ENGINEERING DESIGN SHOWCASE 2017

JUNE 8, 2017
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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!

A SPECIAL THANK YOU

Thank you for attending the 2017 Engineering Design Showcase at UC Davis. I want to especially thank the judges who have taken time to be here today to evaluate our students’ projects and help celebrate our students’ achievements. 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 you have joined us today.

Sincerely,

Jim Schaaf
Associate Dean, Undergraduate Studies
TEAM #1: CRUTCH FORCE SENSOR
- Department: Biomedical Engineering
- Team members: Emmanuel Agu, Zachary Frankman, Joseph Lacommare, Tuan Pham, Nicholas Swanson
- Adviser: Dr. Anthony Passerini

A device that is able to detect the weight being loaded and the position of forearm crutches. This will be used to improve patient tailored stroke patient rehabilitation.

TEAM #2: HARDWARE-IN-THE-LOOP DRIVING SIMULATOR FOR STEERING CONTROL DEVELOPMENT
- Department: Mechanical & Aerospace Engineering
- Team members: Nicholas Choi, Yang Gao, Junfan Lin, Eric Po, Anthony Thai
- Adviser: Dr. Steve Velinsky

A hardware-in-the-loop (HIL) simulator was built to research automotive steering feedback and control development. The testbed built for simulation was modeled after a Hyundai Sonata to simulate realistic driving environments. This project continues on previous year’s senior design work, where they fabricated a testbed frame. Further construction of the testbed includes integrating a driver seat, steering wheel, lower column, rack, pinion, springs, linear actuator, and voice coil actuator. The linear actuator will be used to inject large amplitude forces at low frequencies, resembling inputs from the roadway. A voice coil actuator provides small amplitude forces at high frequencies, to propagate road unevenness. These actuators combine to represent the rack force, which translates to feedback at the steering handwheel. A simulated driver model was also developed using steering wheel torque and road profile as inputs to study how a driver responds in on-center driving. A simulated driver model was also developed using steering wheel torque and road profile as inputs to study how a driver responds in on-center driving. A simulated driver model was also developed using steering wheel torque and road profile as inputs to study how a driver responds in on-center driving. A simulated driver model was also developed using steering wheel torque and road profile as inputs to study how a driver responds in on-center driving.

TEAM #3: 3-2-1 TWIST OFF!
- Department: Mechanical & Aerospace Engineering
- Team members: Chad Hoffdahl, Kevin Letterman, Kusha Miraftab, Garrett Sutherland
- Adviser: Dr. Jason Moore

Plastic drinking bottles are often made from two types of polymer (PET for the body and polypropylene for the caps). Utilizing two materials (as opposed to one) allows bottle distributors to make more robust containers, which exhibit desired characteristics of both materials; a proverbial “best of both worlds.” But this technique comes at the cost of an additional step in the recycling process: material separation. Caps must be removed from bodies of bottles to preserve the material integrity of each plastic. Most U.S. recycling centers employ workers to remove caps from bottles by hand. 3-2-1 Twist Off! is an attempt at automating this process. Utilizing a single motor and a system of “guide rails,” our design proposes a simple machine to orient, separate, and filter plastic bottles on the street, i.e. before reaching the recycling center. The team members would like to acknowledge and thank their counterparts from Meijo University in Japan for their participation on this project.

TEAM #4: AUTOMATED PAPER AIRPLANE MACHINE
- Department: Mechanical & Aerospace Engineering
- Team members: Jason Tsugawa, Ryan Vernon, Curtis Yau, Ye Yuan
- Adviser: Dr. Jason Moore

The Automated Paper Airplane Machine concept involves using a roll of standard printer paper, cutting the paper to size, implementing a folding process to create the paper airplane, and finally, launching the paper airplane. We are competing against a student team from Japan’s Meijo University based on the same objectives. The winner will be determined based on flight time, plane production rate, and power consumption. The team members would like to acknowledge and thank their counterparts from Meijo University in Japan for their participation on this project.
TEAM #5: TRACKMYPOO.COM
- Department: Computer Science
- Team members: Gianina Borcean, Kevin Low, Qianyi Lu, Felix Ng
- Advisers: Dr. William Wung, Dr. Xin Liu

A website in which patients can enter and track details about their daily bowel movements.

TEAM #6: QUADRIPLEGIC FRIENDLY TRICYCLE (ALS TRIKE)
- Department: Mechanical & Aerospace Engineering
- Team members: Felicia Fashanu, Haowei (Wilson) Li, Jake Parkhurst, Aaron Shaw
- Adviser: Dr. Jason Moore

Amyotrophic lateral sclerosis (ALS) is a disease that gradually disables the motor functions of the body. Our project is to adapt a proof-of-concept joystick-driven tricycle so that it can be used by an individual with late stage ALS who has motor control of muscles above their shoulders. As part of bringing the tricycle to production quality, we are replacing the joystick with a mouth controlled joystick (QuadStick). Improving the reliability and usability of the system will involve implementing secure electronic connections, developing a more user-friendly interface, and increasing the factors of safety in various aspects of the design.

TEAM #7: CAPTURE MY MEETING
- Department: Computer Science
- Team members: Mengyingzi (Kimmy) Dai, Mark Emmanuel Diez, Laura Phippen, Zhening (Sirius) Zhang
- Adviser: Dr. Xin Liu

Capture My Meeting is a web application that captures whiteboard content and share it with other meeting participants remotely in a conference room setting. The solution will use the latest computer vision algorithms to merge multiple presenters’ whiteboard content with the presenters removed, and stream it to other meeting participants through a cloud service. This product allows the users to share their ideas with each other as if they were having a meeting in the same room, sharing the same whiteboard. The project’s clients are Eric Law and Prof. Yong Jae Lee.

TEAM #8: BACKONTRACK: A TIME MANAGEMENT IOS APPLICATION
- Department: Computer Science
- Team members: Arvinder Basi, Milad Ghoreishi, Abdulrahman Sahmoud, Minjie Tan
- Adviser: Dr. Xin Liu

An iOS application developed in order to aid students in improving, correcting, or establishing proper time management habits by providing a sleek, modern alternative to traditional paper planners. It allows students to find and allocate their free times, set and maintain a list of goals, and perform statistical analysis on their study data to properly partition their time in order to maximize efficiency.

TEAM #9: CANTERA FOR WEB
- Department: Computer Science
- Team members: Joseph Castaneda, Jaspal Chauhan, Adan Guanlao, Jordan Ho
- Adviser: Dr. Xin Liu

Cantera is a Python library used to analyze different thermodynamic, chemical kinetic, and transport processes. It is a very useful tool, but it requires knowledge of object oriented programming. It requires the user to write Python scripts that take in different gases and values as input and outputs tables or graphs of data. We developed a web app that allows users to use the Cantera Python library on the web. Our client, Professor Shaw, asked us to develop this app because his mechanical engineering students were having trouble downloading and setting up Cantera on their own. Without prior knowledge, they were having trouble with the Unix commands needed to download the library. This app will allow his students to use the Cantera library without any setup.

TEAM #10: CEREBRAL ORGANOID CULTURE DEVICE
- Department: Biomedical Engineering
- Team members: Makena Ewald, Abraham Gerzeghier, David Greene, Anvita Komarla, Charit Mehta
- Adviser: Dr. Anthony Passerini

Cerebral organoids are “mini-brains” that are aggregates of differentiated human stem cells, essentially a small undeveloped version of a brain. Cerebral organoids can more accurately represent the early development of the human brain better than 2D and animal models, prompting researchers to consider them as a method for therapeutic validation in preclinical drug trials. However,
current in-house methods used to grow 3D organoids do not produce consistent results and take up excess space, interfering with other ongoing experiments. Obtaining consistent organoids requires purchasing them commercially or buying an expensive specialized device, neither of which is cost effective. Our objective is to provide researchers with a standard, compact device capable of supporting organoid growth more cost effectively than current commercial devices and more consistently than current improvised methods. Our device will streamline the process by allowing for easy media exchange, visual access, and experimental versatility through a modular design.

TEAM #11: CORDOVA™
- Department: Biomedical Engineering
- Team members: Trixianne Batoon, Magdalena Chau, Zachary Nelson, Sri Lakshmi Vasamsetti
- Adviser: Dr. Anthony Passerini

CORDOVA™, CORtex Diffusive Oximetry Voxel Analysis. At the onset of an ischemic stroke, 2 million neurons die every minute. IV-tPA can mitigate disease progression, however, the risk of a hemorrhage prevents the use of thrombolytic therapy until a hospital CT scan. CORDOVA™ has been developed to provide Paramedics and Physicians with a handheld rapid diagnostic for treatment of traumatic brain injuries in the field.

TEAM #12: CONGESTIVE HEART FAILURE - DRUG DELIVERY SYSTEM
- Department: Biomedical Engineering
- Team members: Emily Chu, Nathaniel-Georg Gutierrez, Simon Liu, Joseph Shing, Serena Min-Yi Zhen
- Adviser: Dr. Anthony Passerini

Current methods for treating congestive heart failure do not have an avenue for automatically delivering heart failure medication with little to no input or interaction from the patient outside of the hospital setting. In particular, a system for automated heart failure drug delivery based on hemodynamic changes does not exist. Current methods are largely comprised of in-hospital visitations and treatments, causing hospitalization costs due to heart failure to increase every year. The objective of the CHF-DDS is to create a processing block for an automated drug delivery system delivering heart failure medication, in the form of diuretics (Lasix), to heart failure patients. The device will be capable of reading in inputs, such as pulmonary artery pressure and weight, to determine the proper steady-state delivery of the diuretics, specifically if the drug should be increased, decreased, or remain at steady state. This will minimize patient interactions with taking drugs as well as lower hospitalization costs.

TEAM #13: NATCAR
- Department: Electrical & Computer Engineering
- Team members: Luke Alcantara, Shaun Jackson, Jason Woodward
- Adviser: Lance Halsted

Design and construct an autonomous car. Implement track sensing, motor control, and steering control for NATCAR track.

TEAM #14: AUTOMATED HOME BREWING SYSTEM
- Department: Mechanical & Aerospace Engineering
- Team members: Bowen Fredericks, Daniel Kotlyar, Jacob Riggs, Peyton Strait, Ari Wargon
- Adviser: Dr. Steve Velinsky

During the all-grain brewing process, the hot mash must be held at a constant temperature while the malt enzymes are activated, allowing the grain starches to convert into fermentable sugars. Our sponsor is Professor Steven Velinsky, who has extensive experience with the home brewing process. The design involves a propane-fired heat exchanger recirculation mash system (HERMS), consisting of two vessels and controlled by an Arduino R3 microcontroller. When a digital temperature sensor reads a value that is below the mash set point, the controller tells the pumps to turn on. The mash liquid then circulates through a heat exchanger and is deposited back into the mashing vessel. The system features an easy-to-use LCD interface and quick disconnects to allow for faster clean up.

The process was simulated in SolidWorks for heat transfer, temperature distribution, and transient characteristics. The analytical results were reconciled with the measured experimental data taken after the system was assembled and validated.
Humans are marvelous machines. They are able to perform simple tasks, e.g. walking and dancing, almost effortlessly, which haven’t been reproduced by the most advanced robots with far more superior sensors and motors than humans. The goal of this project is two-fold. The first goal is to create a robot that can test the validity of control systems that have been created from data collected by studying humans balancing. The second is to create a robot that can be used with the UC Davis COSMOS high school program to help teach high school students the importance of control systems in an interactive environment. The design of the robot is an inverted double-pendulum that can be actuated at the lower and upper joints independent of each other to act as the ankle and hip muscles. This robot is placed on a cart that can be given a prescribed motion path to perturb the upright double-pendulum. The robot can then react to the perturbations based on the control system that is programmed into the robot.

Index My Meeting is a cloud-based application that takes in whiteboard images captured during group meetings, detects and recognizes the handwritten content within those images, and creates a searchable record of this content. The front-end is a web application consisting of a user interface that allows users to search for specific content within their captured meeting images. The back-end is comprised of an OCR service running on Amazon EC2 that uses state-of-the-art text detection and recognition algorithms based on deep convolutional neural networks to spot handwritten text within images. As soon as the Capture My Meeting application produces a set of images from a meeting and stores them in Amazon S3, an AWS Lambda function automatically requests the corresponding recognized text for those images from the OCR service and sends this recognized content to Amazon Elasticsearch. A Node.js server running on Amazon EC2 queries Elasticsearch to provide users with their search results. Our clients are Professor Yong Jae Lee, a faculty member of the UC Davis Computer Science Department, and Mr. Eric Law, a senior director of project management at Bentley Systems. They proposed this application in order to develop a robust method to easily search through the contents of a meeting without having to endure the tedious task of writing meeting minutes.

Many companies that manufacture products have a need to replenish parts at various assembly stations. Usually, a utility worker picks up the necessary cargo from the warehouse and delivers it to the desired assembly station. There is a need for a low cost, versatile AGV (Automated Guided Vehicle) that will automate this process. This group’s AGV is sponsored by Flexible Assembly Systems, Inc., a company based in San Diego, CA. The project’s objective was to design and prototype a functional AGV that meets loading requirements and conforms to safety standards. Our AGV has three bin terminals, each with a separate conveyor track system that can mate with assembly stations. Each bin terminal holds one bin, and each bin can hold up to 30 lbs. of raw materials. The AGV navigates through the warehouse by following a path of magnetic tape on the floor; it also uses ultrasonic sensors for collision detection. The AGV can be sent to a station by using a local website, which can be accessed from any phone or computer.

Microsurgical reconstruction involves removing tissue from one part of the body and transplanting it to another. In order to successfully accomplish this transfer, the blood supply of the removed tissue must be connected to the blood supply at the recipient site. The most dreaded complication of microsurgery is flap failure or loss, which most often is the consequence of venous
or arterial thrombosis, or formation of a blood clot. If a blood clot is caught early on, the tissue may be saved. We have therefore created a website and iPhone app that allow doctors to remotely monitor the blood flow and temperature of tissue flaps.

TEAM #20: TISSUE FLAP REMOTE MONITORING
- Department: Biomedical Engineering
- Team members: Stephanie Chee, Jeffrey Ma, Michael Nguyen-Truong, Connie Yuan, Annie Zhou
- Adviser: Dr. Anthony Passerini

Current free flap surgery procedures require the patient’s blood flow to be monitored continuously over a period of 5 days using an ultrasound Doppler monitor. This constant monitoring is not only demanding for physicians and nurses, but is also susceptible to human error. There is a need for a device to remotely monitor tissue flaps to allow microsurgeons to assess the health of a flap and quickly respond to situations in which a flap has become hypoxic. Our goal is to introduce a remotely accessible, non-invasive, and low-cost method to monitor flap health and quickly detect flap hypoxia. We designed a patch that will collect and relay processed Doppler and temperature data to an accompanying mobile application developed by a computer science team for the flap surgeon to access remotely.

