FRESNO STATE®

Lyles College of Engineering

12TH ANNUAL

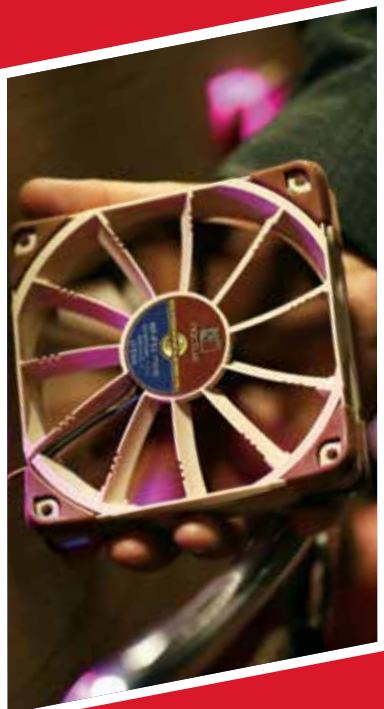
PROJECTS DAY

RESEARCH
INNOVATION
DESIGN

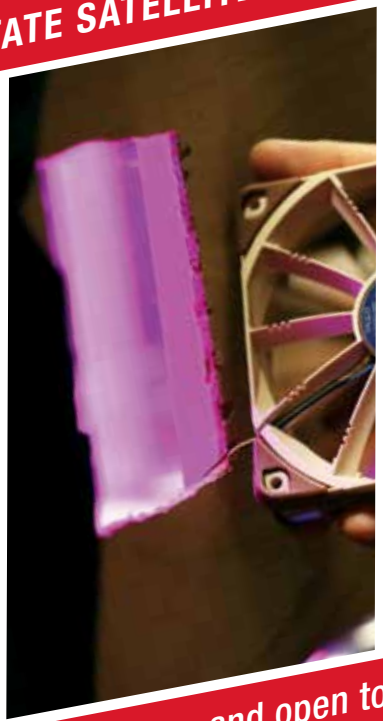
MAY 7, 2019

2:00 p.m. - 6 p.m.

FRESNO STATE SATELLITE STUDENT UNION






Free admission and open to the public

fresnostate.edu/engineering

WELCOME ATTENDEES!

Thank you for attending Lyles College of Engineering's 12th Annual Projects Day. It is an honor and privilege for our students to showcase their hard work and innovative designs to the community.

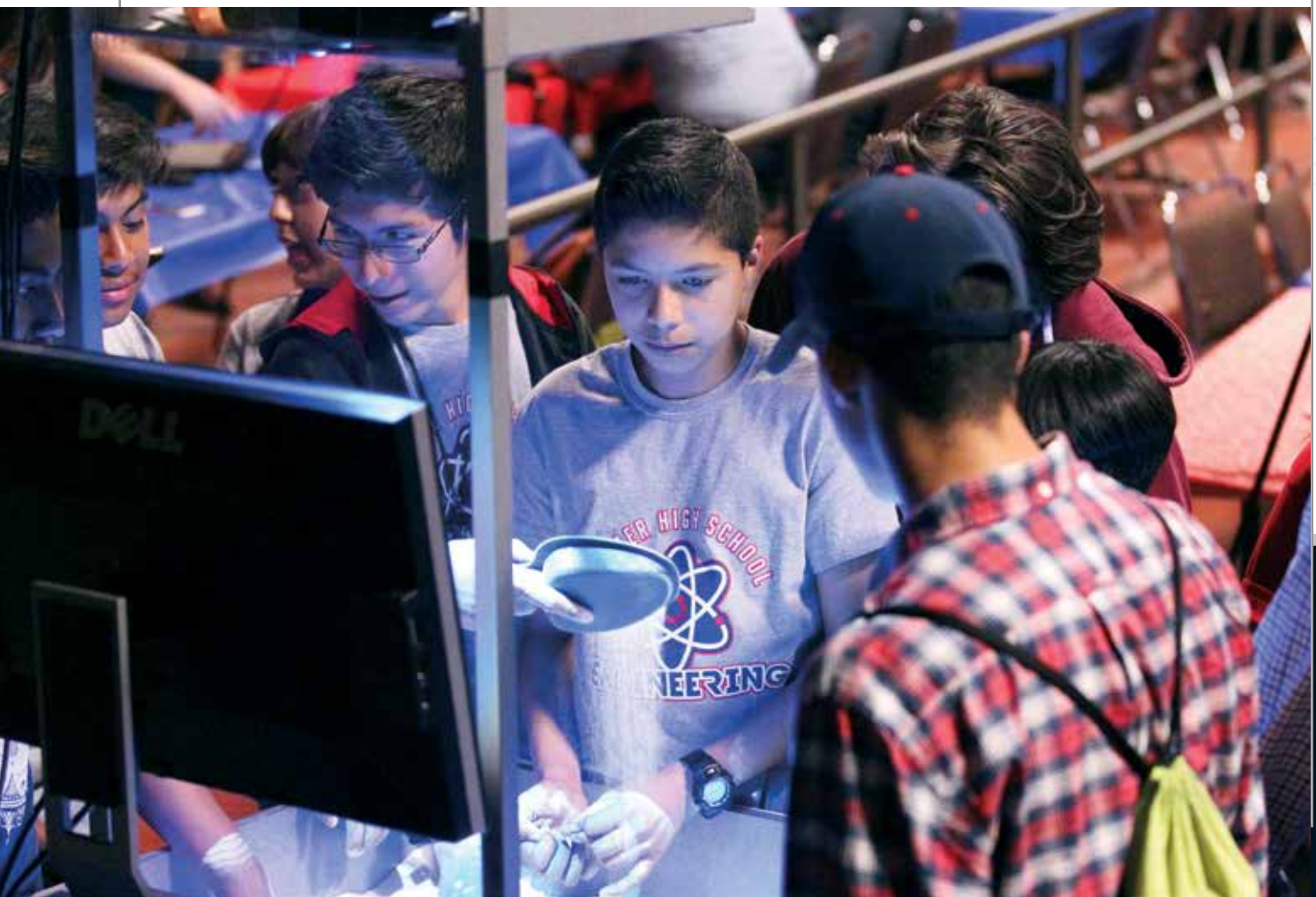
The projects showcased are a culmination of at least one-year of research and design activities in the disciplines of civil, computer, electrical, geomatics, and mechanical engineering as well as construction management. Student projects are supported by Lyles College faculty advisors, staff and industry liaisons and are funded by internal and external grants, companies, and students. Thank you to the numerous industry professionals for their generous gift of time and mentorship.

