: LIQUID PHASE ETHANOLAMINE PLANT DESIGN AND SIMULATION**

- Department: Chemical Engineering & Materials Science
- Team members: Anais Flynn, Aaron Kirschen, Scott Torres, Vinh Tran
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

For our project, we designed a facility to produce 100 million pounds of 99% weight purity ethanolamines. Product distributions consisting of different percentages of Mono-ethanolamine, di-ethanolamine, and tri-ethanolamine were explored. Different Ethanol-amines have long been used as acid gas (H2S and CO2) absorbents. Of particular interest for our project is the potential increase in mono-ethanolamine demand for carbon dioxide capture from power plant and industrial furnace flue gases. Ethanol-amines are also consumed in the manufacture of detergents, surfactants, agricultural products, and textiles. Ethanol-amines are produced by reacting ethylene oxide with aqueous ammonia in the liquid phase/supercritical phase without a catalyst. In addition, a small amount of byproduct ethylene glycol is formed when water reacts with the ethylene oxide. The goal of this project was to produce a product distribution that yielded the maximum profit for the facility while remaining within the product restrictions.

**TEAM #68: GRASS-ROOT PLANT DESIGN BASED IN TRINIDAD AND TOBAGO FOR THE PRODUCTION OF ON-PURPOSE PROPYLENE THROUGH CATALYTIC DEHYDRATION OF METHANOL**

- Department: Chemical Engineering & Materials Science
- Team members: Aditya Agarwal, Alec Liou, Thuy-Quynh Ngo, Layla Sanders
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

In the current petrol-chemical market, shale gas makes the majority of the natural gas being used in production. While this allowed for a boom in ethylene production, there was a significant reduction in propylene production due to the methods used to make ethylene. The proposed design is that of a methanol to propylene plant via catalytic dehydration of methanol to dimethyl ether, followed by dimethyl ether reacting over a modified zeolite catalyst to produce propylene. Using AspenPlus, a flowsheet was constructed for the simulation of a 500 mmib/year plant, along with a detailed economic analysis of yearly operating costs and possible net profit.

**TEAM #69: GRASS-ROOTS ON PURPOSE PROPYLENE PLANT DESIGN**

- Department: Chemical Engineering & Materials Science
- Team members: Linh Doan, Rhys Dylan Robles, Elizabeth Roshal, Solomon Wong
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

Traditionally, propylene is a by-product of steam cracking and fluid catalytic cracking. However, the demand for propylene has grown significantly over the years. In our process, we use packed flow reactors convert methanol to DME, and then DME to propylene. The mixture is then separated by a distillation column into Liquefied Petroleum Gas (LPG), gasoline, light gases, and propylene. With this process and a 0.9 conversion ratio of methanol to propylene, we can expect approximately $72.5 million worth of profit. However, this is including the sale of the by-products obtained by this process. From the Trinidad and Tobago official government and Basel Convention websites, we found that there are many different guidelines that we must follow. In addition to environmental regulations, there are also chemical guidelines that must be followed due to the use of chemicals such as zeolite and aluminum oxide catalyst. From a basic AspenPlus model, it has been calculated that we need about 200,000 lbs/hr of pure methanol and 191,000 lbs. of steam to create the desired 500 million lbs/yr of propylene at the designated process restrictions. Using parameters given by the client, it was found that about 100,000 lbs. of ZSM-5 zeolite catalyst is needed for the first reactor and 47,000 lbs. of NM-1 for the second reactor. Total cost for this process, including utilities, totaled out to be $5,172,310 in capital costs and $272,218,068 every 2 years for operating costs.
**TEAM #70: ETHANOL-AMINES PRODUCTION PROJECT**

- Department: Chemical Engineering & Materials Science
- Team members: Rene Gone, Kevin Hwee, Vincent Phan, Vinh Phuong
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

Ethanol-amines have long been used as absorbents for acid gases such as H2S or CO2 in the chemical processing industry. A market has emerged for the production of mono-ethanolamine which can be used to capture CO2 from power plants and industrial furnace flue gases. In addition, ethanol-amines are consumed in the manufacturing of detergents, surfactants, agricultural products, and textiles. The production of ethanol-amines occurs by reacting ethylene oxide with aqueous ammonia in the liquid or supercritical phase without need of a catalyst. The reaction of successive ethylene oxide molecules with mono-ethanolamine yields di-ethanolamine and tri-ethanolamine respectively. Our group has designed an ethanol-amine production plant projected to be located in Beaumont, Texas. Its annual production rate is aimed at 100 million pounds of ethanol-amines along with some by-product (ethylene glycol) and waste. Aspen Plus® was used to simulate a production plant and the processes within to achieve 99% ethanol-amines purity. This information allowed estimations of annual production, necessary capital investment, annual plant operation costs, and ultimately, profitability.

**TEAM #72: DESIGN OF A COMMERCIAL PLANT FOR ETHANOLAMINES PRODUCTION**

- Department: Chemical Engineering & Materials Science
- Team members: Parampreet Bhatti, Jonathon Jenkins, Chandran Lakshmanan, Waylon Yang
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

At the request of UCD Chemicals, we at Flawless Design have designed a grassroots chemical processing plant in Beaumont, Texas for the conversion of ethyl oxide and ammonia feedstock into ethanolamines. The target was the production of mono, di, and tri ethanolamines at a total capacity of 100 million pounds/year. Design objectives included optimizing process equipment components to maximize ethanolamine conversion while limiting overall operating cost. A detailed economic analysis was performed to single out the current design. We hope our design will leave a positive impact both locally, jobs and environment, and globally, the world market.

**TEAM #71: PLANT DESIGN FOR THE SYNTHESIS OF ACROLEIN FROM PROPYLENE**

- Department: Chemical Engineering & Materials Science
- Team members: Zhi Chen, Xin Cui, Denis Su, Amr Zedan
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

Acrolein (propenal) is the simplest unsaturated aldehyde. Acrolein is produced industrially by the catalytic oxidation of propylene and is used as a chemical intermediate for methionine (an essential amino acid used in animal feed), glutaraldehyde, and cycloaliphatic epoxides. Direct uses include fuel additive to prevent microbial degradation and industrial water-treatment applications. The purpose of this project is to prepare a conceptual design package and economic evaluation of the conversion of propylene to acrolein. This design incorporates new technologies, green design, and economical solutions aimed at delivering a cost effective and environmentally friendly plant. This design's target is to produce 60 million pounds of acrolein per year while reducing the by-products of the process which include carbon dioxide and carbon monoxide.

**TEAM #73: PRODUCTION OF ETHANOLAMINES**

- Department: Chemical Engineering & Materials Science
- Team members: Joshua Co, Katherine Fudge, Van Nguyen, Brandon Wong
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

Ethanol-amines have long been used as an absorbents for acid gases such as H2S or CO2 in the chemical processing industry. Of particular interest is the potential increase in mono-ethanolamine (MEA) demand for carbon dioxide capture from power plant and industrial furnace flue gases. Ethanol-amines are also consumed in the manufacture of detergents, surfactants, agricultural products, and textiles. Ethanol-amines are produced by reacting ethylene oxide with aqueous ammonia (NH3) in the liquid phase/supercritical phase without a catalyst. The addition of one EO molecule forms mono-ethanolamine (MEA). A second EO molecule forms di-ethanolamine (DEA) and a third EO molecule forms tri-ethanolamine (TEA). We plan to produce all three ethanol-amines and the ratio of these products depends on the reaction conditions. In addition, a small amount of byproduct ethylene glycol is formed.
TEAM #74: THE ON-PURPOSE PRODUCTION OF PROPYLENE FROM METHANOL FEEDSTOCKS

- Department: Chemical Engineering & Materials Science
- Team members: Victor Awad, Ravinderjeet Gill, Amar Husic, Jordan Provost
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

To take advantage of a growing number of propylene applications and the rising availability of methanol from natural gas sources, we have designed a process to convert methanol to propylene on a commercial scale. Propylene has historically been a waste product from hydrocarbon cracking, but recent efforts to find uses for the substance have been very fruitful. Demand has now surpassed supplies from traditional product streams, and propylene has become a high-value commodity. In order to assess the commercial viability of the proposed process, we have created a detailed design and economic evaluation. The production plant has been strategically located in Trinidad and Tobago, in close proximity to a number of methanol plants and positioned well to supply propylene to Gulf Coast customers. The production capacity of the facility is 500 million pounds of propylene per year, with a 99.5% purity by weight. All revenues from by-products and utility costs are considered when determining the net profitability of the plant.

TEAM #75: PRODUCTION OF ON-PURPOSED PROPYLENE

- Department: Chemical Engineering & Materials Science
- Team members: Davis Bilsky, Albert De Las Alas, Tien Hao Lee, Curtis Ng
- Adviser: Dr. Nael El-Farra

An important carbon source for organic molecules is propylene. Propylene is commonly a by-product of petrochemical processes, but as demand increases, we must find alternative methods to directly produce propylene. Here, we convert methanol to dimethyl ether (DME), then use NM-15 catalyst for a high selectivity (71%) reaction to produce propylene. With a large number of by-products from this reaction, separation poses a challenge, especially the separation of propylene and propane. By using Aspen Plus for simulations, we are able to design a plant to produce 500 million pounds of 99.5 wt% propylene per year. In addition, we perform the economic evaluation to ensure we maintain profit in our plant, which is scheduled to open in 2018.