TEAM #21: RODENT PERFUSION AND OXYGENATION MEASURING SYSTEM (RPOMS)
- Department: Biomedical Engineering
- Team members: Devan Boyce, Carolyn Davis, Trevor Schrock, Kimberly Tanaka, Matthew Ziegler
- Adviser: Dr. Anthony Passerini, Dr. Eduardo Silva

Our device, the Rodent Perfusion and Oxygenation Measuring System (RPO₂MS), is the culmination of our 2016-2017 BME senior design project. Produced in collaboration with Professor E. Silva, the RPO₂MS is a versatile, noninvasive device designed for measuring blood oxygenation, blood perfusion, and other hematological measurands in rodent test models. The RPO₂MS offers laboratory researchers and veterinarians alike a reliable, compact device that accomplishes the purposes of oximeters and laser perfusion imagers simultaneously at a fraction of the cost and time.

TEAM #22: INCLINED WATER TABLE FOR AEROSPACE RESEARCH
- Department: Mechanical & Aerospace Engineering
- Team members: Nicky Aikawa, Emma Inman, Kinsey Mead, Marisela Miramontes
- Adviser: Dr. Jason Moore

Our mission is to design, manufacture, and test an inclined water table for educational use. The table will model and aid in the visualization of fluid dynamics and compressible fluid flow with custom airfoil and nozzle models, utilizing the hydraulic analogy. Some of the stakeholders in the project include Professor Linke and Professor Hafez, as well as their graduate students, Ian Garretson and Fahad Jan.

TEAM #23: GRAIN STORAGE REAL-TIME INSECT MONITORING AND EARLY DETECTION SYSTEM
- Department: Biological & Agricultural Engineering
- Team members: Brett Bemowski, Cameo Tsui
- Adviser: Dr. Ruihong Zhang

Our team has developed a real-time monitoring system for the early detection of insects in grain storage facilities. Late discovery of insects leads to grain damage, reduced market value, and costly chemical treatment of the grain. The current practice of visual inspection and sieving is labor intensive and less frequent than what can be achieved with our device.

TEAM #24: MIXED REALITY LANDSCAPE DESIGN SOFTWARE
- Department: Computer Science
- Team members: Chen Chen, Brian Tuan Khieu, Matthew Martin, Yiru Sun
- Adviser: Dr. Xin Liu

Our team’s goal is to create mixed reality experience by integrating AR and VR technology and using drones as camera platforms. By meshing the virtual world accurately with a feed of the real world, users will be able to create, make changes, and interact with virtual objects, the locations of which could be precisely realized in the real world. The application of our program covers gaming, architecture, event planning, architecture, military applications, etc.

TEAM #25: REALTIME RSS FEED PARSER
- Department: Computer Science
- Team members: Liem Nguyen, Daniel Ruiz, Nikolai Solgaard, Alan Wei
- Adviser: Dr. Xin Liu

ShortOrange is a cross platform podcast player that allows people to listen to, manage, and organize their favorite podcasts. In order to create real-time notifications, RSS feeds need to be parsed continuously and efficiently. The Realtime RSS Feed Parser was developed in JavaScript using the ANTLR (Another Tool for Language Recognition) framework allowing it to be flexible and easy to refine. It runs on a distributed network on Google’s App engine allowing constant, scalable and concurrent parsing.
Project inspect is sponsored by the company Micro Vu out of Santa Rosa. Micro Vu charged team SuaveKoala with the task of automating their calibration pin quality control process. Micro Vu’s quality control team used to have a technician inspect their calibration pins using one of their visual metrology devices. The old process resulted in a time-consuming process, subjectively chosen pass and failed pins, and handling defects. With the funding of Micro Vu and the minds of SuaveKoala, the automated inspection process comes to life to ease the lives of Micro Vu’s employees. The KoalityControl machine consists primarily of a pair of nested rotary platters that index in a circle on a drive shaft, a camera system to inspect the pins, a pick and place pneumatic arm to sort the pins from the outer platter to the inner platter, and a structure to house all of the sub-assemblies.

Rotational grazing is a sustainable practice in which grazing livestock, such as cattle or poultry, are restricted by use of temporary fencing to certain areas of pasture, for certain amounts of time. By keeping livestock off land that has been recently grazed, the grass can grow back unhindered, developing a more robust root system, which yields healthier and faster growing grass. A lightweight temporary fencing system is essential for managing the movement of the livestock through the pasture. Our sponsor at Pie Ranch, Jered Lawson, has found that the cost and labor involved in moving the temporary fencing system on a daily basis is not acceptable, however he would like to continue practicing rotational grazing. The purpose of this project is to modify the temporary fencing system used in rotational grazing to reduce the time and labor required to move the fence. We have developed a design for a fencing system which connects to a linear move irrigation system (LMS) to alleviate this issue. The LMS will push the new fencing system, accomplishing rotational grazing and irrigation with a single system.

The Baja SAE team at UC Davis is an interdisciplinary student group that designs and builds an off-road vehicle capable of traversing rough terrain. The team uses a Continuously Variable Transmission (CVT) to transmit power from the engine to the gearbox in their drivetrain system. Since the team’s conception in 2012 there was not a reliable way to test the tune of the CVT to ensure that the maximum power could be transmitted through the drivetrain system. A dynamometer that can vary the load applied to the drivetrain system to simulate real world driving conditions is necessary to accurately tune the CVT system and would increase the team’s design score at competition. This senior design project consisted of designing a full-scale dynamometer and a scaled down proof of concept to illustrate how the dynamometer would work. The braking force from the dynamometer is supplied by two eddy current coil packs which consist of conductive wire wound around a steel core. The coil packs create eddy currents in an aluminum rotor which oppose the torque supplied by the engine through the CVT system. Based on the balance of torque supplied by the engine and by the eddy currents the CVT will shift between its lowest and highest ratios in order to maximize the amount of power transmitted by the engine. Users are able to manually vary the load on the CVT system and export data concerning CVT power outputs via USB cord.

The computer science department at UC Davis offers internship and research credit for students in the form of ECS 192 and ECS 199 (ECS 92 and ECS 99 for students of lower division standing). Recently, more students have been using either these courses to fulfill graduation requirements, so the department has taken measures to formalize the process. The current registration and enrollment processes for internship and research courses requires many manual and error-prone steps from both instructors and students. The goal of this project is to automate, formalize, and streamline a significant portion of the processing effort. Special Study Course Management
System (Special Study CMS) is a website that automates a significant portion of the formal registration and enrollment process through which students earn internship and research credit. The website guides students through the initial registration process and keeps them on track for milestones and deadlines. Additionally, it provides an interface for coordinating professor and advisors to verify submitted documents and to provide feedback to students. At the end of each quarter, students’ coursework is archived so it can be easily referenced in the event of an ABET (Accreditation Board for Engineering and Technology) accreditation audit.

**TEAM #30: WORK OF HEART**
- Department: Biomedical Engineering
- Team members: Melissa McCombs, Sam Meyers, Alexis Okasinski, Madison Pallante
- Adviser: Dr. Anthony Passerini

The design objective of the Work of Heart (WOH) device is to create a physical and interactive model of the cardiovascular system that simulates the hemodynamic (delivery of blood) response to the baroreceptor reflex to enhance the student learning experience. The baroreceptor reflex, one of the body’s main homeostatic mechanisms, monitors and regulates the mean arterial pressure (MAP).

**TEAM #31: FALL DETECTION AND COUNTERMEASURES SYSTEM FOR EKSO GT**
- Department: Biomedical Engineering
- Team members: Jacob Dunaway, Emmet Francis, Hannah Kirkegaard, Ori Reches, Julie Zimmer
- Adviser: Dr. Anthony Passerini

The Ekso GT is a robotic exoskeleton that is FDA-approved for rehabilitating spinal cord injury and stroke patients. Use of exoskeletons to aid mobility in these populations significantly decreases the secondary health complications associated with prolonged sitting and inactivity. To maximize the physical and psychological benefits of exoskeleton use, Ekso is working towards bringing the Ekso GT out of the rehabilitation center and into the home and community. However, the major barrier to unsupervised everyday use is the risk of patient injury due to falls. In particular, backwards falls pose the greatest hazard due to the patients’ inability to catch themselves and the risk of serious head injury. Thus, the goal of our project is to create a system capable of reliably detecting a backwards fall and implementing a countermeasure response that minimizes injury to the user. Our design features an IMU that determines several human body kinematic measures, which serve as inputs to our innovative multiple threshold algorithm. When this detects a fall, a signal will simultaneously trigger an actuator response, alert system, and solenoid-activated airbag deployment. Upon impact, a bilayer padding protects the user’s torso and the inflated airbag protects the head. We are optimistic that increasing patient safety with our fall detection and countermeasures system will help allow for everyday use of exoskeletons.

**TEAM #32: EQUIPMENT INVENTORY TRACKING**
- Department: Computer Science
- Team members: Rafaeli Arroyo, Ian Hays, Navpreet Kaur, Amandeep Sidhu
- Adviser: Dr. Xin Liu

The Ergonomics Program maintains several equipment such as keyboards, mice, chairs, etc. These equipment are available to be loaned to the UC-Davis employees for a short period (1-2 weeks) to try and determine if they are the right fit for them, before making an investment to purchase the equipment. Our project keeps track statistics, equipment that is rented out, and handles timely return of equipment through autonomous emails.

**TEAM #33: THE DELTA BREEZER**
- Department: Mechanical & Aerospace Engineering
- Team members: Jonathan Butruce, Sanaulla Mohammed, Michael Perry, Norman Shen
- Adviser: Dr. Jason Moore

The goal for the Delta Breezer project is to reverse the process of auto-venting. Auto-venting is a process that autonomously opens or closes a greenhouse window based off its internal temperature. Delta Breezer’s objective is to design a device that can open or close a sliding window based off the outside temperature. The designed device is called sigma which accomplishes the task by using levers, springs, and a thermal actuator. As the outside temperature changes the thermal actuator will expand or compress thus displacing the springs and rotate the levers. The levers are attached to sliding portion of the window thus moving the window as it rotates. By displacing the springs, energy is stored. This stored energy is used to compress the thermal actuators and move the levers. When the thermal actuator is fully expanded, the window will be closed, and when its fully compressed the window will be open.
**TEAM #34: HARDWARE ACCELERATED HANDWRITTEN DIGIT DETECTION**
- Department: Electrical & Computer Engineering
- Team members: Kyle Blake, Mohamed El-Banna, Andro Nooh
- Adviser: Dr. Soheil Ghiasi

The goal of this project is to develop an FPGA based system for detecting handwritten digits. The implemented algorithm uses a neural network to determine the digit.

**TEAM #35: AN EASY-TO-USE PLATFORM FOR PROVIDING STANDARDIZED STIMULI FOR CANINE RESEARCH**
- Department: Biological & Agricultural Engineering
- Team members: Zachary Gillis, Deborah Porter
- Adviser: Dr. Ruihong Zhang

Originally designed in 2012, the Tilt-A K9 enables researchers to measure muscle activation in response to a tilting stimuli. Specifically, the device utilizes a user-friendly, computer-based arduino connection that controls the platform tilt angle along the pitch and roll axis. A hitch lift mechanism safely transports the canine from the ground level up to the 3-ft-high platform. The safety enclosure for the whole device is embedded within the hitch lift itself while also containing the dog. Foam-coated poles, along with adjustable parts, provide the basis of the enclosure design for practically any dog size. The enclosure, once secured, moves laterally from the top of the hitch lift onto the tilting platform. The data collected from using the Tilt-A K9 can be used to improved canine health through a better understanding of muscle response. Veterinary professionals can then determine effective ways to treating neurologically-impaired dogs.

**TEAM #36: ENERGY EFFICIENT INFERENCE OF NEURAL NETWORKS ON EMBEDDED PLATFORMS**
- Department: Electrical & Computer Engineering
- Team members: Christopher Bacchi, Andrea Lopez, Krysteen Terlouw
- Adviser: Dr. Soheil Ghiasi

This project is a hardware implementation of a neural network trained to recognize handwriting. Opposed to a traditional processor based approach, this embedded system solution is faster, more parallel, and more energy efficient. This team’s solution optimizes performance through a variety of means, including hardware parallelism, algorithm simplification, and data compression. The system is compiled and run on an Altera FPGA board, interfacing with the on-board ARM processor and custom memory controller components to maximize the system’s acceleration and performance. Memory access is fine-tuned on a cycle by cycle basis to ensure that as little hardware as possible remains idle during execution.

**TEAM #37: SEMI-STRUCTURED DATA EXTRACTION**
- Department: Computer Science
- Team members: Matteson Daniel-Padgett, Dan Liu, Chris Sanchez, Shrey Tandel
- Adviser: Dr. Xin Liu

Monty Data Extraction was created to allow the UCD Library to quickly extract information from scans of old wine catalogs for output to a .CSV file so the data can be used for research purposes. The Library had tried using other programs to extract data from individual wine entries from the catalogs, but they found that they were either too inaccurate or failed to find the entries entirely. Data extraction with Monty is a semi-automatic process which uses Tesseract as an OCR engine, and machine learning and user-defined regular expressions (which can be fuzzy-matching) to identify entries for extraction and parse them. Monty includes a regular expression builder, which can use macros for building up the expression from its basic components like price or entry number, and a variety of other tools built into its Qt 5 UI to help the user quickly correct errors from the automated step of the process. While the tool was originally needed for use on wine catalogs, it can be easily configured for different applications by changing the configuration settings, since the UI dynamically changes to fit the user-defined extraction schema.