A very special thank you to Quiring General, LLC, for their outstanding support of the Lyles College of Engineering and especially to help showcase the innovative projects on display today.

QUIRING

Please, enjoy the showcase.

Dr. Ram Nunna
Dean, Lyles College of Engineering
Fresno State



12TH ANNUAL

PROJECTS DAY

RESEARCH • INNOVATION • DESIGN

Projects Day Coordinator
Hernan Maldonado
Director of Pathways Student Services

Communications Coordinator
Rebecca Wass

CONTENTS:

FRESNO STATE®

Lyles College of Engineering

CIVIL ENGINEERING

1 2019 ASCE MidPac Concrete Canoe

Students: **Ruben Amavizca, Darren Fagundes, Sebastian Jue, Linda Lim, Tyler Wilfong (EIT)**
Advisors/Mentors: **Dr. Maryam Nazari, Dr. Aly Tawfik**

Project Summary: The 2019 ASCE MidPac concrete canoe and transportation competitions allow students to utilize technical skills to produce real-world projects. The concrete canoe competition seeks to apply principles of structural analysis, mechanics of materials, and project management. The canoe must follow mix design, reinforcement design, and geometric design specifications. A hypothetical steel display frame and steel storage structure are designed for the canoe. The 'transportation competition' uses traffic analysis and intersection design to improve the traffic safety on Santa Clara St. in downtown San Jose. The project consists of implementing the Vision Zero concept for design of intersections, pavement, and signalization to improve safety conditions within the area.

2 A Case Study on Economy, Energy, and Emissions of the Tire-derived Aggregate Concrete

Student: **Diem Truong**
Advisor/Mentor: **Dr. Fariborz Tehrani**

Project Summary: This research is to study and evaluate the benefit of substituting regular aggregates in concrete with recycling tires. An estimated 300 million tires are disposed in the landfill annually. Using scrap tires in concrete is a great potential to divert waste tires from landfills. Reducing the environmental footprint and protecting the earth from pollution. Previous studies have found that tire derived aggregate (TDA) reduces its strength as increasing the content of tires. However, its toughness and energy absorption are significantly enhanced with tire volume content. Input energy and greenhouse gas emission are unavoidable consequences when producing TDA. This study evaluates the balance between market pricing, input energy and greenhouse gas emission with the application of ENVISION.

3 A Case Study on the Sustainability Assessment and ENVISION Rating of Exterior Masonry Walls Containing Lightweight Expanded Clay Aggregates in Conventional Buildings

Students: **Elnaz Mohammadiyaghini, Roshanak Farshidpour**
Advisors/Mentors: **Dr. Fariborz Tehrani, Mohammad Pouramini, Dr. Alireza Namadmalian Esfahani, Mahdi Mousavi**
Sponsors: **LECA Co., Iran, Fresno State Undergraduate Research Grant Award**

Project Summary: This project presents a case study on input energy and greenhouse gas (GHG) emissions of lightweight expanded clay aggregates (LECA) from production to deployment in masonry units. Substitution of natural mineral aggregates with LECA offers new opportunities to optimize resource allocation and reduce environmental footprints of buildings. This case study investigates a completed office building with exterior walls made of lightweight masonry units and considers a bottom-up estimate of energy and emissions accompanied with lighting, as well as heating, ventilation, and air conditioning (HVAC). Results facilitate an objective assessment of the building in respect to sustainability and provide comparative analyses using ENVISION sustainability rating.

4 A Surface Water Treatment Facility for the City of Los Banos

Students: **Brandon Cauble, Carlos Gonzalez, Ryan Provost (EIT), Jose Ariola**
Advisors/Mentors: **Dr. William Wright, Dr. Fayzul Pasha**

Project Summary: The Merced County Groundwater Basin is the primary water source for the City of Los Banos. Over drafting has lowered the groundwater levels in the past years. If the groundwater is not properly recharged, the cost of retrieval and proper treatment of the groundwater will substantially rise. The City of Los Banos needs to transition from the groundwater supply to a more reliable alternative. In this case, surface water is the most feasible option. This project proposes a surface water treatment facility to produce a quality of water that is safe for human consumption, and in compliance with State and Federal regulations in general, and Environmental Protection Agency (EPA) guidelines, in particular.