TEAM #76: PROFITABLE ON-PURPOSE PROPYLENE IN TRINIDAD

- Department: Chemical Engineering & Materials Science
- Team members: Christina Chun, Thuy Thanh Le, Sean Mercer, Daniel Mulugeta
- Adviser: Dr. Nael El-Farra

Propylene is often a by-product of other processes; however, due to a high demand for it in the petrochemical industry, on-purpose propylene production is a prevalent area for development. In this project, a chemical plant for on-purpose propylene production in Trinidad and Tobago will be designed. For this project, propylene will be produced from a conversion of methanol using a two steps synthesis method, instead of the traditional steam cracking method. The first step of the synthesis method involves the catalytic dehydration of methanol to create an equilibrium mixture of dimethyl ether, methanol and water. This mixture with an addition of steam is then reacted over a zeolite catalyst with high selectivity to propylene. Propylene and by-products will then be purified to achieve 99.5% propylene purity. With Aspen Plus simulation program, the above chemical process will be designed and optimized for large-scale production. Cost analysis will be performed on the design for profitability study. This project’s goal is to design an economically profitable chemical plant for propylene production and purification, with the production capacity of 500 million pounds of propylene per year.

TEAM #77: EFFICIENT FINANCIAL AND ENVIRONMENTAL DESIGN OF ACRYLIE PRODUCTION PLANT THROUGH OXIDATION OF PROPYLENE

- Department: Chemical Engineering & Materials Science
- Team members: Steven Chakerian, Patrick Kanadi, Zahra Memar, Brandon Rotondo
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

The proposed plant design considers facets of efficient acrolein production, dealing with safe handling of the toxic product, and flammable components. A cost effective method of acrolein production is through oxidation of propylene feed-stock. The plant operation considers upstream mixing of components to produce safe reacting conditions, and reactor design is employed to simultaneously reduce carbon dioxide emissions from undesired reactions, and to lessen the cost of plant operations. Downstream separations are developed to produce high purity acrolein, while removing waste products and valuable reactants. Rate law data provided in catalyst tests is fitted to equation for reaction rates. Process cooling requires key control of temperatures, as reaction approaches runaway conditions. Through use of the AspenPlus program for plant design and flow sheets, accurate modelling of the simultaneously dependent processes will occur, which allows us to predict the plant results. Furthermore, equipment
sizes can be optimized within the program, manipulating parameters to lower financial and environmental cost. Plant design further considers fixed cost, material and utility cost to be optimized throughout the whole upstream, reaction, and separations process downstream. Efficient design is employed to reuse cooling water streams, and minimize electricity costs. Safe equipment usage will limit corrosion caused by acrolein product, and prevent explosive limit conditions through steam dilution. Design considerations will attempt to remove CO2 product gas through water scrubbing, such that emissions can be controlled and reduced through treatment. The use of recycle streams and process inter-cooling will allow for a productive reactor.

**TEAM #78: CONCEPTUAL DESIGN AND ECONOMIC EVALUATION FOR THE PRODUCTION OF ETHANOLAMINES**

- Department: Chemical Engineering & Materials Science
- Team members: Brandon Folb, Trevor Gray, Calvin Ma, Felix Tran
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

Ethanolamines are used in a variety of applications including carbon dioxide scrubbing, personal care products, corrosion inhibition, and pH buffering solutions. According to projections the market is also going to expand in the future, especially for monoethanolamine. A full upstream and downstream chemical plant design was performed for the production of ethanolamines using simulation software from a feedstock of ammonia and ethylene oxide. The individual unit operations for this plant including sizing, material choice, and economic evaluation was performed to determine the economic feasibility of our design. From laboratory data, the kinetics for ethanolamine production were determined and was used to design a plug-flow reactor for the upstream section of the chemical plant. The chemicals produced in this reaction are monoethanolamine, diethanolamine, triethanolamine, as well as ethylene glycol. Feedstock ratios as well as operating conditions were manipulated to achieve the distribution of products with the highest economic potential. The downstream portion of the plant focused on the separation of the reaction products to high purity. To accomplish this distillation columns were used in succession to remove unreacted reactants as well as purify each of our products to a minimum of 99 wt%. The process was designed to selectively produce greater amounts of monoethanolamine due to potential growth in its market and 100 million pounds of product per year in total for the chemical plant that is to be constructed in Texas.

**TEAM #79: INDUSTRIAL PRODUCTION OF ACROLEIN THROUGH CATALYTIC OXIDATION OF PROPYLENE**

- Department: Chemical Engineering & Materials Science
- Team members: Paul Arneja, Cindy Luna-Zaragoza, Cori Satkowski, Kelvin Tan
- Adviser: Dr. Nael El-Farra

Plant design focuses on upstream processing steps, including the development of base case simulation model using Aspen Plus, to design and evaluate a proposed Acrolein project that would produce 60 million pounds of acrolein/year for a plant operating 350 days/yr, where conversion of propylene to acrolein reaches 85% conversion.

**TEAM #80: INDUSTRIAL PRODUCTION OF ACROLEIN VIA OXIDATION OF PROPYLENE**

- Department: Chemical Engineering & Materials Science
- Team members: Jeffrey Fan, Po Yue Meng, Brandon Rose, Andrew Sanchez
- Advisers: Dr. Nael El-Farra, Dr. Greg Miller

A method of production for the oxidation of propylene to acrolein is designed for this project. This project utilizes the concepts of fluid mechanics, mass and heat transfer, and kinetics to determine the best way to produce acrolein commercially. Designing a flow sheet is the first step. Using reactors and separators, the reaction can take place and the acrolein can be separated from the other side products. By taking into account the goal of producing 60 million pounds of acrolein per year with a minimum purity of 99.0% by weight, the specifications for the facility can be determined using the software Aspen Plus. From this information, the sizing and cost of each different piece of equipment can be determined using multiple equations and charts. From this, the different equipment needed for the production of acrolein can be chosen as well as the material that is most suitable for making the equipment. The safety of the workers and the environment are the top priority when selecting equipment and designing the process. To prevent any spilling or contamination, appropriate materials will be used when constructing the plant. By accounting for the many factors of building this plant such as safety, production rate, efficiency, and cost, the most appropriate design and specifications were used for the construction of this plant.
Flawless Design Corporation being led by project managers Professor El-Farra and Professor Miller have the assignment from Etheror Chemicals regarding their plans to build a plant for the production of on-purpose propylene by conversion from methanol. Propylene is the second most important starting product in the petrochemical industry after ethylene and a raw material for variety of products. The global market for propylene has expanded in recent years and our team is planning on meeting those needs. The design requires detailed economic evaluation, conceptual design and simulation of the plant, and capital and operating cost estimation to determine the feasibility and profitability of the plant.

Our group is tasked with finding the economic viability of an Acrolien production plant that would hypothetically come online in the year 2018. Acrolein is an important chemical precursor to the production of Methionine, an amino acid for livestock feed, it is also used in the production of another major industrial chemical known as acrylic acid. From preliminary cost analyses, the plant had a projected yearly oncome of 38 million dollars a year, making our venture seem fairly viable. Or project will tackle the challenges of producing the acrolein form propene and air then purifying the substance to 99.0 wt%. There are many challenges that arise in the energy management, which are group is working hard to conquer. The advantage of our product is that competitors around the globe usually supply the acrolein at 95 wt%, making this a very promising capital venture if we can run this efficiently. The task will also include all the miscellaneous cost, including all the startup costs, running costs of the plant, and predicting when we will hit the black from all our capital investments. As mentioned before managing heat will be crucial to this project in order to make it economically viable. In our production, separation boasts a huge challenge, because the contents of our reacted feed form mixtures that are not easily separated. Enormus amount of energy will be released from the reaction and even more energy will be needed for the separations. As our group will go with further investigation, we will find whether or not our process is economically viable.

Ethanol-amines are important compounds which can be used in the manufacture of detergents, surfactants agricultural products, and textiles. They also can be used as acid gas absorbents. Ethanol-amines including MEA, DEA, and TEA can be produced by the reaction of ethylene oxide with excess ammonia. In this project, we consider the design of a plant with the capability to produce 100 million pounds per year of total ethanol-amines located in Texas. The current market has a global production of 2866 million pounds per year of ethanol-amines with increasing global demand, which suggest that such a plant will provide a valuable product in the US. The design includes an upstream reactions and considerable downstream separations which have been optimized to ensure maximum profitability of the plant. We summarize that such a plant is feasible in conceptual design and propose that pilot plant operations are needed to confirm the simulation results.

With over 25,000 total cases and 10,500 confirmed deaths in the past year, the current and deadliest Ebola epidemic has been labeled as a global health crisis. The standard, historic treatment for Ebola victims has been supportive therapy, which includes providing intravenous fluids, maintaining oxygen status, and treating other infections. This is done in order to keep patients alive long enough for their immune systems to develop defenses to combat the virus. However, with this approach, the fatality rate has been 60%. There is still no approved treatment available for Ebola, but ZMapp, a therapeutic cocktail consisting of three separate antibodies developed by Mapp Biopharmaceutical, has resulted in a 100% survival rate when administered to non-human primates infected with the Ebola virus up to 5 days post infection. An efficient and easily scalable method of large-scale production must be designed and analyzed. Our team, Agrozyme Therapeutics, focused on the design of a large-scale production method for ZMapp using transient gene transfer by Agrobacterium tumefaciens into whole Nicotiana benthamiana plants. The biomanufacturing facility can produce 75 kg of purified ZMapp per year, enough for approximately 8,500 treatments per year. The upstream
production and downstream recovery processes were modeled in SuperPro Designer® and an economic analysis was performed.