**TEAM #38: PODCYCLE**
- Department: Mechanical & Aerospace Engineering
- Team members: Cesar Cortez, Navea Dasz, Chen Ding, Karen Ma
- Adviser: Dr. Jason Moore

The PodCycle is a human-powered recreational machine designed for the Franklin County, Virginia, Parks and Recreation Department. The purpose of the machine is to promote exercise and increase social relations within the community. Four bicycles are mounted onto individual “pods” which are connected into a system that rotates similar to a merry-go-round. Riders pedaling the bicycles drive the machine through a system of gears.
TEAM #39: AUTONOMOUS INDIVIDUAL EGG CARE SYSTEM

- Department: Biological & Agricultural Engineering
- Team members: Edwin Diaz, Kevin Hudnall, Vivian Vuong
- Advisers: Dr. David Slaughter, Dr. Ruihong Zhang

In 2014, there were 8 billion chickens consumed and 76.5 billion eggs consumed in the United States alone. In order to feed the growing population while combating the decrease in available manual labor, it is necessary to automate processes in the egg incubation facility. This project designed a fully automated robot that can pick up eggs, sort them by mass, and bring the eggs to the appropriate incubation area. This robot uses a custom claw and arm designed specifically for handling eggs without cracking the shell or harming the inside. The robot picks up eggs from a known location and delivers them to their unknown incubation areas according to weight, a tedious job humans normally do. The robot is designed to work in an arena that simulates the floor of an egg hatchery. This robot is the first step to automating the egg hatching industry.

TEAM #40: FOUNDATION ANALYSIS AND DESIGN FOR LAKE MERRITT RESIDENTIAL DEVELOPMENT

- Department: Civil & Environmental Engineering
- Team members: John Engel, Marie-Pierre Kippen
- Adviser: Dr. Ross Boulanger

Our team presents possible foundation choices for two proposed buildings in Oakland, California. The study includes geotechnical recommendations and design criteria for foundations and earthwork construction at the project site. The analysis and results of the geotechnical conditions at the site, based on boring logs taken by Woodward-Clyde Consultants in 1984, and URS Greiner Woodward Clyde in 1986, are also included in this study. For each foundation type considered, we analyzed both settlement and capacity. For the 8-story building, only shallow foundations are considered. For the 18-story tower, a shallow mat foundation as well as piles were analyzed.

TEAM #41: BUILDING DESIGN OF A PROPOSED UC DAVIS OFFICE BUILDING

- Department: Civil & Environmental Engineering
- Team members: Jason Duroyan, Caleb Huskey, Shuzhou Liu
- Adviser: Dr. Colleen Bronner, Dr. Deb Niemeier

UC Davis’s Long-Range Development Plan (LRDP) predicts a 19% increase in the number of students, faculty, and staff by 2027-2028. An estimated 2 million gross square feet of additional academic and administrative building space is required to accommodate this growth. In order to meet this demand, a new office building is to be constructed in the west campus of UC Davis near West Village. The goal of this project is to design the structural system and foundation of this proposed office building. The structural system consists of a gravity frame that supports all vertical loads, and a moment frame that resists wind and seismic loads. The foundation consists of individual concrete footings beneath the ground floor columns.

TEAM #42: BIKE SIGN ETIQUETTE

- Department: Civil & Environmental Engineering
- Team members: Tului Gantulga, Javier Garduno, James Pence, Haris Softic
- Adviser: Dr. Colleen Bronner, Dr. Deb Niemeier

In a place where the main mode of transportation is bikes, like the city of Davis, there are numerous bike-related collisions. These problems occur most often during rush hour and/or when a wave of new college students arrive on campus each year. Multi-use paths that accommodate bicycles and pedestrians are of particular concern. Currently, there are no explicit signs to let cyclists know when and where to be more cautious and the purpose of this project is to research, implement, and determine the effectiveness of signage to increase bicycle safety on the UC Davis campus and by extension, the city of Davis as a whole. Since the city of Davis does not allow experimental street signs to be in place for more than 24 hours, the project will be conducted on University of California, Davis grounds, which allows signs to remain in place for longer than 24 hours. Specific locations on campus will be chosen based on number of commuters and its generalizability to other places where there is a number of bikers, such as the Davis, New York, or Chicago. There are two main goals for this project, which are to design effective signs and analyze their effectiveness. Video cameras will be placed to record people’s behaviors before and after signs are put in place; this method is preferred over surveys because it is less expensive, less time consuming, easier to collect data no response bias, and it is harder to get volunteers to answer surveys. Collected data will be analyzed for certain changes in behavior, such as, speed, traffic flow, use of helmets and bike lights, and accidents. To get accurate speed data, two markers will be put on the ground and the distance will be measured and divided by the time difference. Video documentation taken before the signs will be used to assess the site, which will be discussed more in depth in Scope.
TEAM #43: SUSTAINABLE WATER IN RURAL AND SEMI-URBAN PERU

- Department: Civil & Environmental Engineering
- Team members: Jessica Cisneros, Fabio La Serna, Edward Oh
- Adviser: Dr. Colleen Bronner, Dr. Deb Niemeier

In developing countries, specifically in rural and semi-urban communities, reliable access to clean drinking water can be difficult. Our team has been awarded a project to improve the water distribution system in the town of La Huaylla, a growing community in the Cajamarca Region of northern Peru comprising of about 230 homes. The community’s current water distribution system sources are local springs. Water from these springs was found to have significant levels of coliforms, which poses a concern for other pathogens and waterborne illnesses. It was observed that the coliform levels increased as water flowed further down the water distribution line, suggesting that issues with water quality also derive from the current infrastructure. However, the main concern for the community is the lack of consistent water flow in the pipes that lead to the homes of La Huaylla. An analysis performed by the UC Davis chapter of Engineers Without Borders in 2016 shows that La Huaylla receives only half of the water it needs, and that water is often not available for residential use during peak usage times (morning and evenings). The aim of the project is to recommend improvements that can be constructed and implemented in the community, to develop a more effective water system. Our goal is to improve the quality of life for the people of La Huaylla, as well as in other communities where similar improvements can be implemented in the future, by improving the quantity of water and quality of service that is received.

TEAM #45: CASE STUDY ON PROJECT PARTNERING FOR CONSTRUCTION AT SAN FRANCISCO INTERNATIONAL AIRPORT

- Department: Civil & Environmental Engineering
- Team members: Amanda Meroux, Justen Tatum, Sydnee Watanabe
- Adviser: Dr. Colleen Bronner, Dr. Deb Niemeier

Project Partnering is a method used by companies and contractors to collaborate, create openness, and trust between all parties, and bring projects in on budget and scope. The purpose of this project is to analyze the San Francisco International Airport partnering process, specifically reviewing if and how surveys are used in project partnering, and to compare them with Caltrans’ practices to determine ways to update their partnering model.

TEAM #46: A NEW EAST WEST BICYCLE CORRIDOR FOR CAMPUS

- Department: Civil & Environmental Engineering
- Team members: Farsheed Fani, Lin Huang, Yesenia Mora
- Adviser: Dr. Colleen Bronner, Dr. Deb Niemeier

The current East West bicycle path on the University of California, Davis campus does not coherently route bicyclists traveling from the East end of campus to the West end. Also, the current path has several issues for current bicyclists. For this project, we will determine the feasibility of creating a new path on the East end of campus to be later linked with a path continuing into the West end of campus.

TEAM #47: ESTIMATING EVAPORATION AT LAKE BERRYESSA

- Department: Civil & Environmental Engineering
- Team members: Dan Nishiguchi, Kathleen Stone, Alexander Sweat
- Adviser: Dr. Jeannie Darby, Dr. Colleen Bronner, Dr. Debbie Niemeier

The project compares existing estimation methods for evaporation at Lake Berryessa with estimation methods from literature and case studies. The analyses from the comparison study will provide information for Solano County Water Agency (SCWA) to evaluate the validity of current estimations of evaporation. In turn, the evaluation of current estimations will assist SCWA with their water management decisions.

TEAM #44: SYNTHESIZING CLIMATE ACTION PLAN STRATEGIES FOR THE SACRAMENTO AIR DISTRICT

- Department: Civil & Environmental Engineering
- Team members: Dolores Aguirre, Michael Lam, Nicholas Toy
- Adviser: Dr. Colleen Bronner, Dr. Deb Niemeier

Our team is synthesizing climate action plan (CAP) strategies from Northern California for the Sacramento Air District. The project will consist of researching and comparing strategies from CAPs. The strategies will be compared using a weighted performance matrix that includes GHG emission reduction potential, cost, and approach for implementation. Co-benefits and climate zone will also be used to evaluate the overall potential of strategies.
TEAM #48: EVALUATING THE EFFICACY OF PATHWAY ETIQUETTE SIGNAGE: TEAM A

- Department: Civil & Environmental Engineering
- Team members: Angel Araiza, Emma Bell, Chenhao Yu
- Adviser: Dr. Colleen Bronner, Dr. Deb Niemeier

The project's objective was to examine the effectiveness of pathway etiquette signs through analyzing the behavior of bicyclists and pedestrians traveling throughout the UC Davis campus. The project complements the ongoing Davis pathfinder program to help bicyclists of all experience levels navigate the city's pathways and bikeways.

TEAM #49: DESIGN OF PERMEABLE AND TRADITIONAL PAVEMENT TEST SECTIONS ON VISITOR PARKING LOT 47

- Department: Civil & Environmental Engineering
- Team members: Lee Fong, Jace Jackson, Aliya Karimi
- Adviser: Dr. Colleen Bronner, Dr. Deb Niemeier

The University of California Davis’ Transportation and Parking Services (TAPS) and Design and Construction Management (DCM) agencies have requested for the design of pervious and traditional pavement test sections on Visitor Parking Lot 47 (VP47). Located in the South-Central part of campus, this particularly large parking lot is home to some severe structural deficiencies and contributes to water quality issues. VP47’s traffic load, soil conditions, underground utilities, and tree root systems have led to substantial cracking making rehabilitation both necessary and inevitable. Environmentally, the existing impervious pavement prevents infiltration leading to polluted storm water runoff that is pumped uphill, an energy intensive process, where it is released into the Arboretum via Putah Creek. To mitigate the structural and environmental issues, the installation of permeable pavement test sections in conjunction with traditional pavement test sections can provide for a testing mechanism from which the project sponsors’ can decide on the most beneficial rehabilitation approach based on the test sections’ performance. Specifically, the sponsors will be provided with cross sectional drawings, suggested locations of implementation, life cycle analyses (LCA), and life cycle cost estimates for each pavement alternative.

TEAM #50: A NEW EAST WEST BICYCLE CORRIDOR FOR CAMPUS

- Department: Civil & Environmental Engineering
- Team members: Justin Morrison, Brian Situ, Sharlene Soltero
- Adviser: Dr. Colleen Bronner, Dr. Deb Niemeier

The purpose of this project is to conceptually design a new bike pathway network through the UC Davis Arboretum to campus. With proposed future developments to student housing at the east end of campus, the bike network must be improved or re-designed to support the area's population increase. The bike network designs also incorporate a bicycle and pedestrian bridge that will allow users to navigate more directly onto campus. Our final design aims to resolve existing path deficiencies while effectively servicing the surrounding campus and city communities.

TEAM #51: FEASIBILITY STUDY OF TRANSIT ORIENTED DEVELOPMENT OF THE NISHI PROPERTY

- Department: Civil & Environmental Engineering
- Team members: Madeline Harriott, Chelsey McGrew, Dennis Riley
- Adviser: Dr. Colleen Bronner, Dr. Deb Niemeier

This project explores the feasibility of developing the currently underutilized Nishi property, located immediately south of the UC Davis campus, in accordance with Transit Oriented Development principals. This development would include the construction of a new electrified rail station as well as new residential and retail units on the property. Included in this project is a proposal for the layout of the property and an analysis of the traffic-related impacts of the new development on the surrounding area. This project aligns with Amtrak’s vision to electrify the Capital Corridor rail line by replacing the existing station in downtown Davis with a new station that is able to accommodate electrified rail. Simultaneously, this project also addresses the city of Davis’ need for additional housing in the city.

TEAM #52: TRANSIT ORIENTED DEVELOPMENT IN DAVIS, CA

- Department: Civil & Environmental Engineering
- Team members: Trent McGowan, Lilly Nowlakha, Aldrich Tan
- Adviser: Dr. Colleen Bronner, Dr. Deb Niemeier

With the growing population in California, new transportation alternatives must be developed. Our project entails the design of an electrified high-speed rail station and Transit Oriented Development (TOD) on the currently unused Nishi Gateway Property in Davis, CA, a city in need of increased connectivity. TOD is the creation of high-density, walkable, mixed-use communities centered around high quality train stations. Upgrading trains would convert the current diesel run system to an electric system, providing a multitude of benefits, including trains that are cleaner, quieter, more reliable, and would reduce fossil fuel dependency.
TEAM #53: AN APPROACH TO OPTIMIZING GOLD RIBBON WEDGE BONDS

- Department: Materials Science and Engineering
- Team members: Emily Beeman, Joseph Brown, Matthew Han, Jared Traynor, Don Valles, Andrew Westle
- Adviser: Dr. Ricardo Castro

Electronic interconnects are produced by manufacturing companies for microwave, PC board repairs, and other microelectronic applications. In the microelectronics industry, ball bonded round wire has been the standard for use as electronic interconnects; this makes them a safe choice due to already established infrastructure and relatively well understood methodologies. However, ball bonded round wires are not optimal for many applications, specifically high frequency and power applications. Wedge bonded ribbon geometries have been shown to withstand higher current densities, higher frequencies, and higher mechanical stresses than similarly sized round wires. Furthermore, gold ribbons are an excellent avenue to pursue due to their high conductivity and resistance to corrosion. The conversion to gold ribbons is essential to improve the speed and efficiency of future microelectronics. Researchers are facing challenges bonding the gold ribbon to gold substrates. The bonds are not forming properly and the ribbons separate from the substrate. If good bonds are not formed, they may come undone within the device, rendering it useless. This group has been working with Keysight Technologies to optimize the bonding parameters and modify the gold ribbons to form strong and reliable bonds. With these optimized bonds, Keysight can move forward in its development of improved microwave frequency devices.

TEAM #54: DIGIT RECOGNITION SYSTEM

- Department: Electrical & Computer Engineering
- Team members: David Ke, Lucas Keller, Goldwayne Leh
- Adviser: Dr. Soheil Ghiasi

Using a combination of hardware and software, the digit recognition system will be able to recognize the digit on an image in under 100 ms.

TEAM #55: RIGHT HERE RIGHT NOW

- Department: Computer Science
- Team members: Brian Becker, Matthew Moua, Nathalia Sandoval, Bradley Wang
- Adviser: Dr. Xin Liu

“Right Here, Right Now” is a location-based social media app on the Android platform, with which people see posts and events hyper-locally. Using “Right Here, Right Now,” users may also keep up with friends’ activities both near and far. In order to help users keep up with all the latest and best content, “Right Here, Right now” is fully interactive and determines post visibility based on post popularity and proximity. On this platform, users may post, like, and reply to posts and events, follow other users, and attend events.