5 Additions to Clovis Community College

Student: **Freddy Gomez, Cameron Moore, Jacob Shwiyhat, Alexander Wiens**
Advisors/Mentors: **Dr. Fariborz Tehrani, Dr. Lalita Oka, Dr. Kimberly Stillmaker, Dr. William Wright, Mr. Cordie Qualle, PE**
Sponsor: **Mr. Sal Alvarez, Technicon Engineering Services, Inc.**

Project Summary: This hypothetical project is to assist Clovis Community College (CCC) in adding new buildings to the campus. CCC expects a total of 20,000 students and faculty by the end of the 2025 Master Plan. Perspective Engineering is tasked with designing the gymnasium along with providing the amenities such as wastewater and domestic water design for the entire campus. The gymnasium covers an area with nearly 43,000 square feet and accommodates nearly 2,500 people. There will be a main court and a viewing area as well as locker rooms, restrooms, classrooms, offices and an entryway. A geotechnical report will also be completed for the location in which the gymnasium will be built.

6 Analytical Study of the Structural Response to Near-Field Earthquakes

Students: **Isidro Perez**
Advisor/Mentor: **Dr. Maryam Nazari**

Project Summary: There are regions where structures, cities, or water reservoirs are built near fault lines. When an earthquake occurs near the fault lines, they can be categorized as near-field earthquakes. A near-field earthquake generally has a higher initial peak resulting in a larger seismic response, when compared to a far-field earthquake ground motion. An analytical model will be created that can recreate synthetic ground motions with the goal to closely represent the characteristics of pulse-type near-field ground motion with pulse extraction methods. The procedure will include utilizing wavelet-based signal processing to extract the peak velocity pulses from near-field ground motions, especially those that exhibit the pulse-type behavior. The results will be utilized to generate a design spectrum for the estimation of design forces for buildings subjected to near-field ground motions, especially those exhibiting a pulse-type behavior.

7 Central Valley's New Medical School Campus

Students: **Abdulaziz Alharthy, Malik Alqatami, Erika Lansburgh, Matthew Tobin, Sheeneng Vang**
Advisor/Mentor: **Dr. Fariborz Tehrani, Dr. Arezoo Sadrinezhad, Dr. Xiajun Li, Dr. Kimberly Stillmaker, Dr. Lubo Liu, Dr. Fayzul Pasha, Jakob Schallberger, EIT (BSK Staff Engineer)**
Sponsor: **BSK Associates**

Project Summary: As the population of the Central Valley grows, so does the need for qualified healthcare professionals. In order to meet the future demand for physicians, it is necessary to increase the capacity to educate these individuals. The new medical school campus will serve to provide the valley with these vital training facilities. The project will be developed in northwest Clovis and consist of three main structures: a main building, a parking structure, and a maintenance building. The main structure, Building A, will consist of offices, classrooms, laboratories, and student accommodations. The new campus will enroll a total of 1,500 MD, MS, and Ph.D. students, a faculty population of 60, and a support staff of 30.

8 Fresno State Student Apartment Complex

Students: **Sara Almahoudi, Roshanak Farshidpour, Vianna Larios, Ricardo Loza, Reyna Rodriguez, Hongyu Tan**
Advisors/Mentors: **Dr. Fariborz Tehrani, Dr. Lubo Liu, Dr. William Wright, Dr. Aly Tawfik, Brad Hyatt, PE**

Project Summary: In an effort to broaden housing options for Fresno State students, Fresno State Student Affairs proposes to develop a 3- Story Apartment Complex containing 1, 2, and 3-bedroom units. The structure will contain amenities including Solar Shaded Parking Stalls, as well as a Recreation Room. The proposed project will require the development of a sustainable building, code compliant, that provides students with amenities needed. The structure will provide required number of units and parking that is able to house 500 students. The project will also include the design of a stormwater management system that complies with local and university standards, promotes sustainability, and prevents flooding by incorporating a temporary detention pond. A collection and conveyance system will be included along with a detention pond that will store the excess water. In addition, a water distribution and sewer systems also needed to ensure that this apartment can function properly.

9 Fresno-Clovis Regional Tertiary Treatment Water Reclamation Facility

Students: Devin Brar (EIT), Dario Daez, Justin Faure (EIT), Brooke Poore, Jose Salgado
Advisors/Mentors: Mr. Cordie Qualle, P.E., Dr. William Wright, Dr. Ching Choo, Aly Tawfik, Dr. Fariborz Tehrani

Project Summary: This project proposes the design of a Tertiary Treatment facility at the Fresno-Clovis Regional Wastewater Reclamation Facility. The City of Fresno requires an increase of potable water sources to service the cities ever-growing population and to alleviate strain on groundwater sources. The proposed expansion has the ability to produce potable drinking water from the city's wastewater source. Once constructed, the facility will have the potential to treat 176 MGD through a multitude of advanced treatment process, including; Biologically Activated Carbon (BAC) beds, ultra-membrane filtration, Reverse Osmosis (RO) and advanced oxidation. To support the expansion, the facility will require an increase in water storage and conveyance, structural design, as well as on-site and off-site transportation upgrades. Once being treated, the finished water will be placed directly into the potable water system and ready for consumption.

10 Investigating Performance Based Analysis of Steel Structural Building Designed Using Buckling Restrained Braces

Student: Nasreen Pathan
Advisors/Mentors: Dr. Fariborz Tehrani, Dr. Maryam Nazari

Project Summary: The energy dissipation or damage prevention of concentrically braced frames can be enhanced by using Buckling-Restrained Buckling restrained brace frames (BRBFs). BRBFs usually consists of a steel core, and a steel casing which may be of either concrete, steel, composite, or other construction. The main characteristic of these braces are that they can yield inelastically both in tension and compression at their adjusted strengths. The primary purpose of this study is to design BRBs, and to check the performance of designed frame elements (beams and columns) to adjusted axial strengths of BRB. Details of the building for investigation have taken from the previous research paper. The structure is assumed to be located in San Francisco, California. A linear static analysis has been performed on a seven-story 2D frame using SAP 2000 to study the performance of braces.