**TEAM #85: FACILITY DESIGN FOR EBOLA THERAPEUTIC, ZMAPP, UNDER SINGLE-USE SEMI-CONTINUOUS PROCESSING**

- Department: Chemical Engineering & Materials Science
- Team members: Kenneth Hernandez, Jack Morel, Kenmond Pang, Brandon Tran, Christy Turcios
- Advisers: Dr. Karen McDonald, Dr. Somen Nandi

The recent outbreak of the Ebola virus in Africa has prompted an increased effort to produce and implement a working Ebola treatment. ZMapp, a monoclonal antibody (mAb) based therapeutic, is the result of a collaboration between Mapp Biopharmaceuticals, Inc., LeafBio, Defyrus Inc., the US government, and the Public Health Agency of Canada (PHAC). ZMapp is currently manufactured by Kentucky BioProcessing using transient mAb gene expression in whole Nicotiana benthamiana plants. This method has proven to be effective in producing mAbs to treat Ebola, but our team, Phytogen Pharmaceuticals, is evaluating a new production method using semi-continuous perfusion reactors with suspended N. benthamiana cells for increased flexibility, scalability and cGMP compliance. Production methodologies for mAbs are highly complex/expensive, and require well-designed infrastructure, economic feasibility, and fast production timelines. For these reasons, we have performed an in-depth design and techno-economic analysis of a facility for ZMapp production under single-use semi-continuous processing. This analysis includes design of unit operations and associated mass/energy balances, equipment selection, equipment sizing, capital investment calculations, overall cost of production, environmental impact analyses, and scheduling of production timelines — all via a computer modeling software called SuperPro Designer®. Special consideration was given to continuous processes and single-use technologies since they are poised to change the biotherapeutic industry.

**TEAM #86: FUEL IT ALL WITH BUTANOL**

- Department: Chemical Engineering & Materials Science
- Team members: Amy Ly, Sean Shelton, Bridgette Smith, Zhimin Xie
- Advisers: Dr. Karen McDonald, Dr. Shota Atsumi

Biobutanol is becoming an increasingly desirable substitute for traditional petroleum-based fuels. There are many advantages of using butanol over ethanol, such as having a higher octane number, a lower vapor pressure, and better mixability. In the interest of being economic and environmentally friendly, we have designed a manufacturing facility that produces n-butanol using *Escherichia coli* that has been genetically modified to assimilate ethylene and convert it to butanol. Our target is to produce 500 barrel of oil equivalent/day, or more, with an n-butanol specific productivity of 1 gram n-butanol/gram dry weight *E. coli* /hour. Using SuperPro Designer®, we modeled upstream and downstream processing units for a facility that operates 351 days per year with continuous n-butanol production runs that each last up to a month. The facility consists of a catalytic reactor for the oxidative coupling of methane to ethylene, a seed train for the preparation of *E. coli* inoculum, production-scale fermenter(s), and separation and purification steps. To improve our productivity, n-butanol is continuously removed through gas stripping, which is the more energy efficient than traditional distillation. The recovered n-butanol-rich vapor is condensed and collected. Biomass produced from the reactors is used as inoculum or nutrients for future production runs while any unreacted ethylene is separated and recycled. An economic analysis is performed to determine the potential profitability of this novel n-butanol production strategy at scale.

**TEAM #87: PRODUCTION OF EBOLA THERAPEUTIC ZMAPP USING NICOTIANA BENTHAMIANA BATCH PLANT CELL CULTURE**

- Department: Chemical Engineering & Materials Science
- Team members: Oliver Chen, James Joly, Kelsey Parsons, Thom Phongvichit
- Advisers: Dr. Karen McDonald, Dr. Somen Nandi

As of April 2015, there have been over 25,000 cases of Ebola in West Africa. The virus causes severe hemorrhagic fever and has an average fatality rate around 50%. This has resulted in over 10,000 deaths since the 2014 outbreak alone. There have been several candidate therapeutics developed, but only monoclonal antibodies (mAbs) have been found to be effective. ZMapp is a cocktail of three different antibodies and was found to bind to three sites on the glycoprotein of the virus. The therapeutic drug, ZMapp, was found to offer a high level of protection against the virus, but production of the drug, which uses a novel plant-based method, has not been able to meet the current demand. Several alternative designs are being considered for ZMapp production to meet the desired amount of treatments for current and future outbreaks. Our design team, Zaratek, has performed a preliminary conceptual design and economic analysis for the production of ZMapp using a *Nicotiana benthamiana* plant cell suspension culture. The production facility uses a three-stage batch plant cell culture to produce the antibodies necessary to make ZMapp. The necessary separation and purification processes were also designed and analyzed. Plant cell suspension cultures derived from glycoengineered *N. benthamiana* are used to produce the ZMapp mAbs through transient expression using Agrobacterium co-cultivation. SuperPro Designer® was used to model the upstream and downstream process units of the mAb facility and to perform the economic analysis.
TEAM #88: MEDICASE: MOBILE POINT-OF-CARE TESTING WORKSTATION FOR DISASTER AND EMERGENCY CARE

- Department: Biomedical Engineering
- Team members: Daicy Luo, Christian Pascual, Jonathan Wang, Amy Yu
- Adviser: Dr. Anthony Passerini

The MediCase is a portable workspace that can shelter delicate point of care medical devices so that they can be more easily transported in disaster situations. By mobilizing point of care treatment, the MediCase can accelerate therapeutic turnaround time and improve the quality of patient care in these situations. There is a cooling system in place to ensure that device reagents remain viable in temperate conditions so that they can continue to provide reliable results.

TEAM #89: SOURCE SUGARS: MOBILE SUGAR BEET PRE-TREATMENT AND CONCENTRATION SYSTEM

- Department: Biological & Agricultural Engineering
- Team members: Raymond Chan, Elizabeth Chun, Curtis Jew
- Adviser: Dr. Ruihong Zhang

With increased need for fuel around the world, there has been an increased demand for alternative fuels. Sugar beets have been a popular plant based alternative due to their large sugar storages. Unfortunately the majority of the plant is comprised of water which adds to the overall weight of material transported. Source Sugar’s goal is to develop a system that can enzymatically hydrolyze sugar beets to decrease transportation costs and to show that sugar beets are a viable candidate for the production of alternative fuel. The project’s objectives are to develop a mobile pilot scale system capable of concentrating sugar beets to concentrate sugar/biomass, to construct key system elements for pre-treatment and concentration of biomass, to test the prototype and optimize the process to produce a biomass concentrate, and to evaluate performance parameters and prototype designs to develop a recommended design of the system. For this design showcase the team is presenting the final prototype design and product of a system that will meet Source Sugar’s goals and objectives.

TEAM #90: UAV DETECT AND AVOID SYSTEM

- Department: Electrical & Computer Engineering
- Team members: Christopher Bird, Shalmali Joshi, Lindsey Raven, Angela Tobin
- Adviser: Dr. Soheil Ghiassi, Dr. Xiaoquang (Leo) Liu

The “Detect and Avoid” system is designed to allow unmanned aerial vehicles (UAVs) or quadcopters to avoid collisions autonomously. While on a preset flight path, the UAV determines if there is a specific object in its path by using image processing algorithms on a video feed from a single camera. Using this information, along with distance signals from a LiDAR sensor, it will calculate a new flight plan to avoid the object. This system is implemented on an Altera FPGA with an ARM processor running LINUX.

TEAM #91: TANTALUM NITRIDE THIN FILM RESISTOR PRODUCTION VIA REACTIVE SPUTTER DEPOSITION

- Department: Chemical Engineering & Materials Science
- Team members: James Bellino, Hannah Flens, Thomas Garcia, Chris Hart, Antonio Hurtado, Monica Lehmann, David Loyola, Benjamin MacDonald, Drew Teller, Allen Volpe
- Advisers: Dr. Ricardo Castro, Mike Powers

Thin film resistors are the fundamental pieces of all equipment produced by Keysight Technologies. Tantalum nitride is a material often used due to intrinsic properties that allow the required resistance ranges to be achieved. Currently, tantalum nitride thin films are produced via sputter deposition. This method of film formation is not ideal for deposition of tantalum nitride due to both of these issues. Our team proposed the development and implementation of reactive sputter deposition of tantalum nitride for use in thin film resistors. The difference between reactive and traditional sputter deposition is that the target can simply be pure tantalum and reacts with nitrogen gas during the deposition process to form a film of the desired composition, leading to a more efficient production, pure tantalum targets are more affordable and have a more reliable composition that will reduce inconsistency found with the tantalum nitride target. The process was developed with existing equipment at Keysight Technologies and key parameters of reactive sputter deposition will be optimized through several experimental depositions. The films produced were characterized and evaluated against a matrix of properties that are expected for a high quality resistor that can be implemented in Keysight Technologies products.