TEAM #56: MESSAGE IN THE SKY

- Department: Computer Science
- Team members: Haofei Chen, Michelle Munteanu, Ishan Thapar, Edward Xu
- Adviser: Dr. Xin Liu

“Message in the Sky” is a project of collective human aspiration. Portraying diverse voices around the world, the project is a digital time capsule that tells a story of basic human aspiration of our time. This project allows the public to cast their hopes and dreams into the sky, both symbolically and literally. Through a database-driven web interface, either input as text-based messages or recorded spoken words, messages can be read/heard in the context of the real-time sky map. The vision of the project is to map the landscape of human aspiration globally and over time, and some day to work with space agencies to encode the messages as radio signals, and ultimately broadcast them into space using high-power, transmittal-enabled instruments on an on-going basis.

TEAM #57: EYELOGIC

- Department: Computer Science
- Team members: Pouneh Aghababazadeh, Dominik Konecny, Alexander Soong, Dimitri Vasilev
- Adviser: Dr. Xin Liu

Eyelogic utilizes the webcam of your laptop to track the user’s eye gaze and maps it to the screen of the computer for cursor movement. Along with eye gaze tracking Eyelogic uses voice control to enable click commands provide hands free use of the computer.

TEAM #58: IMPROVE YOUR ENGLISH

- Department: Computer Science
- Team members: Joshua Basch, Ari Bolton, Kyung Lee, Cameron Willment
- Adviser: Dr. Xin Liu

Nat Crawford runs an English as a second language (ESL) tutoring service in Silicon Valley with many students and many tutors. Currently, his company uses a FileMaker Pro program to store over 10,000 vocabulary words, their definitions, and student data such as names, vocabulary lists, and test results. The program is old, clunky, and badly needs a makeover. We designed and built a web application to replace the current system and streamline the tutoring workflow, encompassing an easy-
to-use student database and functions for maintaining customized vocabulary lists, review exercises, diagnostic quizzes, and examinations. Another primary feature is a “passage reading” screen, which presents an appropriate passage from a curated list of books, with highlighted vocabulary words, allowing readers to more clearly track the context of their vocabulary words. The fully web-based application is built for modern desktop browsers and uses the latest open-source technologies to facilitate future development and maintenance.

**TEAM #59: MOBILE APP FOR SPOKEN CHINESE RECOGNITION**

- **Department:** Computer Science
- **Team members:** Aidan Daniels-Soles, Yixin Hu, Chi Kei Loi, Weidong Wu
- **Adviser:** Dr. Xin Liu

A fun, engaging, and easy-to-use Swift application that catalyzes spoken Chinese learning. We provide functionality for both free, and textbook-based spoken Chinese practice. To build this app, we used Swift, the iFLYTEK Chinese recognition engine, and numerous other awesome iOS frameworks. Come check out our app!

**TEAM #60: JAPA PARKING APP**

- **Department:** Computer Science
- **Team members:** Valerie Cho, Britnney Nguy, Boris (Kam Ming) Tse, Priscilla Yu
- **Adviser:** Dr. Xin Liu

This app shows users which campus parking lots have available parking spots. The idea is to implement a crowdsourcing system which turns smartphones into passive sensors capable of tracking the location and movements of drivers. This requires zero user interaction or ground infrastructure, and running effectively without the phone leaving the user’s pocket. The system would detect arrivals and departures by utilizing activity recognition algorithms, and our backend would crunch the aggregate user actions to determine the likelihood that a lot has an open space.

**TEAM #61: BUILDING ENERGY PERFORMANCE REPORT**

- **Department:** Computer Science
- **Team members:** Raymund Akdsninis, Alice Chen, Allen Chin, Zijun Zhou
- **Adviser:** Dr. Xin Liu

The project is to create a web interface for generating performance reports for energy usage in buildings. The Energy Conservation Office will use this software to present the energy and cost savings due to their projects in curbing energy waste.

**TEAM #62: IMAGE PROCESSING FOR ANIMALS**

- **Department:** Computer Science
- **Team members:** George Burger, Yishen Huang, Taylor McDougall, Will Wu
- **Adviser:** Dr. Xin Liu

The Quail Ridge Reserve is an outdoor research laboratory for ecologists, biologists and computer scientists. The reserve infrastructure features a Wi-Fi network allowing sensors and cameras to be deployed to biologically relevant locations to collect data autonomously. Web and non-networked trail cameras are used to record the presence of various wildlife species including deer and mountain lions, as well as study species such as mice, woodrats and salamanders. The trail camera imagery needs to be sorted according to presence/absence, classification of species, and numbers of animals. The web camera images solely need to be sorted to presence/absence for a single species, but are continuously captured resulting in a large number of images that need to be filtered. All the images need to be intelligently cataloged and archived. The goal is to produce a scalable platform that can be duplicated for other Reserves in the Natural Reserve System.

**TEAM #63: DESIGN OF AN INTERACTIVE BUILDING ENERGY OPTIMIZATION DASHBOARD**

- **Department:** Computer Science
- **Team members:** Christian Aranda, William Herr, Anthony Kacyra, Cuauhtemoctzin Rodriguez
- **Adviser:** Dr. Xin Liu

UC Davis is committed to improving its operational energy efficiency and eliminating waste and so has commissioned a team in Facilities Management to identify and eliminate energy waste in its campus buildings. We were tasked to help design and build an Interactive Building Energy Optimization Dashboard for the Energy Conservation Office (ECO) of UC Davis and their energy engineering team. The dashboard will be used by these engineers and other technical users in their optimization work to identify operational issues in campus buildings and target low performers for project prioritization.
**TEAM #64: BEETAG SYSTEM FOR HUMMINGBIRDS**
- Department: Computer Science
- Team members: Jonathan Gee, Jennifer Kim, Trevor Morisawa, Gi Heok Nam
- Adviser: Dr. Xin Liu

We partnered with Dr. Lisa Tell, a professor of veterinary medicine at UC Davis, and an electrical engineering senior design team to develop a system to efficiently track hummingbirds in the field. In order to identify individual hummingbirds, we adopted the BEEtag, a specially formatted two-dimensional barcode. Our project consists of an Android application that can be used in the field to scan tagged hummingbirds and output the relevant information associated with the birds to an existing SQL database. The electrical engineering team built a camera system to take photos of the hummingbirds at feeders, so we developed a companion desktop application to find and decode the BEEtags in these photos and output information about each sighting to the SQL database.

**TEAM #65: HUMANE NET LAUNCHER**
- Department: Mechanical & Aerospace Engineering
- Team members: Michelle Fernandez, Christopher Lo, Alejandro Ramirez, Juliana Stein-Webber, Eric Tau
- Adviser: Dr. Steve Velinsky

ARMA USA, a subset of B. Dillon Manufacturing, Inc., currently produces a non-lethal projectile launcher for self defense and police work called the ARMA-100. This hand-held, gas-propelled, bean bag launcher is a single shot system capable of deploying projectiles of varying payloads. ARMA-USA would like to expand the ARMA-100’s versatility by having the launcher be capable of ensnaring wild animals via a net-deploying projectile.

**TEAM #66: BUGBOT: PRECISION AERIAL APPLICATION OF PHYTOSEIULUS PERSIMILIS**
- Department: Mechanical & Aerospace Engineering
- Team members: Emmanuel Belonwu, Shaun Hamlin, Patrick Jones, Christian Larreynaga
- Adviser: Dr. Jason Moore

Bugbot is a platform that allows for the precision dispersion of predatory mites from a drone. Automating this agricultural process will have a profound effect on how modern farming is done. The elimination of pesticides and laborious dispersion methods allows for a superior product from fewer resources than previously possible. This project has resulted in the development of a mechanical mechanism specific to drone platforms with the ability to safely and effectively cover specific sections of crops with predatory mites.

**TEAM #67: SKIN PLIABILITY TEAM**
- Department: Mechanical & Aerospace Engineering
- Team members: Benjamin Macdonald, Norberto Martinez, Alanna Mitchell, Enrique Prado
- Adviser: Dr. Jason Moore

Create a design and prototype of a device that can be used to measure skin pliability.

**TEAM #68: AQUATIC UNMANNED SURFACE VEHICLE**
- Department: Mechanical & Aerospace Engineering
- Team members: Justin Deckman, Nicholas Diaz, Tsegazeab Kahsay, Marisa Louie, Tomonobu Nagaoka, Kenneth Westerterp
- Adviser: Dr. Steve Velinsky

For our senior design project, we are sponsored by BlueRobotics, a marine robotics company located in Torrance, California. The goal of the project is to design and fabricate an unmanned surface vehicle (USV) that will travel along the surface of the water, fulfilling a variety of research and mapping needs depending on the consumer. The majority of the USVs on the market today are expensive, often costing upwards of $30000, and are designed for specific purposes. BlueRobotics is interested in offering a USV that is low in cost (approximately $1000), portable enough to be used by one person, modular, and adaptable to be used for multiple purposes. For the purpose of this senior design project, we will focus on sonar mapping for our data acquisition, but our design will reflect adaptability for multiple forms of information collection.

**TEAM #69: IMPLEMENTATION OF A BIOSAND FILTER FOR THE FLOATING VILLAGES ON TONLE SAP LAKE**
- Department: Mechanical & Aerospace Engineering
- Team members: Meysel Amaya Bautista, Samira Iqbal, Purva Juvekar, Jessica Shaw
- Adviser: Dr. Jason Moore

Our goal is to develop a low-cost, light-weight water filtration system for residents of the floating villages on the Tonle Sap Lake in Cambodia. To do this we used a modified biosand filter. The innovation in our design lies in the accommodation of user needs through a customized and uniquely manufactured steel casing and larger dimensions for the filter. The steel casing reduces the weight of the system by approximately 100 lbs and the larger dimensions allow for more water to be filtered for use.
TEAM #70: ALTERNATE GAS GRINDING INVESTIGATION ENCLOSURE (AGGIE)
- Department: Mechanical & Aerospace Engineering
- Team members: Natasha Chernishof, Trevor Fobel, Kelsie Rose Nebreda, Dilkirit Singh, Dashiel Tavernit
- Adviser: Dr. Steve Velinsky

The Manufacturing and Sustainable Technologies Research Laboratory (MASTeR Lab) headed by Professor Linke has research interests that include exploration of manufacturing in alternate gas environments. Future areas of interests may include the need to study the effects of argon gas for components used in the food industry, nitrogen for medical device components, and the study of oxidizing layers in elevated oxygen conditions. Prof. Linke required a rig that can deliver alternate gases to grinding operations allowing further research on sustainable manufacturing and abrasive processes. Specifically, this system must be able to accommodate various grinders, deliver argon, nitrogen, or oxygen gas, incorporate different investigation sensors, and most importantly keep the user and equipment safe from fire risks and grinder wheel fragment impact. The design team’s solution is the Alternate Gas Grinding Investigation Enclosure (A.G.G.I.E.), a steel enclosure that fully houses the largest grinder in the MASTeR Lab and allows for safe operations and research. The overall design was centered around ease of manufacturing and user operation.

TEAM #71: ART POD MOBILE PLATFORM
- Department: Mechanical & Aerospace Engineering
- Team members: Davis Le, Xin Lin, William Thompson, Chloe Travis
- Adviser: Dr. Jason Moore

The Art-through-Pod project was made in response to the growing issue of homelessness, especially in the Sacramento area. The purpose is to build and decorate lightweight mobile shelters for homeless people to dwell. The Artpod team was granted this project in hopes of further developing the current shelters for people in the Oak Park Area of Sacramento. Design concepts were decided upon using engineering experience and research to satisfy the needs of current pod owners. The proposed solutions were considered based on durability, lifespan, and most of all, safety. These solutions will most likely be used in the final prototype, which will be gifted to a homeless individual to reside in.

TEAM #72: HEAT PUMP
- Department: Mechanical & Aerospace Engineering
- Team members: Joshua Dory, Daniel Fust, Kweku Ngissah, Walter Parker
- Adviser: Dr. Jason Moore

The design of a heat pump system installation and integration into a UC Davis campus building in order to reduce the carbon footprint of the campus and increase the overall efficiency.

TEAM #73: BIKE MILL
- Department: Mechanical & Aerospace Engineering
- Team members: Nathan Flores, Rongfei Li, Phillip Nelson, Sumeet Shastri, Yuxiang Tang
- Adviser: Dr. Jason Moore

The purpose of this project is to design an efficient bike powered maize mill for use by residents of rural African villages. Energy and output considerations are primary needs of concern.

TEAM #74: NET ZERO
- Department: Mechanical & Aerospace Engineering
- Team members: Adam Alemnew, Stephen Becker, Maxfield Herrenbruck, Steve Sucheski, Kieran Wolk
- Adviser: Dr. Jason Moore

The purpose of this project was to accurately model the 2016 energy usage of the Indigo Architects LLP building in Davis, California and to provide consulting advice to them pertaining to the achievement of zero net energy consumption. This building has an unconventional radiant heating and cooling system that pumps water through pipes in the floors and upright columns to condition occupied space. This system, in addition to unique building geometry and composite materials, presents a challenge to model in conventional industry-standard software packages. Our team has used a combination of modeling techniques and coding strategies to effectively model energy usage, and has devised strategies for energy use reduction to use in conjunction with photovoltaic energy gains to approach a net-zero usage facility.
**TEAM #75: HELIOS: THE SOLAR REGATTA MOTOR-PROPULSION SYSTEM**

- **Department:** Mechanical & Aerospace Engineering  
- **Team members:** Vien Bui, Joshua Mouzakis, Ashley Osborne, Susana Ramirez  
- **Adviser:** Dr. Jason Moore

The senior design team, Helios, joined the UC Davis Solar Boat Team to design and create a boat for the Sacramento Municipal Utility District’s 2017 Solar Regatta. The Solar Regatta is an annual competition for college and high school students to design, build, and race solar powered boats. The boats must compete in a sprint, an endurance, and a slalom race, and must be able to run on both solar and battery power. Helios was specifically tasked with designing and manufacturing the motor-propulsion system for the Solar Boat Team. To accomplish this, the senior design team worked closely with frame, steering, and electrical sub teams. The final motor-propulsion system incorporates a waterproof, angled drive train that connects a propeller mounted below the water to a motor mounted above the water. The system rotates, to aid maneuverability of the boat, and lifts out of the water, to prevent damage of the propeller. The Solar Regatta occurred on May 6, 2017, where the UC Davis Solar Boat Team placed second overall and took home trophies for spirit, sustainability, design, and drive train.