11 Multi Story Public Housing

Students: Shabeeb Al Dossary, Isaac Macias, Jake Perez, Alberto Romero, William Yeung
Advisors/Mentors: Dr. Lubo Liu, Dr. Kimberly Stillmaker, Dr. Arezoo Sadrinezhad, Dr. Fayzul Pasha, Dr. Xiaojun Li, Jakob Schallberger, EIT (BSK Staff Engineer)
Sponsor: BSK Associates

Project Summary: The City of Fresno hosts 40,000 low-income families who spend 50% or more of their income on housing. Fresno County currently has 20,000 affordable rental homes available. This project proposes 300 more units to be available for low-income families to reside in. The proposal involves designing a three-story apartment complex that is located in an area with access to public transportation, nearby medical facilities, and nearby schools. The project also includes a parking lot with minimum 120 stalls to accommodate the residents, visitors, and employees of the apartment complex. This proposal anticipates heightened traffic demands, and thus, addresses this issue by widening the Marks Avenue, the nearby collector street, to accommodate the growth of vehicles and pedestrians.

12 Shake Table Study of Pile-Cap Effects on Seismic Behavior of Structures

Student: Diana Rosas
Advisor/Mentor: Dr. Maryam Nazari
Sponsor: Lyles College of Engineering Graduate Research Grant

Project Summary: There are several factors to consider while assessing the seismic performance of structures; the superstructure, the foundation, and the soil beneath it. However, the interactions between these components are usually neglected in the seismic analysis of structures. In nonlinear time history analysis of structures, the free field ground motions are usually applied to the fixed base structure and the effect of foundation flexibility is ignored. In this study, the effect of foundation flexibility on seismic performance of tall buildings is assessed. For this purpose, a 3D moment resisting frame building is modeled in SAP2000 and nonlinear time history analysis is conducted. The structure sits on different foundation types; shallow foundation, pile (deep) foundations with rigid and flexible pile caps. The structure rests on loose sand. The results from the analytical models are used to create a framework for shake table testing of a 15-story prototype building, which is scaled down with a scale factor equal to 1/22, using the facilities in the structural lab in the Lyles College of Engineering at Fresno State.

13 Tesoro Viejo Land Development Project

Students: **Mohammad Almobaid, Meshari Alsahli II, Bo Campbell, Chee Lee, Alyssa Nishikawa (EIT)**
Advisors/Mentors: **Dr. Fariborz Tehrani, Mr. Cordie Qualle, PE, Dr. Aly Tawfik**

Project Summary: Tesoro Viejo is an existing three-phase land development project located in Madera County, east of the intersection of State Route 41 and Avenue 15. At full buildout, this project will consist of 5,190 homes within 1,600 acres of property which will house about 100,000 people. The development of the proposed project will include residential, commercial retail, recreational, office, and light industrial areas. For utilities and storm water facilities, the propose project will provide 37 acres. Additionally, 28 acres will be dedicated to the State Route 41 for realignment. Tesoro Viejo is currently in construction and has already been furnished with a few model homes along with a town welcome center. The sheriff substation, elementary school and fire department are also complete along with other commercial and multi-office use buildings. The full project build-out has been estimated for 2030.

14 Urban Design Project

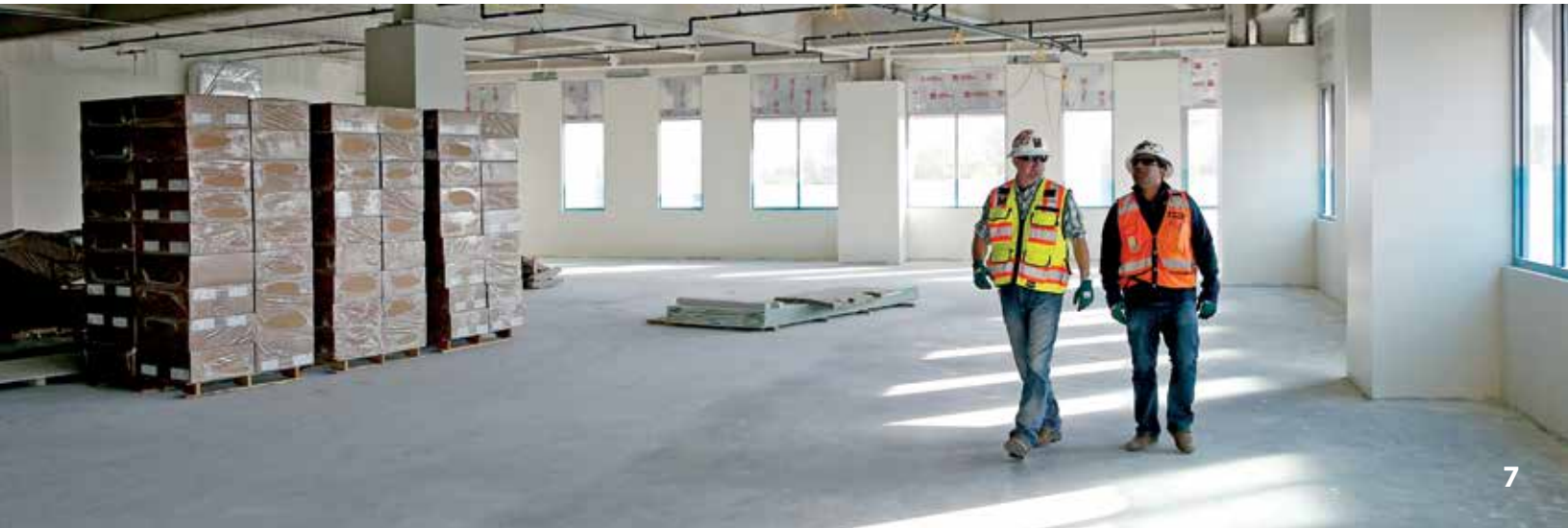
Students: **Justin Green, Tiffany Ljuba (EIT), Gladis Reyes, Joey Serrano (EIT), Nicholas Yanes**
Advisors/Mentors: **Dr. Aly Tawfik, Dr. Fariborz Tehrani, Dr. Fayzul Pasha**