TEAM #92: CULTURING AQUATIC SNAILS IN A RECIRCULATING AQUACULTURE SYSTEM

- Department: Biological & Agricultural Engineering
- Team members: Galen Anderson, Felicia Manan, Sumana Seshadri
- Advisers: Dr. Ruihong Zhang, Dr. Bryan Jenkins, Tien-Chieh Hung

This project is aimed at accomplishing the following goals: (1) to construct a viable habitat in a recirculating aquaculture
system (RAS) to support and control the reproduction and growth of a continuous population of aquatic snails, H. aniceps; (2) to minimize the energy consumption of the RAS with efficient design, integrating active solar water heating, and an automatic control system; and (3) to minimize the labor required to maintain the system with design, automatic controls, and a monitoring system. While RAS show promise to contribute significantly in future worldwide aquaculture production, the high initial investment and operating costs compared to other aquaculture methodology inhibit its widespread adoption. This project has the potential to develop and prove some possible solutions to the high cost of RAS.

TEAM #93: THE MECHANICALLY STABILIZED EARTH GEOCHALLENGE COMPETITION
- Department: Civil & Environmental Engineering
- Team members: Alan Espejo, Tyler Mathews, Krishen Parmar, Gordon Tat, Jimmy Wong, Colleen Woolcott
- Adviser: Dr. Bruce Kutter

The Mechanically Stabilized Earth GeoChallenge is a competition that consists of designing a model retaining wall using only a sheet of poster board with kraft paper strips as reinforcement, rather than concrete with steel tiebacks. Engineering properties of the paper reinforcement and the geotechnical properties of the soil back fill were acquired using ASTM testing methods. The competition requires students to construct the wall, along with compacting the back fill, on site in 50 minutes. Once construction is completed, the back fill material is vertically loaded. The final scores are calculated based on the total mass of reinforcement and amount of deflection induced by the vertical load.

TEAM #94: NATCAR
- Department: Electrical & Computer Engineering
- Team members: Weitang Liu, Zhisen Qian, Guangliang Wu
- Adviser: Lance Halsted

Design and construct an autonomous race car.

TEAM #95: GETEXPERTS
- Department: Computer Science
- Team members: Sonia Chourappa, Syeda Kauser Inamdar, Anjaly Nedumala, Anthony Tran
- Adviser: Dr. Xin Liu

GetExperts is a web application where businesses can find experts qualified to undertake their listed projects. This professional networking site allows experts to publish their profiles including expertise areas, years of experience, past projects, etc. A business can post a project profile with its description and the types of skill it requires. An expert can search for and submit proposals to projects that need their expertise while a business can browse for and send invitations to experts to view their posted project(s). The site primarily runs on searching and matching algorithms which recommend businesses, experts, and projects to each other based on common tags (skills and expertise) linked with their profiles. A business will then be notified if a potential expert is interested in their project(s) and an expert will be notified when a published project requires his or her skill set. If the expert and project make a good match, then the business can take the next step in contracting the expert for the duration of the project development period. This application is powered by MongoDB, Express, AngularJS and Node.js. Geared to the pharmaceutical industry, GetExperts connects well-suited experts with projects that need their skills.

TEAM #96: COMPREHENSIVE AGRICULTURAL MONITORING SENSOR SYSTEM (CAMSS) FOR THE CALIFORNIA STRAWBERRY INDUSTRY
- Department: Electrical & Computer Engineering
- Team members: Jonathan Earl, Joshua Garrison, Yosi Shturm, Jackson Thomas
- Adviser: Dr. Andre Knoesen

The Comprehensive Agricultural Monitoring Sensor System provides the California strawberry industry with a mobile sensing platform to monitor plant and environmental conditions. Environmental, chemical, and visual data is collected for real-time analysis of the plant and field conditions. A TIG-welded aluminum chassis is ergonomically designed for user comfort and field integrity. The chassis includes an environmental sensing unit to obtain and correlate ambient conditions. An adjustable wing assembly featuring a soil sampling probe provides an analytical platform that can be used for a variety of field infrastructures. As the system is guided through the field by a user, profiles for soil moisture, conductivity, and temperature are generated based on geographical location. The system also features a depth-monitoring surface detector and an object-identification PIXY camera for obstacle awareness. Physical parameters measured by the probe are correlated with visual data obtained from a webcam as well as an NDVI camera. The webcam obtains colorimetric and shape data for crop forecasting and visual disease diagnosis. The NDVI unit provides an overall plant health assessment including moisture levels, stress factors, and chemical composition. An Android tablet allows the user to control the device sampling and operation as well as receive feedback from the sensors and sampling maneuvers. The data from the probe and camera units is processed and stored using on-board controllers and selectively transmitted for further analysis. This project is generously sponsored by Northrup Grumman Corporation and Texas Instruments Incorporated.
**TEAM #97: COMPREHENSIVE AGRICULTURAL MONITORING SENSOR SYSTEM (CAMSS) FOR THE CALIFORNIA STRAWBERRY INDUSTRY**

- Department: Mechanical & Aerospace Engineering
- Team members: Madeline Campbell, Virginia Hartz, Kaleb Klauber, Michael Lambert, Jeffrey Ware
- Adviser: Dr. Cristina Davis

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**TEAM #98: PROGRAMMABLE FOOD-TOY DISPENSER FOR DOGS**

- Department: Mechanical & Aerospace Engineering
- Team members: Trevor Cardiff, David Kuchta, Josh Mandeville, Estella Wong
- Advisers: Dr. Melissa Bain, Dr. Liz Stelow, Dr. M. Sarigul-Klijn

The food-toy dispenser can distribute several toys in order to provide enrichment throughout the day to dogs who are left alone at home for longer periods of time. This is especially beneficial for dogs who suffer from separation anxiety, as food-toy dispensers have shown to decrease misbehavior while owners are away. The device can dispense dog toys of various sizes over a period of time that is set by the user. The product is battery operated, light-weight, portable, stable, robust, and reliable. It also has the added feature of being wall-mountable, allowing dog owners to mount the device wherever works best for their situation. Our design has four flip-out compartments that dispense an individual dog toy. The compartments rotate outward under the force of torsion springs that are located underneath each compartment. These compartments are latched in place by solenoids that are controlled by an Arduino microcontroller. The user will program the dispenser’s settings through a LCD interface and keypad controls, telling the device how long they will be gone and how many toys need to be dispensed. The microcontroller’s programming then divides the allotted time into equal intervals and releases the toys accordingly.

**TEAM #99: VETMOD – CCL TEAR MODEL**

- Department: Biomedical Engineering
- Team members: Sean Kindelt, Johnny Lai, Sneha Pandey, Tara Puccioni
- Adviser: Dr. Anthony Passerini

We have designed a model of a canine knee that allows veterinary students to practice conducting diagnostic tests for cranial cruciate ligament (CCL) tears without using live models. VetMod improves upon existing methods used to teach veterinary students how to diagnose CCL tears in canines. This product will benefit veterinary students by using a hook system to convert between a torn and a healthy CCL; students can feel and compare the difference between the two states side by side. VetMod includes accurate geometry from a CT scan to create the individual components of a canine knee: bones, ligaments, muscle, and skin. The product is manufactured using 3D printing, mold casting, and laser cutting techniques. Using VetMod to practice the diagnostic tests repeatedly allows vet students to become familiar with them, which will lead to fewer false diagnoses in the future.

**TEAM #100: REACTIVE SPUTTERING TO INCREASE THE SHEET RESISTANCE OF W-SI-N THIN FILM RESISTORS**

- Department: Chemical Engineering & Materials Science
- Team members: Raymond Chen, Antonio Cruz, Martin Kwong, Jack Lam, Niteesh Marathe, Camron Noorzad, Johnny Sun, Alan Wu, Disheng Zheng
- Advisers: Dr. Ricardo Castro, Michael Powers

We researched and developed a process to fabricate W-Si-N thin film resistors with sheet resistance of 2000 ohms/square. Previous work had achieved only 250 ohms/square. We used reactive sputtering to increase the nitrogen content in the resistors.

**TEAM #101: BEE POLLEN DEHYDRATOR**

- Department: Biological & Agricultural Engineering
- Team members: Laura Metrulas, Alex Thornton-Dunwoody
- Adviser: Dr. Ruifong Zhang

Our project is a desiccant and solar operated bee pollen dehydrator. It was designed to operate without electricity in
works by increasing the effective sweep area seen by the turbine to generate power. The concept on fossil fuels. The proposed concept is a Keel ship design currently an under-utilized and potentially valuable energy source to meet growing demand and reduce dependence on fossil fuels. The Ocean Current Energy Concentrator, or OCEC, is a novel power generation method designed to produce consistent, affordable and clean power from weak, but steady ocean currents. For example, the Florida Straits current flows above 1 m/s for 85% of the time, carrying the same energy density as a 21 mph atmospheric wind. These ocean currents are currently an under-utilized and potentially valuable energy source to meet growing demand and reduce dependence on fossil fuels. The proposed concept is a Keel ship design with an attached turbine to generate power. The concept works by increasing the effective sweep area seen by the turbine, proportionally increasing the power that could otherwise be obtained. The project objective is to create a functional prototype as a proof-of-concept of the technology. The designed prototype features a boat hull with an attached hydrofoil. The hydrofoil, referred to as the keel, provides lift to increase the ship's speed relative to the water current. This allows the ship to tack back and forth, sweeping out a relatively large area. The prototype was designed for manufacturability and affordability, allowing for easy transportation, handling and testing.