**TEAM #76: JACKALOPE PAV (PERSONAL AIR VEHICLE) FLYING CAR**

- **Department:** Mechanical & Aerospace Engineering  
- **Team members:** Erik Braun, Xinwen He, Hattie He, Joshua Morse, Wyatt Ramsey  
- **Adviser:** Dr. Steve Velinsky

The goal of this project is to design and manufacture a 1:4 scale prototype for a VTOL (vertical takeoff and landing) flying car, which is the second iteration of this concept. This prototype uses three stabilizing rotors set up in a tri-copter configuration during hover, as well as a set of main lift rotors that supply the majority of the prototype’s thrust. After taking off vertically, the stabilizing rotors turn off while the main lift rotors rotate forward, allowing the prototype to transition to horizontal, wing-borne flight with a canard configuration. This design, at full scale, conforms to legal road width regulations while being able to seat four people in a single row. The future of this design will be a personal flying car that allows the user to travel without the necessity of using commercial airlines.

**TEAM #77: BIKELEAP BUS STORAGE SOLUTION**

- **Department:** Mechanical & Aerospace Engineering  
- **Team members:** Seth Dike, Xiwen (Herman) Li, Ahmad Zuhayri (Harry) Mohamed, Nicholas Pio  
- **Adviser:** Dr. Jason Moore

We have designed a storage solution for foldable bikes to be implemented within the storage compartment of motor coach buses. Our client, BikeLeap, will install three of these per coach as a means of storing 24 Brompton bicycles total. Their goal is to incorporate bicycling into the daily commute. An average user of the subscription service can expect to ride a bicycle a short distance to a designated pickup location. BikeLeap shuttles would then transport both the user and their bicycle to a drop off location- this is the part of the commute too lengthy for simply biking. The bikes would be used as the transportation for the last segment to each user’s workplace, school, etc. Our design features a series of linearly extending rail beds that have the potential to hold 8 bikes apiece. This rail system allows users to easily load and unload individual bikes to improve user’s bike and bus experience. Our deliverable for this project is to design and construct a demonstration unit that will serve as a proof of concept for our client and as a basis for future work.

**TEAM #78: TECHNO-ECONOMIC ANALYSIS OF RECOMBINANT BACTERIOPHAGE ENDOLYSIN PRODUCTION IN TRANSGENIC SPINACH**

- **Department:** Chemical Engineering  
- **Team members:** Alicia Byrn, Daniel Ding, Kevin Tom, Merryanna Yin  
- **Advisers:** Dr. Somen Nandi, Dr. Karen McDonald

Food safety is becoming a widespread issue particularly during this era of globalization and free trade. A potential method for securing food safety is the treatment of food products with endolysin, a hydrolytic enzyme produced by bacteriophage capable of breaking down the cell wall of bacteria, to target harmful food-borne pathogens. Since humans are routinely exposed to both bacteriophages and endolysin in their diets, consumption of food treated with endolysin should not be a major safety concern. In this study, we developed a process simulation model for the large-scale production of bacteriophage endolysin expressed in transgenic spinach for use as a food safety additive. Potentially lower capital and operating costs, a simpler upstream process, and linear scalability make plant-based biomanufacturing an attractive alternative to more established production platforms such as microbial fermentation. In our model, transformed spinach plants were grown, induced to express endolysin, and harvested,
and the endolysin product was partially purified to 75% purity (as spinach is a “Generally Recognized as Safe” organism). The total capital investment, annual operating cost, cost of goods sold of endolysin, and production capacity were determined based on potential need and production feasibility for the base case scenario of 500 kg endolysin produced per year with an expression rate of 4 g endolysin produced per kg of spinach fresh weight. Our preliminary results will be discussed in detail during the presentation and made available for further development.

TEAM #79: PRODUCTION OF A BIOSIMILAR MONOCLONAL ANTIBODY IN CONTINUOUS CHO CELL CULTURE

- Department: Chemical Engineering
- Team members: Keiko Fong, Jeanatan Hall, Yi Huang, Changnyeong Song
- Advisers: Dr. Somen Nandi, Dr. Karen McDonald

Monoclonal antibodies (mAb) are antibodies that specifically bind to targeted antigens, such as cancer cells. A biosimilar is a generic version of a biologic product, such as a mAb, that has come off patent. Chinese hamster ovary (CHO) cells are a common host used for producing antibodies. Filtration and chromatography steps are then used to separate the product from impurities. The unit operations for these processes are conventionally done in batch mode, but previous studies show that a change from batch to continuous operation increases productivity and flexibility while decreasing costs. A simultaneous shift from traditional stainless steel materials of construction to single-use disposable systems also favors the shift from batch to continuous operation. This design for production of biosimilar mAbs encompasses both of these new changes by replacing the expensive stainless steel chromatography column with a continuous countercurrent tangential chromatography (CCTC) system that enables the use of single-use disposable bags during production. The CCTC system along with continuous operation of the upstream bioreactors changes the traditional batch process to a continuous process that is more productive and more responsive to changes in demands. The model presented will have a techno-economic analysis for both upstream and downstream processes, and will be accompanied by an environmental health and safety analysis.

TEAM #80: PRODUCTION OF A MICROBIAL CROP PROTECTANT - FACILITY DESIGN AND TECHNO-ECONOMIC ANALYSIS

- Department: Chemical Engineering
- Team members: Benjamin Croze, Courtney Lam, Sally Mai
- Advisers: Dr. Somen Nandi, Dr. Karen McDonald

Today, many herbicides have been employed to control the growth of weeds in large-scale agricultural settings. Historically, the focus of most companies has been on producing chemical herbicides since they are inexpensive to research, easy to mass produce, and highly effective on weeds. Over time however, the main weeds affecting large farms have begun to develop chemical herbicide resistance and many farmers are looking for alternatives. One such replacement for traditional chemical herbicides is microbial herbicides, often referred to as “bioherbicides”. These microbial herbicides have huge potential to target specific weeds without damaging crops and minimize long term environmental impacts. Our group has investigated the viability of producing a bioherbicide by designing a manufacturing facility and performing an in-depth cost analysis. Specifically, this project considered the production of the BRG100 strain of Pseudomonas fluorescents. After research and review on past bioherbicide production and on BRG100, our group carefully selected upstream and downstream equipment and operating conditions to meet projected market demands. After research and review on past bioherbicide production and on BRG100, our group carefully selected upstream and downstream equipment and operating conditions to meet projected market demands. To further understand our proposed unit operations our group modelled the facility using SuperPro Designer. After equipment selections and productions rates were finalized, an economic analysis was conducted to check for the validity of this concept. Pricing for capital investments, start-up costs, operating costs, and overall return on investments were determined based off of our proposed model and predictions of market demands for this product. Ultimately, this proposed facility shows potential market viability and will hopefully bring more attention to the immense potential of the bioherbicide market.
TEAM #81: PRODUCTION OF CYANOBACTERIAL HYDROLYSATES WITH CARBON-13 AND NITROGEN-15 AMINO ACIDS FOR USE IN INSECT CELL CULTURE MEDIA

- Department: Chemical Engineering
- Team members: Jennifer Chao, Margie Cheung, Lily Hwang
- Advisers: Dr. Somen Nandi, Dr. Karen McDonald

The use of hydrolysates, containing free amino acids of certain heavy isotopes, added to insect cell culture media for recombinant protein expression and subsequent structure analysis is a relatively new concept. Knowing that the baculovirus and host cell system is a popular drug discovery method allowing for robust gene expression and protein production, the incorporation of certain labeled amino acids into target proteins greatly facilitates the determination of protein crystal structures and can complement other emerging technologies of crystal structure analysis such as electron microscopy. In this study we will present a detailed process model to simulate a large-scale cyanobacteria-based biomanufacturing facility that uses Oscillatoria foreaui as the host organism to produce \( ^{13}C \) and \( ^{15}N \) amino-acids by feeding correspondingly labelled carbon dioxide gas and ammonium sulfate in 12h/12h light/dark cycle. The model is used to evaluate the total capital investment, annual operating cost, and potential selling price of the products as a function of protein expression level in the cyanobacteria. For the Base Case design scenario (300 kg isotopically-labelled hydrolysates/year, 7% protein expression level, and 90% recovery in downstream processing), the model predicts a potential reduction in both product selling price and total capital investment cost compared with products of similar production platforms. Detailed economic analysis will be presented during presentation. Furthermore, the process model can also be modified to assess the profitability of alternative designs using different hosts or raw materials in order to help guide process development and optimization.

TEAM #82: PRODUCTION OF A VACCINE AGAINST BOVINE KERATOCONJUNCTIVITIS USING SEVEN SEROGRUPS OF KILLED MORAXELLA BOVIS CELLS

- Department: Chemical Engineering
- Team members: TJ Blackburn, Vuthithorn Chinthammit, Kostyantyn Luferov, Hudson Romain
- Adviser: Dr. Somen Nandi, Dr. Karen McDonald

Infectious Bovine Keratoconjunctivitis (IBK), colloquially known as “cow pink-eye”, creates an economic loss of 4 billion USD due to a reduction in meat and dairy production in cattle. The economic cost stems from severe weight loss and blindness in cattle. Treatment is expensive and laborious, and the infection takes at least three weeks to cure; therefore, prevention through vaccination is a better alternative than treatment. With 9 million cattle affected annually there is a large market for an IBK preventative vaccine. IBK is caused by Moraxella bovis; vaccination efficacy is \( M. \) bovis serogroup-specific and pili dependent. Currently, the majority of vaccines on the market contain only three serogroups, whereas our vaccine includes all seven serogroups. The production process was modeled and optimized using process design software “SuperPro Designer”. The upstream process is composed of an initial seed train to cultivate \( M. \) bovis cells, a production fermentor, and a media preparation system. The downstream process is optimized for efficiency and cost by reducing the shear stress to increase pili retention and utilizing single use disposable unit operations. Downstream unit operations include microfiltration steps, sterilization, and fill and finish steps. Our analysis suggests each batch will produce 3.9 kg of one serogroup, and the process can produce a thousand batches at 100% capacity. The final vaccine solution will consist of 10 mg cells per serogroup and have a final volume of 5 mL per dose. We will present upstream, downstream and a thorough techno-economic analysis of the entire process.
TEAM #83: ACRYLIC ACID PRODUCTION FROM CRUDE GLYCEROL
- Department: Chemical Engineering
- Team members: Stephen Cao, Kristopher Quon, Jonathan Reifman, Alda Tan, Zhishan (Alina) Wei
- Adviser: Dr. Ahmet Palazoglu

A preliminary study was conducted in order to inspect an economically and environmentally feasible manufacturing process design of the production of 20 million kilogram of acrylic acid from crude glycerol. Due to the environmental contamination of the traditional production of acrylic acid, which increased regulatory pressure on the manufacturers, a bio-based acrylic acid is in high demand. The design consists of separating glycerol from the crude source, dehydration of the input glycerol into acrolein, and oxidation of acrolein to acrylic acid.

TEAM #84: PRODUCTION OF ACRYLIC ACID FROM GLYCEROL
- Department: Chemical Engineering
- Team members: Michelle Banh, Francesca Campagna, Andy Huynh, Eian Palo
- Adviser: Dr. Ahmet Palazoglu

Although propylene is the most conventional raw material for commercial acrylic acid production, crude oil resources are being exhausted. As an alternative, glycerol is an appealing raw material because it is a renewable resource and an abundant byproduct of biodiesel production. Hence, the reaction pathway of interest for our process design is the conversion of glycerol to acrylic acid.

TEAM #85: ACRYLIC ACID PRODUCTION FROM GLYCEROL BY-PRODUCT
- Department: Chemical Engineering
- Team members: Westley Blacklock, Ria Khanna, Melissa Knedel, Zachary Kyser
- Adviser: Dr. Ahmet Palazoglu

Glycerol is a by-product from the methanolysis of plant oils in biodiesel manufacturing plants. The oversupply of glycerol presents an opportunity to produce acrylic acid by catalytic dehydration and oxidation. Acrylic acid is an intermediate for the production of plastics and rubbers. This project focuses on designing a production facility in Broken Bow, Nebraska to produce acrylic acid at 99.5 wt% purity. Aspen Plus is used to construct a base case simulation of two solid catalyzed plug flow reactors. An economic and environmental analysis is performed to determine the feasibility and profitability of this process.

TEAM #86: ACRYLIC ACID CATALYTIC PRODUCTION FROM GLYCEROL
- Department: Chemical Engineering
- Team members: Yaeir Halfon, Alejandro Martinez, Lili Tong, Hritey Werede
- Adviser: Dr. Ahmet Palazoglu

Our aim is to produce 20 million kg acrylic acid per year from crude glycerol in a two-step catalytic reaction scheme. Aspen Plus v9 is used to generate the detailed flowsheet to design an acrylic acid production plant in Broken Bow, Nebraska. Our design flowsheet includes two catalytic packed bed reactors, the separation units and the purification units to obtain 99.5 wt% of acrylic acid. The detailed cost analysis is an ongoing process.

TEAM #87: PRODUCTION OF ACRYLIC ACID FROM GLYCEROL
- Department: Chemical Engineering
- Team members: William Buhler, Vlad Pavlushkin, Derek Southard, Hayley Vukelic
- Adviser: Dr. Ahmet Palazoglu

The growing bio fuel production within the United States has caused an excess of glycerol, from the methanolysis of plant oils, to be introduced into the market today. Acrylic acid is an intermediate component for making plastics, and can be produced from a multi reactor system containing the catalytic dehydration and oxidation of glycerol. Our senior design project aims to build an operational plant that produces 20 million kilograms of acrylic acid per year, located in Broken Bow, Nebraska. This plant will start up on January 1, 2020, and operate for 10 years.

TEAM #88: PRODUCTION OF ACRYLIC ACID FROM GLYCEROL
- Department: Chemical Engineering
- Team members: Emily Bader, Sergio Garcia, Patrick Obin Sturm, Winnie Wambui
- Adviser: Dr. Ahmet Palazoglu

The growing biofuel industry produces excess glycerol, which can be utilized to create acrylic acid. Acrylic acid is commercially valuable, used in the manufacture of adhesives, plastics, and various coatings. Aspen simulations have optimized this two-reaction process, with realistic constraints. A full economic analysis was ran on the construction and operation of a plant producing 20,000 tons of acrylic acid a year.
Crude glycerol is a highly accessible feedstock derived from biodiesel processes. Our overall goal is to produce 20 million kilograms of pure acrylic acid per year from this glycerol feed. A two-step mechanism is considered which involves the catalytic dehydration of glycerol into acrolein and subsequent catalytic oxidation into acrylic acid. Furthermore, a detailed economic assessment of the plant’s profitability was calculated and used for additional optimization. All plant simulations were performed using Aspen Plus V9.