Project Summary: The region of Southwest Fresno has been neglected, when it comes to new developments in the City of Fresno. This has led to a decline in the economy, safety, and community development. This project proposes an urban design project in this location to address those developmental neglects. This project will focus on the civil engineering planning and design to implement a superblock concept in Southwest Fresno. The superblock concept is a proven urban development that allows communities to strive in self-sustainability, economy, and safety. Successful implementation of this project requires major renovations and additions to current transportation systems and water infrastructure. The project also includes structures to house different facilities that are necessary for the superblock concept.

15 Using Recycled Asphalt Pavement in Portland Cement Concrete and Its Effects on Strength, Shrinkage, and Deformation

Student: **Tahrima Alam**
Advisor/Mentor: **Dr. Xiaojun Li**
Sponsor: **Lyles College of Engineering Research Award**

Project Summary: Portland cement concrete (PCC) is a very versatile and cost-effective structural material. It is fairly cheap, strong, and it can be molded into the desirable shape and need. A downside to PCC, however, is its propensity to shrink while drying. This project entails examining the advantages of using recycled asphalt pavement (RAP) in PCC. Usually using RAP as natural aggregate substitution to produce PCC (RAP-PCC) will cause a reduction in strength. However, in pavement engineering, normally the strength of the concrete is not a big concern. Rather, the shrinkage cracking is the major cause of distress. This study will investigate the shrinkage and deformation properties of RAP-PCC as well as the compressive strength. Typical mechanical properties that are tested include compressive and tensile strength, modulus of rupture, and shrinkage.



GEOMATICS ENGINEERING

1 Comparing Surfaces

Student: **Kelly Hobbs**
Advisors/Mentors: **Dr. Mike Berber, Dr. Scott Peterson, Dr. Riadh Munjy**

Project Summary: Using different sets of data (potentially terrestrial LiDAR, aerial LiDAR, photogrammetric data, etc.) obtained in the field, the accuracy between the control points and the means of interpolating between these points will be analyzed and compared using different methods available. (Example: ArcMap, AutoCAD, LP360) Using the conclusions drawn, a site will be chosen to apply the information and provide a rendering of the area to a high degree of accuracy. The 2014 ASPRS digital elevation standards are expected to be used..

2 Survey Field Day VR Training

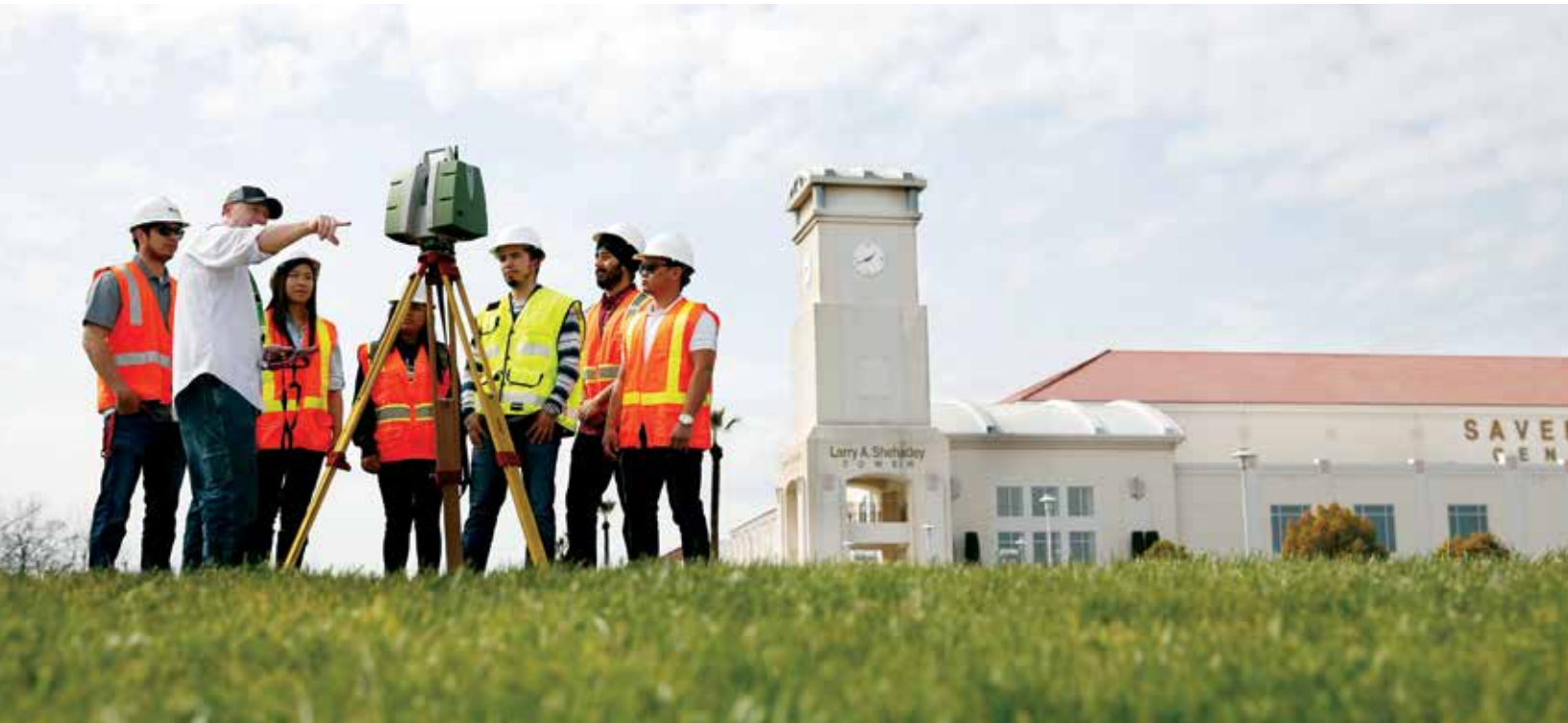
Student: **Amir Ayyash**
Advisors/Mentors: **Dr. Yoshin Ahn, Dr. Scott Peterson**