**TEAM #102: DIRECT SOLAR DESALINATOR**

- Department: Mechanical & Aerospace Engineering
- Team members: Kevin Bower, Matthew Elmore, Reed Gunsalus, Kellen Masuda
- Advisers: Dr. Anthony Wexler, Dr. Sanjay Joshi, Dr. Martinus Sarigul-Klijn

The team has designed a scalable water desalination system that will be optimized for agricultural purposes. This device was conceived as an effort to recycle high salinity wastewater while in the midst of a major drought here in California. The objective is to give small farmers who do not have affordable access to clean water the ability to reclaim potable water from high salinity sources. The device uses a proven method of evaporation-condensation water collection powered by direct solar irradiation. Although this method is not as efficient as processes such as reverse osmosis, it is a low-cost solution that is scalable, easy to install, and requires little technical prowess to operate. Moreover, the device will allow small farmers to reduce their dependence on the federally allocated water supply. The distinction between this design and other solutions is the implementation of a convective cooling system built into the main window. Ideally, there will be evidence that the method of cooling the main condensing surface greatly increases the efficiency of the device, without hindering the transmittance of solar irradiance. This added efficiency could potentially yield enough water, at low cost, to compete with municipal water rates. To accommodate varying production needs, the desalination system was designed with modularity in mind. The overall system of the solar desalination will consist of multiple desalination twinwalls connected in series and supplied with source brine water via a pump. This initiative will bring California’s small farmers a big step closer to water independence.

**TEAM #103: OCEAN CURRENT ENERGY CONCENTRATOR (OCEC) PROTOTYPE**

- Department: Mechanical & Aerospace Engineering
- Team members: Miguel Duran, Nicolas Gonzalez, Ben Mathia, Adan Valdes
- Advisers: Dr. Martinus Sarigul-Klijn, Dr. Nesrin Sarigul-Klijn

The Ocean Current Energy Concentrator, or OCEC, is a novel power generation method designed to produce consistent, affordable and clean power from weak, but steady ocean currents. For example, the Florida Straits current flows above 1 m/s for 85% of the time, carrying the same energy density as a 21 mph atmospheric wind. These ocean currents are currently an under-utilized and potentially valuable energy source to meet growing demand and reduce dependence on fossil fuels. The proposed concept is a Keel ship design with an attached turbine to generate power. The concept works by increasing the effective sweep area seen by the turbine, proportionally increasing the power that could otherwise be obtained. The project objective is to create a functional prototype as a proof-of-concept of the technology. The designed prototype features a boat hull with an attached hydrofoil. The hydrofoil, referred to as the keel, provides lift to increase the ship’s speed relative to the water current. This allows the ship to tack back and forth, sweeping out a relatively large area. The prototype was designed for manufacturability and affordability, allowing for easy transportation, handling and testing.

**TEAM #104: AEROBRICK 2015 SAE AERO DESIGN WEST COMPETITION**

- Department: Mechanical & Aerospace Engineering
- Team members: Maxwell Drolet, Thomas Graham, Jerry Li, Catherine Mamon, Alexander Peimann, Alejandro Pensado
- Adviser: Dr. Nesrin Sarigul-Klijn

Aerobrick is an undergraduate student project team that designs, manufactures, and flies a radio-controlled airplane. The team participates as part of the Regular Class in the annual Society of Automotive Engineers (SAE) Aero Design Competition. The objective of the regular class is to lift the most payload possible given several design constraints placed on overall dimensions, usable materials, and electronic components. Aerobrick represents a tremendous learning opportunity for students.

**TEAM #105: PURSENSE (PRESSURE ULCER RELIEF)**

- Department: Biomedical Engineering
- Team members: Mutaal Akhter, Aaron Avazian, Jenn Cao, Kayla Perigen
- Adviser: Dr. Anthony Passerini

Our design team is proposing an air-cell incorporating wheelchair seat cushion, featuring an interface sensing mechanism to provide automated repositioning for pressure relief. The front of the cushion is composed of a static, high-density foam to support the patient’s legs, which are subject to lower, negligible interface pressures. The back of the cushion utilizes a dynamic air-cell system, in order to target high pressure areas that are more susceptible to pressure ulcer development. This overall cushion system allows for targeted pressure redistribution, while still providing the necessary support to maximize patient comfort. Each air-cell features an Interlink Electronics force sensor to track interface pressure between the patient and the seat cushion. Utilizing a microcontroller, high pressure readings can control the corresponding solenoid valves to deflate the associated air cell, promoting pressure relief from high pressure ulcer risk areas.
TEAM #106: FAST PEEL (FRACTIONATED ADHESIVE STRIP TREATMENT PEEL)

- Department: Biomedical Engineering
- Team members: Maya Estrada, James Nguyen, Nicole Teale, Bryan Zee
- Adviser: Dr. Anthony Passerini

Presently, there does not exist an effective skin resurfacing technique that has both a quick recovery time and is cost effective. Our objective is to develop a fractionated chemical peel that combines both the cost effectiveness of the chemical peel and a short recovery time of the fractionated laser resurfacing treatment. Our team has created a pattern-embedded facial strip made out of a solid phenol-resistant polymer designed to block the phenol acid from reaching untreated, predesignated areas of the skin. When placed on skin before a chemical peel, our product will allow for a similar polka dotted pattern to the one that arises when a fractional laser is used. By blocking portions of the skin from being treated, the treated areas of the skin will be able to regenerate from the healthy areas of skin untouched by the chemical yielding a quicker recovery time than that of current full facial chemical peels. To hold the material onto the skin, a silicone based adhesive, a compound particularly gentle to the skin, will be used. Once the material is placed on the treatment area, a phenol chemical is applied over the strip in the same manner as the full facial chemical peel. After the designated amount of time on the skin, the phenol will be neutralized and the strip will be removed from the skin.

TEAM #107: MOBILE INJURY RELIEF

- Department: Biomedical Engineering
- Team members: Adam Kohut, Mary Love, Zac Rossen, Armeen Etemad
- Adviser: Dr. Anthony Passerini

Sideline thermotherapy for athletes. Providing mobile injury relief for athletes of all types.

TEAM #108: PRE-ANALYTICAL BLOOD SEPARATION DEVICE

- Department: Biomedical Engineering
- Team members: E. Aaron Cohen, David Gomez, Rohan Marathe
- Adviser: Dr. Anthony Passerini

The aim of our project is to create a portable, real time, blood separation device for phlebotomists outside the laboratory setting. The device will separate whole blood into plasma, which can then be used by medical professionals to analyze relevant assays. The device will replace the vacutainer and the centrifuge by performing both of their functions in a fraction of the time.

TEAM #109: THE HEMIRIDE WHEELCHAIR

- Department: Biomedical Engineering
- Team members: Marcel Bernucci, Phuong Dang, Dat Ho, Christopher Zikry
- Adviser: Dr. Anthony Passerini

Patients affected by hemiplegia, a disability characterized by the complete paralysis of either side of the body’s sagittal (vertical) plane, are reduced to wheelchairs as the only form of self-transportation. With the inability to control one of their arms, hemiplegic patients cannot operate standard manual wheelchairs, leaving electric wheelchairs as the only alternative to hemiplegic transport. Consequently, electric wheelchairs have several drawbacks, including low portability, high cost, battery recharging, and oftentimes, an inactive lifestyle for the user. The HemiRide aims to provide hemiplegic patients a manual wheelchair designed specifically for them. Incorporating a lever arm propulsion system known as the Wijit®, the HemiRide allows a hemiplegic patient to drive with one functioning hand and foot. The combination of the Wijit® and a drag-link mechanism enables the user to steer by swiveling their foot while propelling themselves using the lever arm, supplying a simple solution for hemiplegic transport. The HemiRide offers the hemiplegic patient a superior alternative to electric wheelchairs by fostering neuromuscular rehabilitation, while remaining safe, fun, and easy to use.
TEAM #111: PREVENTION OF ICE FORMATION ON DIRECT VENT SYSTEM IN COLD TEMPERATURE ENVIRONMENTS

- Department: Mechanical & Aerospace Engineering
- Team members: Hae Chun, Anna Jung, Bradley Notestine, Matthew Wong
- Advisers: Mr. Ryan Devine (M&G DuraVent, Inc.), Dr. M. Sarigul-Klijn

Our team’s project objective is to provide M&G DuraVent, Inc. with a design or method which would prevent ice from forming on a horizontal direct vent terminal. High efficiency combustion appliances extract a significant amount of heat resulting in a low temperature exhaust. In extremely cold climates, water vapor from this exhaust can freeze on vent terminals. For a direct vent system, both the air intake and exhaust are located on a combined vent terminal, allowing the ice forming on the exhaust to accumulate at the air intake. This blockage can shut off the appliance without any means of turning it back on until the ice is removed. The exhaust plume exiting the vent can also hit adjacent buildings or structures, causing ice to build up on these structures. To combat these problems, our team has redesigned DuraVent’s existing horizontal concentric vent terminal by integrating an expanding cross-section exhaust vent. The expanding cross-section slows the exhaust plume and limits the ice formation on adjacent structures. The slope of the vent facilitates any water collected on the vent to slide off due to gravity before it forms ice. A hydrophobic coating is also applied to the inside of this vent to further prevent the accumulation of moisture. This new vent is designed to integrate with DuraVent’s existing products allowing it to easily transition into a final marketable product.