The utilization of crude glycerol from the byproduct of biofuel refining as an intermediate in the production of acrylic acid.

Traditionally, acrylic acid is produced a two-step reaction where propylene is catalytically dehydrated to form acrolein, which is then catalytically oxidized to yield acrylic acid. This project seeks to replace the propylene with readily available glycerol.

As the domestic energy market continues to invest in alternative energy sources that reduce our dependence on foreign oil sources, opportunities to capitalize on modern technologies and evolving processes has become increasingly attractive. One of these processes that has been gaining popularity is the production of biodiesel from plant and animal fats which also generates the low value byproduct of crude glycerol which contains approximately 21% water by weight with small amounts of salt and methanol. Since this excess glycerol is quite expensive to purify into glycine, we strive to take advantage of the evolving marketplace by designing a chemical process that will generate purified acrylic acid which is nearly 12 times as valuable as the crude glycerol. Our proposed plant located in Broken Bow, NE ensures a reliable crude glycerol source as 70% of the total US biodiesel production comes from the 96 biodiesel plants located in the Petroleum Administration for Defense District 2 that produce 2.2 billion gallons of biodiesel per year. The plant is designed to react the semi-purified glycerol feedstock to generate acrolein via catalytic dehydration which is then converted to acrylic acid under catalytic oxidation in two separate reactors. This product will then be purified to 99.5% acrylic acid by weight then sold and shipped on rail cars to any number of customers in various industries that may manufacture various plastics, elastomers, coatings, adhesives, paints, or polishes. Based on a preliminary input/output economic analysis, or proposed process appears to be promising as we expect to produce 5 million gallons of acrylic acid per year which will generate $70 million in annual revenue. This will be more than adequate to cover the running costs of the plant and should provide a reliable source of income which will allow us to expand our business in the near future.
the medical personnel involved in insertion or removal of the wires. Currently there is no standardized or effective approach within the medical community on how to address the problems associated with sharp K-wire ends. To address the issue of sharp K-wire ends, we designed a K-wire Alleviating Device (KAD) - a burr cup device, powered by the same K-wire driver used for wire insertion, that will smooth the sharp K-wire end. KAD will be suitable for use within the standard range of K-wire sizes, require minimum technical skill, and ultimately enhance the quality of patient care. With smoother K-wire ends, the risks posed to the patient and to medical personnel involved are greatly reduced.

TEAM #94: NAMAI: NECK ANITGRAVITY MUSCLE ATROPHY INHIBITOR

- Department: Biomedical Engineering
- Team members: Lillian Eng, Preston Leung, Jessica Shum, Darrion Yang
- Adviser: Dr. Anthony Passerini

Astronauts experience an accelerated amount of muscle atrophy in a microgravity environment. Currently, NASA has multiple exercise machines that on the International Space Station that combat muscles atrophy. However, there is no machine on the ISS that targets the muscles of the neck. Post spaceflight, astronauts have a greater risk of having neck injuries due a weakened neck. Our objective is to design a neck exercise device that is able to function in a microgravity environment. Our design transfers a variety of resistances from a fitted helmet and shoulder brace to the muscles and it can accommodate the different anthropomorphic sizes of most of the population.

TEAM #95: ANALYTE TRANSPORT CONTAINER

- Department: Biomedical Engineering
- Team members: Jose Octavio Bejarano Padilla, Aleksander Grim, Sarabeth Schommer, Oscar Vargas, Ventura Vega
- Adviser: Dr. Anthony Passerini

At the UC Davis Medical Center (UCDMC), analytes, medical samples used in diagnostic testing, are transported in containers that fail to keep samples from leaking due the pressure build up in the test tube during which the container is exposed to increasing environmental temperature. Current methods of transportation lack the features that prevent temperature increase inside the container causing a delay diagnostic testing, cause a biohazard, and impair decision making for patient care. The objective of the Analyte Transport Container (ATC) is to address the thermal regulation resulting in pressure build up while exposing the container to differing temperature. The ATC will securely store analytes samples for transportation while modulating refrigeration temperature via passive thermoregulation.

TEAM #96: CANINE SUSPENSTORY LIGAMENT INSTRUCTIONAL MODEL (CSLIM)

- Department: Biomedical Engineering
- Team members: Crystal Avila, Riley Edsen, Edward Golden, Kathleen Hornbacker, Megan Loy
- Adviser: Dr. Anthony Passerini

Detaching the suspensory ligament from the abdominal wall is an essential part of a canine ovariohysterectomy (spay) procedure. To perform this detachment, surgeons rely on tactile skills to navigate the body cavity. Therefore, obtaining these tactile skills is crucial for veterinary students to sufficiently practice this procedure. Unfortunately, the limited availability of cadavers denies some students the chance to practice. This presented a need for a teaching model that accurately emulates the force and technique required to detach the suspensory ligament in order to provide all veterinary students the opportunity for repeated and realistic practice of suspensory ligament detachment. CSLIM is a model that aims to accurately mimic the suspensory ligament detachment procedure in order to familiarize students with the skills needed to complete this step of an ovariohysterectomy. This has been achieved through a durable, reusable model design that allows for multiple procedure attempts without prolonged suspensory ligament replacement time. This model is also portable, cost effective and accurate with regard to canine anatomy. Ultimately, the goal of this model is to refine the technique required to execute suspensory ligament detachment and reinforce the students’ understanding of the force necessary to detach it.

TEAM #97: INSULIN DOSE TRACKING DEVICE

- Department: Biomedical Engineering
- Team members: Charlie Allen, Richard Bassin, Matthew Long, Brandon Ma, Rianna Romayor
- Adviser: Dr. Anthony Passerini

Diabetes is a disease characterized by increased glucose levels resulting from the body’s inability to effectively use or produce insulin. In the US, about 1 in 11 people have been diagnosed with diabetes and it is the 7th leading cause of death. To supplement treatment, diabetes patients may administer insulin, with insulin pens being the preferred mode of administration. Although insulin pens are effective at administering insulin, there is currently no consistent method to automatically obtain patient data regarding their insulin usage. Our objective is to create a device that is capable of being transferred from pen to pen that aids in the dose tracking of insulin pens. Through measuring the amount delivered and recording the time of delivery, we can accurately generate and insulin logbook that can be relayed to physicians to help make patient care more personalized and effective.
**TEAM #98: EXCELERATE: LOW COST LOWER LIMB PROSTHETIC SOLUTION**
- Department: Biomedical Engineering
- Team members: Bonnie Lee, Sean Maroney, Claire Sasse, Gurdeep Sullan
- Adviser: Dr. Anthony Passerini

In developing countries, a market has evolved for a low-cost prosthetic device that allows lower limb amputees to live with a higher quality of life. There are six identified children that are living under the guardianship of a hostel in the Kathmandu valley; three are transtibial amputees and three are transfemoral amputees. They do not have regular access to a prosthetic care facility and current devices are improperly fitting, do not prevent pressure ulcers, and provide limited mobility. The objective of our project is to develop a low cost prosthetic solution for lower limb pediatric amputees in developing countries, using this representative population of six identified children in Nepal.

**TEAM #99: NIGHTBULB: SLEEP APNEA DEVICE**
- Department: Biomedical Engineering
- Team members: Sunaina Aluru, Alexandra Dozsa, Abbey Mulligan, Ariana Perez
- Adviser: Dr. Anthony Passerini

Our objective for this project is to design a customizable, low-cost, durable, and adjustable device that will lower the apnea-hypopnea index (AHI) below 5 for patients with slight to moderate obstructive sleep apnea. We aim to create a dental device that is custom-fit to any mouth size and has adjustable advancement of the jaw for maximum effectiveness and patient comfort.

**TEAM #100: EXO-K9 (CANINE FIXATION DEVICE)**
- Department: Biomedical Engineering
- Team members: Patrick Foster, Matthew Ho, Christian Lu, Jennifer Nguyen, Anthony Sorbera
- Adviser: Dr. Anthony Passerini

Our objective is to provide a new method for treating maxillomandibular injuries in canines that reduces the risk of improper fracture healing as compared to current methodology used by our clients at the UC Davis School of Veterinary Medicine. The device must provide structural support and maintain proper bone alignment and dental occlusion. It will be reusable, provide stabilization of the skull, and be impact resistant to allow optimal healing that would yield better results than internal fixation.

**TEAM #101: RAPID WHOLE BLOOD HEMOLYSIS DETECTION**
- Department: Biomedical Engineering
- Team members: Meghan Doherty, Jordan Feeney, Erica Nash, Shefali Pandya
- Adviser: Dr. Anthony Passerini

We have created a point of care device to rapidly detect whole blood hemolysis when blood is drawn for laboratory testing. The device separates plasma from whole blood, which is analyzed by a handheld spectrophotometer. The hemolysis index is displayed to the user. This device will allow confirmation that the blood specimen is suitable for testing and eliminate excess time required for redraws if the specimen has gross hemolysis. The device is lightweight and portable so that healthcare personnel can use it in both standard conditions or emergency situations.

**TEAM #102: SEAWATER DESALINATION VIA INTEGRATION OF ADSORPTION AND MULTI-STAGE FLASH**
- Department: Chemical Engineering
- Team members: Turner Kraus, Kristen Torres, Andrew Wang, Sung Won
- Adviser: Dr. Spyros Tseregounis

As drought and water scarcity have impacted an increasing number of people, desalination has become a more attractive and potentially necessary method for delivering potable drinking water to people around the world. The economic and environmental feasibility of turning to the sea as a near-infinite source of water is studied. The techniques used are adsorption desalination combined with multi-stage flash. In developing this study, it was determined that water consistent with California drinking water standards can be produced by the above technologies. This work will prove beneficial if the design can be applied to water-stressed regions and provide people an additional source of fresh drinking water.

**TEAM #103: INTEGRATED METHOD FOR THE DESALINATION OF SEAWATER**
- Department: Chemical Engineering
- Team members: Amandaclaire Broffman, Katelyn Cooper, John Martin De Guzman, Morgan Jones, Max Peng
- Adviser: Dr. Spyros Tseregounis

As the global population continues to increase and climate change becomes progressively unpredictable, the availability of potable water is decreasing, forcing us to find a solution. Our senior design project features an integrated design and operation for a desalination plant. Utilizing the methods of multi stage flash separation and salt crystallization, we aim to produce 50 million gallons
of potable water per day in the most cost and energy efficient way possible. To accrue a greater profit, we will separate the NaCl from the brine waste and sell the salt to the government for use for road maintenance. Our plant was designed and optimized with the aid of Aspen Plus and DOW’s ROSA simulations. It combines the aforementioned methods so that seawater enters a multi stage flash separation unit followed by a salt crystallization unit, where the liquid brine is fed through a crystallizer to maximize yield. Our plant is scheduled to begin operation January 1, 2020 in Santa Fe, New Mexico after two years of construction. It will run for 20 years, producing a total of 365 billion gallons of potable water.

**TEAM #104: SPYROS DRAGONS DESALINATION PLANT**
- **Department:** Chemical Engineering
- **Team members:** Jason Chang, Jasmine Jagur, Danielle Magadia, Travis Tran
- **Adviser:** Dr. Spyros Tseregounis

1.1 billion people worldwide do not have access to fresh water and it is estimated that by 2025, two-thirds of the world’s population will face water shortages. One of the ways to mitigate this issue is through the desalination of seawater. Desalination is a process used to remove salt as well as other minerals from water to make it usable for agricultural purposes and to also make it potable. In our desalination plant, we will be using multi-stage flashing along with adsorption desalination technologies. Our proposed design aims to produce 50 million U.S. gallons of potable water per day. The plant will take in seawater near the coast of Torrance, CA, which will be pretreated to disinfect the water and remove any solid particulates. The treated seawater will then enter a multi-stage flash distillation, consisting of five stages. The plant will consist of two multi-stage flash units. Within the five stages, the pressure and temperature of each stage is lower than the preceding. The brine stream exiting the flash units will enter an adsorption pressure swing unit. The brine will be evaporated and the water vapor will be adsorbed by silica gel, which will then undergo a desorption step to produce potable water. The multi-stage flash units recovers about 15%-18% of the incoming seawater and the adsorption desalination recovers about 65% of the incoming brine as potable water.

**TEAM #105: WATER DESALINATION BY MULTI-STAGE FLASH AND SALT CRYSTALLISATION**
- **Department:** Chemical Engineering
- **Team members:** Christopher Lam, Rattanah Mahal, Ariel Secharia, Aaron Wong
- **Adviser:** Dr. Spyros Tseregounis

In this conceptual design project, we are tasked with the design and optimisation of a water desalination plant. We utilised a preliminary multi-stage flash operation to recover 20 percent of the potable water from the intake seawater. The reject brine is sent to a crystalliser to recover industrial-grade salt and more potable water. The goal is to attain zero-liquid discharge (ZLD) operation while optimising energy and capital costs. The potable water and crystallised salts can then be sold without further treatment.

**TEAM #106: SEAWATER DESALINATION**
- **Departments:** Chemical Engineering
- **Team members:** Ariel Bautista, Viet Pham, Sean Rader, Caitlin Walker
- **Adviser:** Dr. Spyros Tseregounis

Optimization of reverse osmosis and multistage flash processes for seawater desalination.

**TEAM #107: MSF/RO HYBRID DESALINATION PLANT**
- **Department:** Chemical Engineering
- **Team members:** Nicholas Di Pressi, Robert Herrell, Mitchell Padilla, Madison Stadtmueller
- **Adviser:** Dr. Spyros Tseregounis

Our proposal investigates the integration of multi-stage flash (MSF) distillation into a reverse osmosis desalination process with which to produce 50,000,000 gallons of desalinated water per day. This water will adhere to the Environmental Protection Agency’s standards for potable drinking water. Aspen Plus was used to create a model of MSF distillation, and General Electric’s Winflows program was used to create a model of reverse osmosis (RO). From the preliminary design we determined the input for the RO model to be the cooling seawater used in the heat exchangers of the MSF plant. The feed stream for the RO stage of the desalination plant uses the cooling water from the heat exchangers in the MSF stage. This water comprises 88% of the total 50 million gallons of potable water per day. The feed water is treated with hydrochloric acid to drop the Langelier Saturation Index (LSI) in the brine concentrate to below zero. The water travels through a cartridge filter and is then pressurized into the RO membrane. The RO building contains 999 pressure vessels each with seven elements totalling approximately 7000 RO membranes. The membrane selected for seawater application is a high rejection AD-440 model. The RO system currently recovers 30% of the feed seawater. Once through the RO membrane, the water is post-treated with calcium hydroxide and the necessary body minerals to make it potable.
TEAM #108: DESALINATION USING HYBRID REVERSE OSMOSIS AND ADSORPTION DESALINATION PLANT

- Department: Chemical Engineering
- Team members: Tue Doan, Kevin Enriquez, Gabriel Ferreira, Arshdeep Kahlon
- Adviser: Dr. Spyros Tseregounis

Our team is designing a desalination plant with 50 MGD capacity for the city of Torrance, CA. This plant will include both a salt water reverse osmosis (SWRO) process as well as an adsorption desalination (AD) process. Our objective is to reduce the brine water waste flowing from the RO units, while reducing the energy required to treat each gallon of water. Models of our system are being developed on Aspen Plus, Aspen Adsorption, and DOW ROSA. The AD process is modeled by Aspen Adsorption, the RO process is modeled by DOW ROSA, and the entire system will be integrated in Aspen Plus. Currently we are evaluating whether or not solar components may be incorporated in our design.