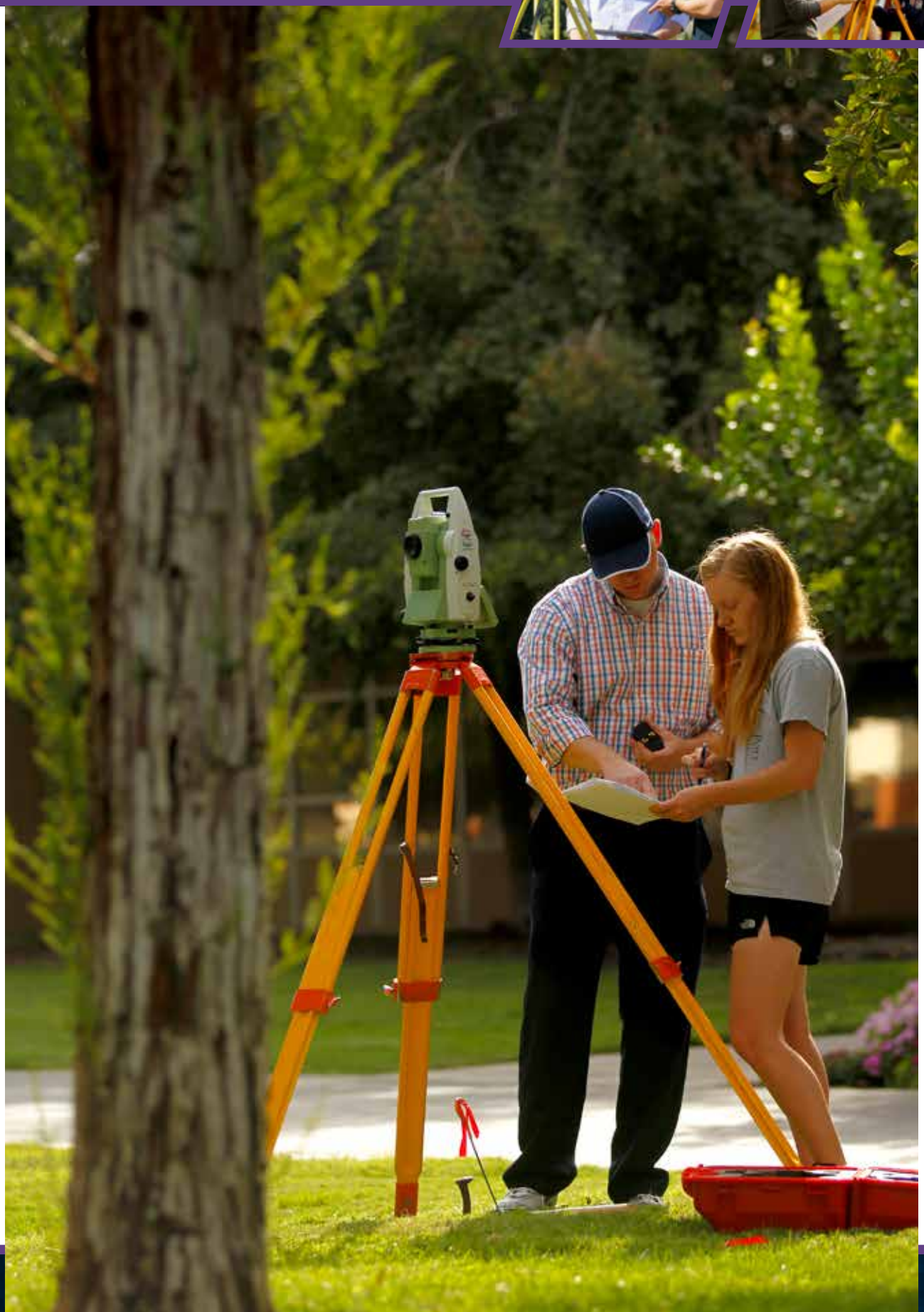
Project Summary: The field of Geomatics Engineering, specifically as a surveyor, involves both field and office work. To give an interactive representation of what field work would be like in a convenient and timely manner, and to appeal to a wider audience, a new method of demonstration is available in the form of Virtual Reality/Augmented Reality. This project aims to simulate what typical work is like in the field, but may also include office work or import office work done prior to the simulation. This project will attempt to emulate the field processes of: finding control, setting up a tripod (centering and levelling), using a prism to take points and set control, and general terrain issues.