TEAM #112: PEDIATRIC THERAPY AMBULATORY DEVICE

- Department: Biomedical Engineering
- Team members: Samantha Arellano, Jonathan Chen, Emma Meng, Hongzhu Yan
- Adviser: Dr. Anthony Passerini

Children should be able to receive proper treatment in the comfort of their own home. When they encounter homes that do not have stairs, therapists are forced to take their own set of stairs for treatment. Our mission is to enable these therapists to provide these children with proper care by making a set of stairs that is more convenient for them to transport from their workplace to these children’s homes. These stairs should be safe for the children and lightweight to ease transportation.

TEAM #113: DEVELOPMENT OF A COST EFFECTIVE DYNAMOMETER FOR HIGH SPEED MACHINE TOOL SPINDLES AND POWER TOOLS

- Department: Mechanical & Aerospace Engineering
- Team members: Jun Chen, Isaac Hong, Chris Ng, Qi Ruan, Jimmy Tran
- Advisers: Dr. Stephen K. Robinson, Dr. Cristina Davis, Dr. Barbara S. Linke, Michael Schirle

Manufacturing processes on an increasing small scale necessitates high speed rotary tools operating in excess of 100,000 rpm. The operational profile of these tools must be clearly defined in the form of a torque-speed-power graph. The overarching goal of this project is to develop a cost-effective dynamometer to characterize torque, speed and power generated by a high speed spindle, specifically the GTV 1000 air turbine. Typical conditions dictate that the dynamometer will have to operate at 100,000 rpm, 40 mN*m of torque and 100 W of power generated. The specified goals are accomplished through three phases. The first is the design and execution of an experiment estimating the torque generated by accelerating a flywheel to steady velocity. This necessitates the design of a testing chamber that can accommodate the required equipment as well as safely contain shrapnel should the flywheel fractures or slips out of the spindle. Additionally, a modular design priority allows for a wider range of experiments to be conducted on the same platform. Finally, an alternative method of defining the torque speed curve was developed. By coupling the rotary tool to a high efficiency DC motor as a generator, the resultant electrical output can be examined at to generate the torque-speed curve while the spindle operates at a constant angular velocity. To verify our results, the first test examined will be done comparing the experimental results to the provided manufacturing data sheet.

TEAM #114: STATISTICAL DESIGN ANALYSIS FOR SELF-DEFENSE BEAN BAG DEVICE

- Department: Mechanical & Aerospace Engineering
- Team members: Eric Cibit, Timothy Geiger, Edward Rozhko, Andre Vovchuk
- Advisers: Dr. Marti Sarigul-Klijn, Burton Dillon Sr., Burton Dillon Jr., Terry MacAdam

The ARMA 100, designed by ARMA USA, is a self-defense device that serves as a less lethal option for personal self-defense situations. The weapon system is designed to launch a 37mm bean bag round at very high speeds, which allows the user to keep a safe distance from the attacker while still being effective. Our team was asked to perform additional testing to determine the lethal capabilities of the device with realistic considerations. Therefore, we developed a series of tests that successfully measured the output velocity of the ARMA 100. The device’s output specifications were a function of multiple variables which we precisely quantified and recorded through experimental procedures. A statistical technique known as Yates analysis was used to derive the
relationship between the various ARMA 100 inputs (i.e. bean bag weight, gas cylinder pressure, and target distance) and the output (impact energy). The results were compared with existing research on human blunt trauma. Finally, the blunt criterion approach was used in assessing the potential injury on the human body, and injury risks were attributed to the different target distances.

**TEAM #115: NATCAR-AUTONOMOUS VEHICLE SENIOR DESIGN PROJECT**

- Department: Electrical & Computer Engineering
- Team members: Pachia Cha, Jeanne Eberhard, Michael Grimes
- Adviser: Lance Halsted

We created a miniature self-driving car by using a small microcontroller board to interface to a servo motor, DC drive motors and optical sensing linescan cameras. We designed, built and tested speed control circuits, track sensing circuits and a steering control loop. We also controlled the motors using a custom circuit.

**TEAM #116: TURBOJET THRUST MEASUREMENT AND DATA ACQUISITION SYSTEM**

- Department: Mechanical & Aerospace Engineering
- Team members: James Sitzmann, Jonny Weeks, Jiawei Zhao
- Advisers: Rob Kamisky, Dr. Paul Erikson, Dr. Cristina Davis, Dr. Stephen Robinson

The Department of Mechanical Engineering at UC Davis has a Gas Turbine Engine that needed a new mechanical thrust measurement and data acquisition system. The purpose of creating a mechanical thrust measurement system is to allow students in the EME107A class to compare the theoretical thrust measurements calculated in their lab write-ups to a physically measured one. The Gas Turbine Control Panel was outdated and needed a new data acquisition program that could interface with the sensors that measure temperature, RPM, oil pressure, and air pressure. With this new system, students will be able to acquire all the measurements through a USB drive. Additionally, the turbojet mounting structure was updated to a new steel frame design with greater structural integrity, allowing for increased safety and measurement accuracy.

**TEAM #117: UNDERWATER TREADMILL FOR PEDIATRIC THERAPY**

- Department: Mechanical & Aerospace Engineering
- Team members: Bernardo Alfaro, Myron Lam, Julie Lin, Cuong Ly
- Advisers: Alejandra Hartle, Dr. Martinus Sarigul-Klijn

Easter Seals is a nonprofit organization that focuses on helping those with autism and other disabilities, and they have given us the task to design and build an underwater treadmill for young children with motor disabilities. This treadmill is intended to be used in a 98°F warm water therapy pool at the Easter Seals’ Sacramento center, so that therapists can train children to walk with the buoyancy of the water reducing the stress on the child’s legs. The intended user is a 1-3 year old child. The design of this underwater treadmill is similar to that of a land-based treadmill. The battery powered electric motor is above water and is enclosed in a splash proof shielding, providing 100 W for the treadmill’s designed capacity of 50 lbs. The dimensions of our treadmill are 3 ft x 2 ft x 4.67 ft with a total weight of 70 lb. Therapists can control the speed of the treadmill belt from 0.1 to 1.0 mph as well as track the distance and time traveled. Our design constraints required materials that could withstand chlorinated water, so the frame of the treadmill is made of steel angles and reinforced with polycarbonate twinwall sheets. This project was partially funded by UC Davis Clinical and Translational Sciences Center (CTSC), School of Medicine and MUSUMI USA. We hope that with this underwater treadmill, Easter Seals will have a long-lasting solution for continuing their mission of promoting the development of motor skills in children.

**TEAM #118: APP FOR DETECTING AND RESOLVING VIBRATION PROBLEMS DURING CNC MACHINING**

- Department: Mechanical & Aerospace Engineering
- Team members: David Carter, Marti Sarigul-Klijn, Stephanie Shijo, Marlin Wijekoon
- Advisers: Dr. Cristina Davis, Dr. Stephen K. Robinson, Dr. Masakazu Soshi

Chatter is unwanted vibration that occurs during machining processes, and is experienced when cutting forces interact with the workpiece in a way that produces a poor surface finish, increased tool wear, and excessive noise. In order to avoid these unwanted vibrations, traditional machinists tend to reduce cutting speeds and/or depths of cut, which decreases productivity; it is a well-known fact that increasing cutting speed with proper knowledge of machining dynamics can also solve vibration problems. The objective of this project was to build an application that would determine and suggest optimal cutting conditions for chatter-free machining. The application collects and analyzes machining acoustic data recorded by the user, and if chatter is detected, suggests optimum cutting conditions for chatter-free machining. In addition to detecting chatter, the application displays the sound data in the frequency domain and has an intuitive graphical user interface.
TEAM #119: “SOLARRI” UC DAVIS SOLAR CAR SUSPENSION SYSTEM

- Department: Mechanical & Aerospace Engineering
- Team members: Farhad Ghadamli, Josue Melendez, Vivian Phan, David Zurita
- Advisers: Dr. Kim Parnell, Dr. Jim Schaaf, Mr. Charles Rodgers, Dr. M Sarigul-Klijn, Dr. Paul Erickson, Dr. Valeria La Saponara

A goal of the solar powered vehicle team at UC Davis was to design and fabricate a functioning suspension system that can support the weight of the vehicle and withstand road forces in order to compete in the American Solar Challenge in 2016. A well designed suspension offers the vehicle a strong grip to the road while minimizing road noise, bumps, and vibrations. The team researched the different types of systems, determined the one that best meets the requirements, analyzed the loads that the components should withstand, and designed a unique system for the project. The team determined that the parallel short long arm (SLA) double wishbone met the requirements of the solar racecar. The dimensions for the coilover, upright, lower arm, and upper arm of the suspension were calculated to meet vehicle constraints and competition regulations. Besides the coilover, these components were fabricated by the team. The suspension team used CAD software (SolidWorks) to generate a full model that includes all the parts ready to be manufactured or purchased. Static and dynamic testing and analysis were performed to demonstrate that the system meets requirements and to prove that the design can tolerate all the loads applied to it. By completing the design of the suspension system as well as the chassis, the Solarri team has a basis to work with for the rest of the vehicle.