TEAM #109: DESIGN AND OPTIMIZATION OF A DESALINATION PLANT

- Department: Chemical Engineering
- Team members: Marco Ambriz, Sunveer Bajwa, Minyi Chen, Zack Noorzad
- Adviser: Dr. Spyros Tseregounis

Using technical principles learned in the chemical engineering curriculum combined with practical elements of economics, business practices and organization, environmental and sociological issues, we designed and optimized a water desalination plant using Aspen Plus Process Simulator and Reverse Osmosis System Analysis (ROSA). The design project uses reverse osmosis in series with multi-stage flashing to produce a total of 50 million gallons of potable water per day.

TEAM #110: A COGENERATION ZERO LIQUID DISCHARGE DESALINATION PLANT

- Department: Chemical Engineering
- Team members: Ryan Chen, Gabriel Lock, Christopher Miller, Benjamin Quach
- Adviser: Dr. Spyros Tseregounis

This desalination plant design provides an efficient way to generate desalinated water and industrial salt products. The design uses a once through multi-stage flash plant configuration in parallel with salt crystallization to produce 50 million gallons of potable drinking water that meets California’s drinking water standards. Concentrated brine from multi-stage flashing is fed to a crystallization unit that crystallizes and separates salt from the remaining concentrated brine. This design heavily reduces the environmental impact of cooling systems by not dumping highly concentrated, warm brine back into the ocean. To reduce operating costs the plant is recommended to be in cogeneration configuration with a power plant to make use of industrial waste heat.

TEAM #111: MULTI-EFFECT & ADSORPTION DESALINATION

- Department: Chemical Engineering
- Team members: Chun Wing Kong, Harrison Neff, Christopher Oliver, Steven Whittlesey
- Adviser: Dr. Spyros Tseregounis

This project aims to tackle the need to help maintain the supply of fresh water that can be used for drinking and cleaning. Multi-effect desalination is a variation on multi-stage flash desalination but MED is less energy intensive than MSF. Adsorption will take on the remaining brine from MED to further increase the yield of MED. In addition to using this strategy to attempt to reduce energy consumption, we are also using a brackish water feed, which is less saline than normal seawater. The lower salinity should reduce the energy needed to run the system, a positive prospect on a process that is intended to make 50,000,000 gal/day of fresh/potable water.

TEAM #112: STRATOPAC - SUPERSONIC BUSINESS JET

- Department: Mechanical & Aerospace Engineering
- Team members: Timothy Cuatt, Raul Moya, David Moyers, Ivan Pandev, Evan Roper
- Adviser: Dr. Case van Dam

A novel business jet designed to fly at speeds of Mach 1.8, it provides up to 12 passengers a quick but luxurious trip.

TEAM #113: SUPERSONIC SPROCKET - SUPERSONIC BUSINESS JET

- Department: Mechanical & Aerospace Engineering
- Team members: Brett Bacharach, Bond Isheim, Maureen Murphy, Braden Tinucci, Nikos Trembois
- Adviser: Dr. Case van Dam

Imagine flying from New York to London in the morning, having a mid-day business meeting, and being back in time for an evening dinner with your family in New York. The Supersonic Sprocket aircraft aims to do just that by
shortening intercontinental flying time by more than 30%. As part of the NASA Aeronautics Design Challenge, the Supersonic Sprocket is a business jet capable of traveling Mach 1.6 with 17-19 passengers. Our aircraft uses a notched delta wing design to minimize wave drag and a lifting canard to provide longitudinal stability. The Sprocket design aims to beat the competition by using leading edge vortex flaps to establish leading edge suction over the delta wing and improve aerodynamic performance. Adding little to the structural complexity of the wing, the vortex flaps allow the Sprocket to fly at the optimum lift coefficient to perform a cruise climb, flying at an altitude range of 55,000 to 60,000 feet. Two aft-mounted Pratt and Whitney JT8D-219 turbofan engines provide a maximum range exceeding 4000 nautical miles. Superior supersonic inlet engine design reduces the engine inlet shock losses and increases the thrust specific fuel consumption of the engine. Designed to be operational by 2025, the Supersonic Sprocket allows customers a quick and affordable alternative over competing aircraft, opening the skies for a new kind of leisure and business travel.

**TEAM #114: NASA N+1 (NEAR TERM) SUPersonic BUSINESS CLASS AIRCRAFT**
- Department: Mechanical & Aerospace Engineering
- Team members: Manuel Cordova, Jesus Corro Acevedo, David Debenham, Logan Mcgowan, Carlos Ortiz
- Adviser: Dr. Case van Dam

In order to meet the NASA Near Term Supersonic Business Jet challenge, Team Rise developed the SCT-1. This aircraft is designed to cruise at Mach 1.6 with a range of 4000 nautical miles with the implementation of natural laminar flow (NLF).

**TEAM #115: STREAM AEROSPACE SSBJ**
- Department: Mechanical & Aerospace Engineering
- Team members: Patrick Amidjojo, Alvin Chang, Nathan Davis, Honson Si, Stanley Wu
- Adviser: Dr. Case van Dam

Stream Aerospace design team presents a design solution for the NASA university aeronautics design challenge. The design for the next generation supersonic business get features a cranked arrow wing planform, canards and a tri-engine propulsion configuration capable of cruise at Mach 1.6.

**TEAM #116: SUPersonic BUSINESS JET CHALLENGE: TEAM MACH TECH**
- Department: Mechanical & Aerospace Engineering
- Team members: Kasumi Kanetaka, Rachel Meyer, Rina Onishi, Brandon Reddish, Andy Trang
- Adviser: Dr. Case van Dam

The next step in advancing commercial aeronautics is achieving practical supersonic flight. By reducing time in air, the transportation industry can better accommodate the increasing popularity of air travel. Additionally, the demand for convenient city-to-city travel is growing among the business class. In the past, supersonic air travel has been constrained by the technical barriers of efficiency, noise pollution, and safety. The Velox aircraft is being developed to overcome these technical barriers and satisfy the market's demand for convenient commercial air travel. This project showcases the supersonic business jet design of Mach Tech's Velox aircraft which meets the design goals of NASA's Aeronautics Research Directorate for the 2017 University Aeronautics Design Challenge. The aircraft provides means of transporting 14 passengers from Seattle to Tokyo (about 4800 miles) in less than 7 hours at an unparalleled commercial flight Mach number of 1.7. Additionally, the aircraft is a competitive alternative to traditional air travel with an efficiency of 1.21 passenger-miles per pound of fuel consumed. The Velox business jet achieves these design goals through the unique cranked arrow wing design and the adjustable three lifting-surface configuration. The aerodynamics of the aircraft are balanced to optimize flight in the supersonic and subsonic flight regimes which allows for subsonic flight over land and reduced noise pollution. This project embodies the pursuit of increasing speed and efficiency of the current market while also reducing the environmental burdens of supersonic travel.

**TEAM #117: STRATUS LIGHT BUSINESS JET FAMILY**
- Department: Mechanical & Aerospace Engineering
- Team members: Kuanhsu Chen, Noh Kahsay, Alan Manalani, Mark Talan
- Adviser: Dr. Case van Dam

The Stratus Light Business Jet family consists of two jet aircraft designed to carry up to 6 and 8 passengers. The jets are designed for a 2020 entry into service, and boasts a minimum 2,500 nmi range and a maximum cruise Mach number of 0.85. In addition to market leading performance characteristics, this family of jets will have increased flexibility in destinations and operational capacity. Anywhere around the globe, customers can expect a tailored flying experience designed to maximize comfort and minimize cost in this sleek yet efficient platform.
TEAM #118: FINAO 056: THE SUPersonic BUSINESS JET OF THE FUTURE

- Department: Mechanical & Aerospace Engineering
- Team members: Zachary Fitterer, Duarte Lucas, Nikko Mendoza, Tomas Torres-Garcia, Tung Tran
- Adviser: Dr. Case van Dam

There are multiple examples of different types of aircraft achieving supersonic flight. However, there are not any existing supersonic aircraft designed for civilian transport. The FINAO 056 is a supersonic business jet, it’s conceptual design was in response to the NASA Advanced Air Vehicles Student Competition. The FINAO 056 focuses on landing and takeoff performance, cruise performance and sonic boom noise reduction during supersonic cruise. The FINAO 056 cruises at 60,000 feet at Mach 1.8 and carries 10 passengers. The canard wings, which are used to improve performance during takeoff and landing as well as during subsonic flight, are retracted during supersonic cruise in order to reduce drag, improve supersonic cruise performance and avoid possible detachment. The use of the telescopic nose spike allows the FINAO 056 to break down shock waves caused from supersonic cruise ideally reducing the sonic boom noise to inaudible levels. The FINAO 056 supersonic area ruling allows for the reduction of wave drag with out having an overcomplicated design making manufacturing simple and cost efficient. The FINAO 056 is both an efficient and a cost effective option for any businessman that will definitely be ready for commercial service by 2025 and will also be ready to compete with other top of the line supersonic business jets that are currently being designed.

TEAM #119: EMPEROR - SUPersonic BUSINESS JET DESIGN

- Department: Mechanical & Aerospace Engineering
- Team members: Matthew Bauer, Andrew Chuen, Matthew Huang, Keyur Makwana, Daniel Torrecampo
- Adviser: Dr. Case van Dam

This paper describes the design of a commercial supersonic business jet focused on meeting the requirements specified in the 2017 NASA Advanced Air Vehicles Student competition. The design focuses on meeting the RFP limits for supersonic cruise efficiency and high-lift for take-off and landing with an initial operational capability of 2025. Our team’s proposed design, designated Emperor, is a low-wing, 3 engine aircraft capable of accommodating up to 10 passengers. The current design has a range 4,003 nautical miles cruising at Mach 1.6 with a payload of 10 passengers. Emperor has a maximum take-off weight of 86,931 lbs, an empty weight of 43,508 lbs, and a maximum payload of 2,150 lbs. Emperor requires 55,984 lbs of takeoff thrust and is powered by three TF33-P-7 turbofan engines. Emperor combines a Sears-Haack fuselage and a cranked arrow wing to achieve high supersonic efficiency feasible for deployment by 2025.

TEAM #120: SAJETTA - A SUPersonic BUSINESS JET CONCEPT

- Department: Mechanical & Aerospace Engineering
- Team members: Troy Chuang, Venkata Devalaraju, Casey Miller, Oliver Torrealba, Adam Zufall
- Adviser: Dr. Case van Dam

This project consists of designing a supersonic business jet that is to cruise at Mach 1.6 with a range of 4000 nautical miles. The project details the major components of the jet, named “Sajetta”, and also produces results regarding Sajetta’s performance during operation. With a supersonic business jet reemergence currently on the forefront of commercial aviation, Sajetta and its design process aims to facilitate interest in the future technologies of aeronautics.

TEAM #121: DRAGON OF THE WEST

- Department: Mechanical & Aerospace Engineering
- Team members: Mark Bungcayao, Eric Chavez, Abed Fashho, Zian Huang, Ariana Jagodzinski
- Adviser: Dr. Case van Dam

This project was to design two aircraft in a family of light business jets.

TEAM #122: HYDROGEN PRODUCTION THROUGH GASIFICATION OF WASTE WOOD CHIPS

- Department: Chemical Engineering
- Team members: Aaron Choi, Tiffany Ho, Dexter Luu, Robert Wu
- Adviser: Dr. Jason White

Due to growing greenhouse gas emissions causing global warming, cleaner methods of energy and commodity chemicals production are in demand. Biomass gasification is a promising pathway due to the low net pollutant emissions, as a result of carbon dioxide removal from the environment. In this particular study, the plant design is located in Linz, Austria, where woodchips are used to produce hydrogen. This design is crucial because there is an abundance of forest land in Austria that is negatively affected by the increasing greenhouse gas emissions that cause acid rain. Furthermore, this abundance of forest land provides a surplus of feedstock. Hydrogen has a variety of practical applications ranging from ammonia production to fuel cells. The plant model produces 140 million standard
cubic meters of hydrogen gas annually at a purity of 95% by volume. The process is simulated in Aspen Plus and equipment is accurately sized by meticulous analysis. Rigorous economic considerations are taken into account to make the process model a profitable venture. Based on the results of our simulation, we believe that a large-scale hydrogen plant is a promising venture that has the potential of being profitable, sustainable, and environmentally friendly.

TEAM #123: DESIGN OF A HYDROGEN GASIFICATION PLANT TO PRODUCE HIGHLY PURIFIED HYDROGEN GAS EFFECTIVELY AND PROFITABLY

- Department: Chemical Engineering
- Team members: Antonio Del Rio, Zhentao Lin, Joshua Meuser, Yeonju Song
- Adviser: Dr. Jason White

Growing concerns regarding climate change and pollution have fueled efforts to devise new, environmentally friendly methods for fuel production. Biomass gasification is one process that can sustainably produce hydrogen gas—a reliable, practical, and economic renewable source of energy. In this study the catalytic gasification of wood chips in a plant located at Redding, California, was assessed for feasibility and profitability. The process must be capable of supplying local ammonium plants with 145 std m3 H2/year, with a product quality of 95% per volume that can be sold at $1.40 per kilogram on a basis of operating 335 days/yr. To meet these specifications, a circulating fluidized bed reactor (CFB) with a Rh/CeO2/SiO2 catalyst was chosen, operating at 1 bar and 500°C. These operating conditions allow the plant to minimize environmentally harmful byproducts (char and tar), while maintaining a high product conversion rate of 86% at a significantly lower operating temperature and pressure compared to traditional non-catalytic gasification processes. The size of the equipment, reactants required for the feed, and amount of catalyst were determined based on the kinetics of a series of reactions modeling the synthesis of H2 and utilizing Aspen Plus to perform these simulations. Pressure swing adsorption (PSA) was proposed for separating hydrogen and allows for up to 90% hydrogen recovery while achieving 99.9% purity. In order to maximize the profit, a series of sensitivity analyses were performed using Aspen Plus and production efficiency, product quality, and cost analysis were taken into account to ensure that the process is viable and profitable.