3 Writing and Recording an Easement

Student: **Hunter Eldridge**
Advisors/Mentors: **Dr. Yushin Ahn, Iley Ballinger**

Project Summary: My sister is in the process of buying a house. After reviewing all legal documents and maps, we realized that it is a land-locked parcel, which could cause problems when trying to get a loan from the bank. The driveway to this house crosses over two different properties. With consent from both land owners, I will create the easements for both properties. I will be preparing the exhibits and writing legal descriptions for the easements. I will have a licensed land surveyor, Iley Ballinger, review my work and sign it. Then, I will take it to Fresno County for it to be recorded.





CONSTRUCTION MANAGEMENT

1 AT&T Tiny Office

Students: Victor Lopez, Angel Sandoval, Jacinto Moreno, Max Ramirez, Mohammed B.
Advisor/Mentor: Molly LM Smith, AIA
Sponsors: AT&T, Fresno State Student Affairs

Project Summary: The purpose of this office will be to aid the student body at Fresno State. Making it easier for students to get help with financial aid or any other admirative questions a student might have. We have created a few designs that showcase the appearance of what the tiny office will look like. The design was presented to student services and they provided feedback on what they would like to add or edit. We as students will oversee the budget, design, and construction of this tiny office. The estimated completion for this project is May 2019.

2 Community Facilities Challenge - Common Space

Students: Marco Chavez, Saud Alhajry, Edward Rangel
Advisor/Mentor: Lloyd Crask, PE
Sponsor: Northern California Community Loan Fund

Project Summary: Northern California Community Loan Fund is proud to present for the 5th time, the Community Facilities Challenge at Fresno State. Students from the Construction Management Department, Department of Art and Design, and the Humanics Program will apply our skills and knowledge in preparation for a real estate feasibility analysis for Common Space, a nonprofit center in Fresno, CA. Common Space recently leased more than 8,500 square-feet to create a nonprofit hub for organizations to lease office space, hold events, and incubate new organizations. Our team is to create a construction budget and schedule that will help Common Space decide on future additions to their location to better help create positive and sustainable change for the Central Valley by collaborative-community centered efforts.

3 Cultivating Construction Management Students' Career-Specific Skill Sets With Mixed Reality

Student: Angel Sandoval
Advisor/Mentor: Dr. Wei Wu
Sponsor: Fresno State ASI Undergraduate Research Grant

Project Summary: The purpose of this project is to explore how the use of mixed reality technology such as the Microsoft HoloLens, impacts the development of career-specific skill sets among construction management students. During Fall of 2018 research was conducted and in Spring 2019 the data will be analyzed. The data acquired came from a lower division Construction Management course in which students built a wood framing structure. Students who were part of the research were provided with Microsoft HoloLens to analyze a 3D model and build it. The students were instructed to use the 3D model and build off of it without any paper plans. The objective of this research is to analyze the advantages and disadvantages that mixed reality will provide to those who use the Microsoft HoloLens versus those who use the traditional plans.

4 Fresno State Parking Structure

Students: Juan Navarrete, Beatriz Sandoval, Melanie Valladares
Advisor/Mentor: Brad Hyatt, PE
Sponsor: Built Environment Collaborative (BEC)

Project Summary: As Fresno State continues to attract more students, the need to provide convenient parking on campus is a significant concern for students. The density and limited amount of development land around the campus has made it challenging to increase the parking supply in the past. As such, the team considered the construction of a cast-in-place parking structure to replace Parking Lot 23 and 24 located on Barstow Avenue and Campus Drive, Fresno, CA. The proposed parking structure is a four-story building that will accommodate 1,400 cars and have a pedestrian bridge. The bridge will allow students from Parking Lot 20 to cross Barstow Avenue in order to improve pedestrian traffic in this area. The parking structure will not only accommodate the parking supply need but can serve as extra parking for football events. The concept of a $27,000,000 cast-in-place parking structure will not only meet Fresno State's parking supply needs but also provide a viable solution for the concern of parking convenience.