TEAM #120: PEDIATRIC VENTILATION MANAGER

- Department: Biomedical Engineering
- Team members: Sevak Estepanian, Justin Koos, Masatoshi Minakuchi, George O'mictin, Josue Ortega
- Adviser: Dr. Anthony Passerini

Our device will guide the users in administering proper ventilation rates to patients of all sizes, while at the same time monitoring certain vitals such as respiration rate and tidal volume. Our objectives are prioritized in the following order: First, the device will be able to monitor ventilation rate in a bag-valve mask (BVM). Second, the device will have an alarm system that is triggered when users are hyperventilating or hypoventilating the patient. Third, the device will have adjustable settings for pediatric patients of varying sizes. Finally, the device will monitor respiratory tidal volume (volume of air displaced from the patient between inhalation and exhalation) and incorporate this into the alarm system so when respiratory tidal volume that’s measured is abnormal, the device triggers the alarm.

TEAM #121: TRANS-ESOPHAGEAL ECG MONITORING

- Department: Biomedical Engineering
- Team members: Valerie Huette, Kadi Hui, Derrick Renner, Sabah Rezvani, Kevin Wong
- Adviser: Dr. Anthony Passerini

The design team’s proposed solution utilizes a co-linear electrode placement on a Corflo® feeding tube. Three ring electrodes (90% platinum, 10% iridium) will be utilized in the design to collect the electrical impulses of the heart and propagate the signal to the Arduino device. The device will be coated with a biocompatible material, polydimethylsiloxane (PDMS). The Arduino device will be coupled with an ECG circuit to analyze the signal received. The circuit will consist of three operational amplifiers, one to amplify the circuit and the others in order to filter out the unwanted signal. The output of the circuit will be displayed on a miniature oscilloscope as a traditional ECG signal and provide a simple avenue for the surgeons to analyze the heart activity.

TEAM #122: DYNAMIC AUTOSAMPLER

- Department: Mechanical & Aerospace Engineering
- Team members: Adrianna Amsden, Alison Ang, Stephen Hayes, Dagan Trnka
- Advisers: Crocker Nuclear Lab, Dr. Cristina Davis, Dr. Stephen Robinson

The Air Quality Group of Crocker Nuclear Lab (CNL) monitors the air quality of 170 sites around the world. Samples are created by passing air through a thin layer of Teflon, which gathers particulate matter over time. Each site produces 21 samples a year, which are brought back to CNL and run through a variety of tests, one of which is the Hybrid Integrating Plate/Sphere (HIPS) system. The HIPS system directs a beam of 633 nm at the samples and measures the amount of light transmitted and reflected by the sample. A new system is being developed, the Broadband Integrating Transmittance/Reflectance Spectrometer (BITS), that will be capable of running the experiment with a broadband light source (190 to 1700 nm). With this broader spectrum, the BITS system can obtain much more information about each sample. The BITS requires a new system, the Dynamic Autosampler, to hold and move the samples through the experimental axis (Z axis). This system has motion control in the X and Y directions and is controlled by the user with a LabVIEW Graphical User Interface. A tray subsystem holds a set of 21 samples as they are tested by the BITS. The Dynamic Autosampler is also able to automatically load and unload trays from the motion control subsystem, which allows a stack of 126 trays to be loaded and automatically passed through the system. By increasing the rate at which samples can be run through the BITS experiment, the Dynamic Autosampler be a significant improvement to Crocker Nuclear Lab’s process flow.
TEAM #123: ELECTRONIC GONIOMETER

- Department: Biomedical Engineering
- Team members: Carlos Gutierrez, Riley Knox, Hanh Le, Ellie Yeung
- Adviser: Dr. Anthony Passerini

Our project is an electronic goniometer designed to be used on dogs with stifle injuries. When a dog sustains an injury to the stifle, or knee, its range of motion can become limited. Through rehabilitation this range can be brought back to normal, but through this process veterinarians must measure the joint angles to make sure that the current treatment is benefiting the patient. Traditionally, these measurements are done using plastic goniometers which require laying the dog on its side, and manually bending and extending its leg. Even though simple, this technique can be very subjective and may also give inaccurate results because of the dog’s inability to communicate about any discomfort it may be experiencing. With our device, which consists of two rotating arms with a potentiometer at the center of rotation, our team seeks to remedy some of these issues. The device can be strapped on to a dog’s leg, and as the dog is walked by its owner, data in the form of voltages is collected and saved onto an SD card. The SD card can then be inserted into an SD card reader, and using a program written by our team, the voltages are converted into joint angles. By using our device, veterinarians will be able to collect data about the dog natural range of motion, and the collection process can become a more pleasant experience for the patient.

TEAM #124: INNOVATIVE DESIGN OF THE NISHI PROJECT

- Department: Civil & Environmental Engineering
- Team members: Salman Azam, Chirag Patel, Naranjan Purewal, Harsev Singh
- Adviser: Dr. Deb Niemeier

Our team of graduating civil engineers has designed a development plan for the Nishi property. We have considered alternatives for all aspects of the design, and through the design process we have made tough, critical decisions as to which are the best alternatives to implement. The final design has been reached by incorporating interests of all entities that are to be affected by the development of this site. The fundamental goals of our projects include: reduce greenhouse gas emissions, increase quality of life, water conservation, and connectivity.

TEAM #125: CREATING NISHI GATEWAY: THE WINDOW INTO DAVIS, CALIFORNIA

- Department: Civil & Environmental Engineering
- Team members: Carl Gutekunst, Harrison Kwan, Victoria Liang, Sophie Nguyen
- Adviser: Dr. Deb Niemeier

The Nishi Gateway is the upcoming bustling community hub for future Davis residents. The fusion of renewable energies, alternative transportation modes, and captivating spaces come together in a new destination, home, and shared living room. With an emphasis on minimizing our carbon footprint, our approach pursues higher standards for conscious living while coexisting with the surrounding world. Nestled between Downtown Davis and the university campus, Nishi builds upon the identity of this city while responding to the changing contexts of this evolving community. We have developed a community that represents life transformed.

TEAM #126: NISHI GATEWAY DESIGN PROJECT

- Department: Civil & Environmental Engineering
- Team members: Chase Havemann, Aaron Tsang, Jeff Williams, Tom Yao
- Adviser: Dr. Deb Niemeier

The Nishi site adjacent to UC Davis Campus and the Arboretum has been an undeveloped area with no particular use in past years. The property’s proximity to downtown Davis, UC Davis Campus, and the Interstate 80 make it an ideal location to add new student and family housing and provide space for furthering research, while being a sustainable development. Our design for this site aims to meet the needs and desires of the City of Davis, UC Davis, and various other stakeholders.

TEAM #127: NISHI PROPERTY GATEWAY DEVELOPMENT

- Department: Civil & Environmental Engineering
- Team members: Nathaniel Bautista, Juan Mares Ayala, Christopher Quevedo, Mariza Sibal
- Adviser: Dr. Deb Niemeier

The overall design goal of the Nishi Property development project accomplishes academic, residential, and sustainable needs through the development of a mixed-use innovation district. The project seeks to accommodate high-density housing primarily. In addition, commercial and research facilities will be developed, which will provide additional employment opportunities to Davis residents and be a center for innovation. The Nishi community hopes to enrich and nourish community life through easy and safe accessibility to work and school, increasing student activity, life, and experiences, providing sustainability, and promoting innovation. These infrastructures will be integrated by a sustainable roadway network that combats traffic congestion by reducing transportation via automobiles, providing alternate access to the university and downtown, and advocating for transportation via biking, public transportation, and walking. Ultimately, this sustainable roadway network strives to facilitate safe and environmentally attractive connections to Downtown Davis and the University of California, Davis by improving access from Interstate 80. Furthermore, the project aspires to have annual maximum greenhouse gas emissions of .7MT (metric tons) for both residential and transportation energy through the encouragement of green modes of transportation and the incorporation of energy-efficient infrastructures. The overall
design will serve as an innovative, environmentally friendly mixed-use center that will contribute to the sustainable, livable character of the Davis community.

TEAM #128: NISHI SITE
- Department: Civil & Environmental Engineering
- Team members: Kelsey Ballesteros, Sam Follett, Sharon Ly, Mariza Mananquil
- Adviser: Dr. Deb Niemeier

The proposed Nishi site will have residential apartments, condos, and commercial facilities built. The housing will be geared more towards students while the commercial facilities will be geared toward research and development. There will also be a very small portion of retail space. This project addresses design issues that are present with the site, including environmental impact, site connections, drainage, etc.

TEAM #129: THE NISHI PROPERTY DEVELOPMENT
- Department: Civil & Environmental Engineering
- Team members: Ming Tak Ching, Rhafael Herrera, Gordon Tat, Emily Wolff
- Adviser: Dr. Deb Niemeier

The Nishi Property represents one of the largest developable parcels in Davis, approximately 45 acres, with downtown Davis to the north and the University of California, Davis (UC Davis) to the northwest. It is located in a particularly interesting and problematic area because it is situated between a Union Pacific railroad line and major highway I-80. While the property is within close proximity to downtown and campus, the access roads from the property to either locations are congested and limited. The development of the Nishi Property encompasses the objectives of community members, UC Davis, the City of Davis, and those concerned with the environment. The main focus of the design is to utilize open space with high density housing, connect to adjacent areas, and improve the overall circulation of traffic. Connection to the UC Davis campus and downtown Davis is critical to increase mobility. The space is designed for bike and pedestrian traffic throughout the community and to adjacent areas. With the goal of having the lowest emissions possible, the layout of these structures in the Nishi Property helps to decrease the need for vehicle use. In addition, there are solar panels on apartment roofs and parking structures to achieve net zero energy. Mixed land use is utilized to create a diverse community, including student and family housing, research and development space, office buildings, and retail businesses.