TEAM #124: COMPUTER SIMULATED GASIFICATION OF WOOD CHIPS FOR HYDROGEN PRODUCTION

- Department: Chemical Engineering
- Team members: Gieunbong Cheung, Tiffany Hamzar, Phong Nguy, Taehoon Song
- Adviser: Dr. Jason White

Hydrogen is important for the production of ammonia. Wood chip is an important waste product in the western United States. This plant will be situated in Redding, California. The simulation of hydrogen production from the gasification of wood chips is modeled using Aspen Plus. A fluidized reactor is proven to maximize hydrogen production. Heat management strategies were explored to increase energy efficiency. Cost analysis were performed to calculate the profitability of this system, including the capital investment and the return on investment.

TEAM #125: DESIGN AND OPTIMIZATION OF A EUCALYPTUS GASIFICATION PLANT FOR HYDROGEN PRODUCTION

- Department: Chemical Engineering
- Team members: Joshua Olivera, Michael Persyn, Lane Stephens, Michael Tate, Emma Willard
- Adviser: Dr. Jason White

Hydrogen, an energy resource that can remove our dependence from fossil fuels, is a challenging gas to produce industrially. A plant situated in Newcastle, Australia that is fueled by eucalyptus biomass is the designated basis for this reactor design optimization project. The hydrogen produced will be sold to ammonia production facilities nearby. Project specifications included several parameters: a selling price of $1.40/kg of hydrogen, 140 million std m3/yr hydrogen produced with a purity of 95% by volume, and the hydrogen is to be transported from the plant as compressed gas at 400 psia. Of the different types of available methods for gasification of biomass, an entrained reactor was selected to model in Aspen. Upstream processes include biomass drying and preparation. Gases that leave the gasifier are separated to acquire the appropriate purity of hydrogen. Based on the Aspen simulation an economic analysis was performed to determine if the project is feasible.
TEAM #126: HYDROGEN PRODUCTION VIA WASTE TIRE GASIFICATION IN MODESTO, CALIFORNIA

- Department: Chemical Engineering
- Team members: Chong Lee, Xinyu Li, Shayla Nikzad, Zaid Said
- Adviser: Dr. Jason White

In general, gasification technologies involve the thermochemical transformation of a carbonaceous feedstock (fuel) into relatively large quantities of syngas (a mixture of H₂, CO, CO₂, and volatile hydrocarbons), and relatively small quantities of ash/slag, tars/condensables, and char. Steam and air/oxygen are often both injected into the gasification vessel to maintain an oxygen-deprived environment where complete combustion is restricted (Arnayat et al.). The composition of the syngas produced in the gasifier can be shifted more towards hydrogen by varying several parameters—mainly steam-fuel ratio, air-fuel ratio, and temperature. The produced syngas can be further processed to produce more hydrogen in a catalytic water-gas shift (WGS) reactor.

TEAM #127: HYDROGEN GAS PRODUCTION FROM FINNISH PEAT GASIFICATION

- Department: Chemical Engineering
- Team members: Ivana Morris, Raphael Muli, Dylan Roos, Victor Tran
- Adviser: Dr. Jason White

Our group's design assesses the viability of hydrogen production through gasification of peat for an ammonia production plant in Vaasa, Finland. Peat is composed of partly decomposed plant matter. Gasification is the process by which organic material, such as peat, is converted into hydrogen gas, carbon monoxide, carbon dioxide, and other hydrocarbons. The most abundant biomass in Finland is peat, where it is typically used for power generation or soil improvement. There is approximately 89,000 km² of peat spread throughout Finland especially in the northern and western regions. In 2009, only about 620 km² was used. In order to determine the viability of hydrogen production in Finland, safety, environmental, economic, and design consideration will be investigated and taken into account. Using this information, a plant flowsheet was designed on ASPEN Plus in order to assess the viability of producing 140 million standard m³ per year 95%-purity hydrogen from peat in Vaasa, Finland.

TEAM #128: HYDROGEN GAS PRODUCTION VIA WOOD CHIP GASIFICATION

- Department: Chemical Engineering
- Team members: Nathan Maddox, Colleen Salmon, Erika Shaw, Christopher Wheatley
- Adviser: Dr. Jason White

Our project details a process to produce hydrogen gas using the gasification of wood chips—turning carbon waste into a usable form of energy. Gasification is a process in which waste biomass is broken down into its elemental components to produce syngas and solid byproducts. The syngas is then refined through a series of separations to yield a high purity hydrogen gas product. We economically optimized our process in terms of return on investment, net present value, and discounted cash flow by using a bubbling fluidized bed gasifier, a tar reforming catalyst, and chose operating conditions influenced by literature data. An ASPEN Plus simulation was used to develop a heat management system to minimize the dependence on utilities and predict an accurate product yield.

TEAM #129: HYDROGEN PRODUCTION USING WASTE EUCALYPTUS VIA GASIFICATION

- Department: Chemical Engineering
- Team members: Ian Gordon, Vinh Nguyen, Osereme Ujadughele, Bao-An Vuong
- Adviser: Dr. Jason White

Our senior design project focuses on the feasibility of producing hydrogen gas via gasification of waste Eucalyptus in Newcastle, Australia. The goal of this project is to design a process to produce about 140 million std m³ of hydrogen per year with a minimum purity of 95% by volume. Our design model used Aspen Plus V9 simulations in order to optimize for economic viability, safety, and heat efficiency while minding environmental impact. The process includes a drier-gasifier to convert raw waste eucalyptus into a gaseous form, a steam-methane reformer, hot gas cleaning, a 3-stage compressor, a water-gas shift reaction, flash separation, and pressure swing adsorption to convert approximately 250 tons/day of biomass into the desired product. Through research and creativity, the assessment of our technology, economic potential, environmental impact and existing regulations enabled us to determine whether or not this process is practical, economically feasible and environmentally acceptable.

TEAM #130: GASIFICATION OF MUNICIPAL SOLID WASTE TO PRODUCE HYDROGEN GAS

- Department: Chemical Engineering
- Team members: Raoul Carpio, Justin Kwong, Michael Li, Maureen Njuguna
- Adviser: Dr. Jason White

The goal of this project is to propose a gasification design
for the production of hydrogen which includes the pretreatment of the municipal solid waste feed, production of syngas, as well as the hydrogen purification process. This facility which is located in Beijing will provide hydrogen to ammonia production facilities in China where there is a large demand for this as China produces more ammonia than any other country. The design specification of our plant is to produce 140 million standard m3 of hydrogen gas that is 95% pure by volume. In order to achieve this production rate, Aspen was utilized to model our process and it was determined that 27910.6 kg/hr of municipal solid waste was needed, of which, only 6.7% by mass of the feed was usable. The proposed gasifier is a circulating fluidized bed reactor that will operate at in conjunction with a decomposer and char combustion reactor. In order to provide the necessary oxygen, it was determined that a 98% oxygen feed source would be achieved using an in-house facility that purified the oxygen in air. This is a design that not only eliminates landfill waste in a more environmentally sustainable manner than typical waste treatment facilities, but also is able to produce valuable hydrogen gas. Included in this technical analysis are a detailed operation and performance of the process as well as the capital costs and investments of this facility.

**TEAM #131: GASIFICATION OF WASTE TIRES TO PRODUCE HYDROGEN**

- **Department: Chemical Engineering**
- **Team members: Noah Ekstrom, Kenneth Gath, Michael Silva, Joseph Zablocki**
- **Adviser: Dr. Jason White**

This design utilizes waste tires as a gasifying feedstock for the production of hydrogen at a plant located in Modesto, California. This plant will produce 140 million standard cubic meters of hydrogen per year at 95% purity. The hydrogen must be transported from the plant at 400 psia and can be sold at $140 per kilogram. Based on current literature and preliminary reactor design, our plant will produce the required amount of hydrogen with a feedstock around 190,000 pounds of tires - roughly 9.7 million whole tires - per year. A base-level input-output analysis shows a potential annual profit around $14 million per year while simultaneously reducing the landfill burden currently caused by waste tires.

**TEAM #132: ESSENTIAL OIL PRODUCTION FOR ALLEVIATING POVERTY IN BRAZIL**

- **Department: Biological & Agricultural Engineering**
- **Team members: Tara Randall, Thomas Wickett, Ashley Yamada**
- **Advisers: Dr. Kurt Kornbluth, Dr. Ruihong Zhang**

Boa Vista do Acará is a small agricultural community in northern Brazil. Like many communities in the region, Boa Vista is impoverished and lacks basic social services such as healthcare and education. Residents make a large portion of their income through the cultivation and sale of herbs to large corporations, however, financial crisis would occur if these companies were to cancel their contracts. The ability to distill essential oils would allow Boa Vista Do Acará residents to stabilize their income. Our team is collaborating with the Association of Organic Farmers of Boa Vista do Acará (APOBV) to build an oil distillation device to suit the needs of this community. Due to the remote location of Boa Vista, the community does not have access to electricity, so the oil distiller must operate in humid conditions with fire as the primary energy source. The distiller must also be practical and safe because it will be introduced to a community without a technical background. Lastly, the oils must be high quality to successfully sell to tourists in local markets. With these parameters in mind, our team will help alleviate poverty in Boa Vista by designing an essential oil distillation device that produces high quality essential oil without the aid of modern technology.

**TEAM #133: WALNUT WATER ACTIVITY SENSOR**

- **Department: Biological & Agricultural Engineering**
- **Team members: Crystal Dinh, Nathan Evangelista, Yuanjing Zhang**
- **Advisers: Dr. Irwin Donis-Gonzalez, Dr. Ruihong Zhang**

Walnut drying control is a large issue due to the influence of weather, drying facilities, and walnut species that result in difficulties to determine the optimal drying time. Therefore, there is an urgent demand to find a method that accurately depicts this value in various drying scenarios. Currently, water content is used as an indicator for drying time, however water activity has a more direct representation when it comes to processing and preserving food. Water activity is the ratio of partial vapor pressures of the water within the substance to pure water. It is also the percentage of water in a system available for chemical, microbiological and enzymatic reactions. Water activity only includes capillary and free water, which are responsible for these reactions. Thus in comparison to water content, it is a better gauge for walnut drying time. The goal of this project is to develop an inexpensive portable real-time water activity sensor with accuracy within 0.1 water activity units for the walnut drying process. This sensor has an Arduino Uno microcontroller that will calculate water activity from temperature and relative humidity measurements. Theoretically, this sensor will minimize over-drying and the consequent loss of product, fuel and time.
TEAM #134: CO24U: LOW-COST CARBON UPTAKE SENSING SYSTEM FOR PLANTS

- Department: Biological & Agricultural Engineering
- Team members: Sandi Mar, Matthew Paddock, Francisco Zorrilla
- Advisers: Dr. Kurt Kornbluth, Dr. Ruihong Zhang

Global carbon dioxide concentrations are rising and directly affect the growth of crops. Assessing the impacts this will have on our food production is vital to ensure adequate food supply for a growing population. Current carbon uptake sensing systems for crops measure the change in carbon dioxide concentration in the presence of plant material. While simple, these systems can exceed $30K which makes them inaccessible to many students and researchers. This project aims to design and develop an inexpensive arduino-based carbon uptake monitor system for plants. It will measure the change in carbon dioxide concentration in a closed system as well as other environmental parameters such as air temperature, leaf temperature, relative humidity, atmospheric pressure, and light intensity. By using inexpensive and readily accessible materials, future engineers and scientists will be able to utilize our design and make necessary changes to better fit their projects.

TEAM #135: PILOT SCALE ALGAE PHOTOBIOREACTOR UTILIZING ANAEROBIC DIGESTER FEEDSTOCK

- Department: Biological & Agricultural Engineering
- Team members: Kenneth Cunningham, Wilson Fung, Kyle Huen, James O’Brien
- Adviser: Dr. Ruihong Zhang

Microalgae is becoming a major player in diversifying world energy feedstocks. At UC Davis, researchers in various departments have been working together to make this a financially viable option by growing algae on organic waste products. Our group is taking these lab-bench experiments a step further to scale up this process. We are building a 100-liter photobioreactor equipped with automatic pumping, mixing, CO2 bubbling, and temperature control for optimal algae growth. This algae can then be dried and filtered for biodiesel production. We are working in collaboration with the Ruihong Zhang Bioenvironmental Engineering Lab, the Chemistry Department, the California Energy Commission, and Clean World Partners.

TEAM #136: TREE WARMING CHAMBER

- Department: Biological & Agricultural Engineering
- Team members: Wesley Lee, Cameron Osborn, Eduardo Rojas
- Adviser: Dr. Maciej Zwieniecki, Dr. Ruihong Zhang

Temperatures are rising due to global warming effects, and are thereby decreasing the number of chilling hours of deciduous fruit trees, which affects fruit growth and development. Scientists need a way to study these changes now, before they actually occur. The Tree Warming Chamber is an automated heating chamber that will not allow the enclosed tree any chilling hours, and thereby allowing researchers to observe the development effects under the worst case scenario should global warming continue as projected.

TEAM #137: DESIGN OF CUCUMBER PICK-UP IMPLEMENT FOR THE BALFER CUCUMBER SEED HARVESTER

- Department: Biological & Agricultural Engineering
- Team members: Julie Meyers, Cinthia Reyes, Wisia Wong
- Advisers: Dr. Kurt Kornbluth, Dr. Ruihong Zhang

The overall goal of this project is to design and build a prototype of a cucumber pick-up implement that will be adapted for use on an existing cucumber seed harvester (the BalFer) to optimize the cucumber pick-up process. The existing harvester, which is located in Valparaiso, Chile, was constructed by our client, José Balbontín, to expedite cucumber seed harvest. Before the creation of this machine, harvest was done by hand, so this machine has the potential to greatly improve the efficiency of processing cucumber seeds. However, during the harvester’s first use in the field, several problems arose such as cucumbers being missed by the harvester. The team has decided to improve the machine by replacing the spiked pick-up wheel component, which is not effective enough at picking up cucumbers to make using the harvester profitable.
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