TEAM #130: NISHI PROJECT
- Department: Civil & Environmental Engineering
- Team members: Sophia Huynh, Michelle Lee, Erika Pantoja, Amanda Zucker
- Adviser: Dr. Deb Niemeier

The Nishi Gateway Project addresses a 57.7-acre site located northeast of the University of California, Davis campus and southeast of Downtown Davis. In the past, the site was designated for agriculture, but it is currently under consideration for a mixed-use development. Since the City of Davis has little undeveloped land, this project presents a rare opportunity to develop a sustainable mixed-use community that is located in close proximity to both campus and Downtown Davis. However, rising transportation and emission concerns still remain. Our team offers an alternative to achieve zero net energy, safe and efficient connectivity, affordable housing, and a sense of community, which are essential characteristics to establishing efficient transportation and reducing emission concerns. Along with these fundamental objectives, our overall goal is to create a development plan to limit the greenhouse gas emission from residential energy plus transportation energy to 0.7 MT.

TEAM #131: SUSTAINABLE NISHI GATEWAY
- Department: Civil & Environmental Engineering
- Team members: Mark Bretz, Tony Chan, Vincent Hua, Jinhao Mai
- Adviser: Dr. Deb Niemeier

A proposed design alternative for a sustainable land-use of the Nishi Property. This design has a main focus on residential housing, business, connectivity, and the environment.

TEAM #132: NISHI PROPERTY PROPOSAL
- Department: Civil & Environmental Engineering
- Team members: Colin Braun, Kevin Dumler, Natalie Mall, Erik Maroney
- Adviser: Dr. Deb Niemeier

The Nishi property is a controversial proposed development near downtown Davis. We incorporated smart growth principles to limit greenhouse gas emissions and produce a sustainable design that best meets the needs of the surrounding community.

TEAM #133: NISHI GATEWAY PROJECT
- Department: Civil & Environmental Engineering
- Team members: Tyler Clark, Cyrus Ghandi, Estephany Monroy, Alan Sau
- Adviser: Dr. Deb Niemeier

Design of the Nishi Gateway project that neighbors University of California, Davis.
TEAM #134: NISHI GATEWAY PROJECT

- Department: Civil & Environmental Engineering
- Team members: Ryan May, Seong Heon Kim, Benny Ng, Andy Zhou
- Adviser: Dr. Deb Niemeier

The Nishi Gateway Project was undertaken by our team due to the ideal real estate located east of the University of California, Davis. The land is currently unutilized and has the potential to be an ecologically viable and economically attractive zone for residential housing, recreational use, commercial use, and conceivable energy generation. Because of the increasing demand for housing in Davis, shaped by the large influx of students to the University, the use of the Nishi property to satisfy this demand is being examined and analyzed by the City of Davis. Subsequently, our team has undertaken this project with the goal of having zero-emissions and zero-net energy use concerning the property, thus making the Nishi property fundamentally self-sufficient. The Nishi property is an ideal candidate to achieve the City’s demand for sustainable housing because of its ideal location. The property is located between Interstate 80 and the Union Pacific Railroad tracks. However, this prime location is close to the UC Davis campus and Downtown Davis making it an ideal housing opportunity for a diverse population with the intention of creating a robust mixed-used community. The Nishi Project developed by our team will also help promote healthier business in the downtown area due to its proximity to the aforementioned location. Finally, the project will accommodate sites for research development and innovation center with the intent of being owned both privately and by the University.

TEAM #135: NISHI GATEWAY DESIGN

- Department: Civil & Environmental Engineering
- Team members: Craig Lanza, Kaitlyn Thatcher, Eric Watson, Ruby Yu
- Adviser: Dr. Deb Niemeier

The purpose of this report is to present the recommendations for the proposed development plan known as the Nishi Gateway. Our team provides recommendations for the 45 acre parcel of land known as the Nishi Property, located in Yolo County, as well as the 11 acre parcel of land located adjacent to the Nishi site along West Olive Drive. These recommendations provide solutions to issues raised by various stakeholders throughout the planning stages of the proposed project. The proposed mixed use development includes medium to high density residential units, research and development space, and some limited retail space. This proposed community aims to be as sustainable and environmentally friendly as possible by limiting annual greenhouse gas emissions to 0.7 MT (metric tons). The design seeks to accomplish this goal through the use of onsite energy production and promoting the use of multiple, sustainable modes of transportation. In addition to improving sustainability, the development will enrich community life by creating more green space for recreational activities, increasing the current vacancy rate in Davis, and generating more revenue for the downtown area.

TEAM #136: THE NISHI PROJECT: SUSTAINABLE LAND USE DESIGN OF THE DAVIS NISHI PROPERTY

- Department: Civil & Environmental Engineering
- Team members: Jiaxing Gu, Jiaqi Huang, Dalia Mulato, Connie Lee
- Adviser: Dr. Deb Niemeier

The Nishi Project involves the development of the Nishi Property, a strip of land located south of the UC Davis campus. The City Council wishes to develop this land into a mixed-use innovation district that will benefit the UC Davis academic core, generate support for local businesses, and enrich community life of residents in that area, all while maintaining a low environmental impact framework. Our goal for this project was to generate around 0.7 metric tons of greenhouse gases, including residential and transportation energy. Our design addresses several issues, because this project will affect several stakeholders. Connectivity between the property and surrounding areas is important, so our development plan includes space for high-density housing units which is affordable, safe, and conveniently located when traveling to campus or downtown. Our plan also addresses the issue of traffic flow and greenhouse emissions when passing through this area. Aesthetics were essential to the design, so we included green spaces in our design to improve this aspect as well as the sense of community. Despite the several challenges and obstacles faced while working on this project, we were able to produce a design which aims to improve the economic, social, and environmental aspects of this property and surrounding Davis communities.

TEAM #137: NISHI DEVELOPMENT PROJECT

- Department: Civil & Environmental Engineering
- Team members: Roger Tsung, Colleen Woolcott, Di Wu, Lillian Xie
- Adviser: Dr. Deb Niemeier

The goal of the Nishi Project is to design a sustainable and affordable mixed-use development plan that emits no more than 0.7 metric tons of greenhouse gases annually. This design takes into account specific goals mentioned by stakeholders from the surrounding community.

TEAM #138: NISHI PROJECT DEVELOPMENT PLAN

- Department: Civil & Environmental Engineering
- Team members: Pierre Hery, Shawn Katebian, Trevor Riel, Greg Rugh
- Adviser: Dr. Deb Niemeier

An alternative production to the existing Nishi design. Affected stakeholder fundamental values are the design drivers for our integrative approach. The ingenious nature of
the design elements captures Davis’ penchant for sustainable innovation. Our goal is to reduce greenhouse gas emissions associated with the Nishi project by focusing on limiting VMTs and implementing energy efficient technologies.

**TEAM #139: NISHI TRANSPORTATION AND LAND USE DEVELOPMENT**
- Department: Civil & Environmental Engineering
- Team members: Stephanie Caudle, Zaurbek Dzardanov, James Hill, Samin Khan
- Adviser: Dr. Deb Niemeier

The Nishi Gateway project is being undertaken in order to create a sustainable design that will provide more housing, commercial, and research facilities in the City of Davis. In order to reduce environmental impacts, green technology will be utilized. Ideas from the city and community were the drivers of design when developing this property. The main goal of the project is to increase residential and commercial spaces in Davis without having an impact on traffic congestion and additional Green House Gas emissions.

**TEAM #140: NISHI PROPERTY DEVELOPMENT**
- Department: Civil & Environmental Engineering
- Team members: Yea Na Kim, Ricardo Rodriguez, Mayra Velazquez, Kenneth Weng
- Adviser: Dr. Deb Niemeier

The Nishi Property Development is a collaborative effort by the City of Davis, UC Davis, and the landowners to create a sustainable mixed use district that provides high-density urban housing that connects with the UC Davis campus and Downtown Davis.

**TEAM #141: DAVIS GREEN GATEWAY**
- Department: Civil & Environmental Engineering
- Team members: Dina Estipona, Zaid Hadid, Mark Miller, Michael Yoder
- Adviser: Dr. Deb Niemeier

The Davis Green Gateway is a concept design for the development of the Nishi Property, a narrow parcel of land north of Interstate-80 and southeast of campus, into housing units and business space. This model’s most prominent design goals are to maximize on-site energy generation and to create a community where students and Davis residents can interact together in a sustainable and secure environment.

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**UC Davis College of Engineering: Increasingly Selective**

- **First-Year Applications Received**
- **% of First-Year Applications Granted Admission**

![Graph showing the increase in selectivity from 2006 to 2014](image)

*Source: UC Davis Undergraduate Admissions, D. Owfook, Fall Quarter 2013*
# UC Davis College of Engineering

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- #18 Best Public Graduate Program (US News, 2016)
- #17 Best Public Undergraduate Program (US News, 2017)