5 NCCLF Community Challenge-VISION VIEW

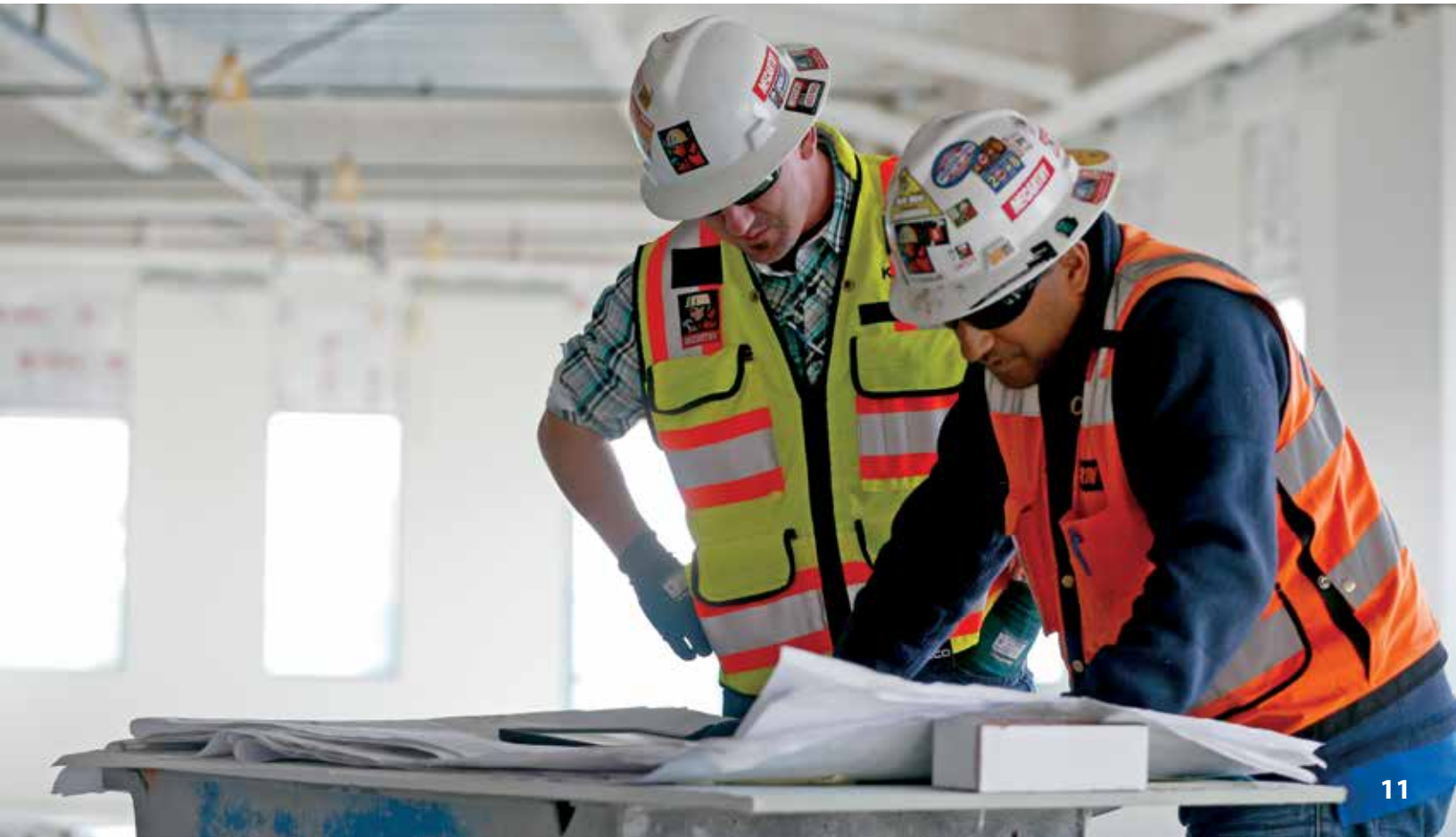
Students: **Trent Soechting, Wes Mohler, Kaycee Sexauer, Elaria Meleka, Janessa Pacheco, Yer Vang**
Advisor/Mentor: **Lloyd Crask, PE**
Sponsor: **Northern California Community Loan Fund: Vision View**

Project Summary: Our team has the opportunity to partner with three non-profit organizations that have come together under the Vision View name. We've been tasked with designing and estimating new renovations to the complex the nonprofit organizations are located at. With the complex being located right next to the Fresno International Airport, the owner has a desire to create a space where travelers can perform their work in a comfortable space. Vision View also wants to appeal to the community by providing healthy food at their international themed food court. Our team is excited for the challenge of designing an appealing complex that attracts the community and travelers to check out all that Vision View has to offer.

6 Vision View Building B

Students: **Elizabeth Espinoza, Miguel Uribe, Hilda Abigail, Luis Quintanilla, Jordana Guy, Gaonoucci Belle Vang**
Advisors/Mentors: **Brad Hyatt, PE, Molly LM Smith, AIA, Lloyd Crask, PE**

Project Summary: The Northern California Community Loan Fund (NCCLF) invests in nonprofits and social enterprises that better lives and build equity in low income Northern and Central California neighborhoods. They provide nonprofits and social enterprises the financing they need to make a difference in their communities and help nonprofits with challenges that need to be addressed. The Community Facilities Challenge (CFC) is a competition where teams made up of Fresno State students develop solutions to real world nonprofit facility projects in the Fresno area. The project for NCCLF this year is renovating a business campus. The primary focus is on the Vision View Building B, which is currently non-operable. The roof of the building collapsed more than two years ago. Since then, there has been water damage, environmental issues, and other hazardous problems. The owner of the buildings would like to have spaces to rent out. The client envisions offices, a dance studio, a movie theater, coffee shops, cafés, bistros and multi use rooms. The team's goal is to create a design, budget, & schedule that incorporates the client's wants and needs.



ELECTRICAL AND COMPUTER ENGINEERING

1 Determining Glucose Levels Using Photo-Acoustics

Student: Jodi Bishop
Advisor/Mentor: Dr. Soumyasanta Laha

Project Summary: Monitoring glucose is discomforting and usually involves pricking a finger. There are wearable devices which can monitor the glucose levels within the bloodstream. The objective of this project is to be able to provide a proof on concepts that determines the glucose levels within the bloodstream. The application for this project is photo-acoustics. Photo- acoustics is a non-invasive way to determine the glucose levels within the bloodstream. This methodology uses both peak-to-peak values and peak arrival time delay information. It combines the high sensitivity of optical waves and the deep penetration offered by ultrasonic waves. This method requires the use of a microcontroller, a low noise amplifier, an ultrasonic transducer, a beam splitter, and a laser diode.

2 Development of Artificial Neutral Network based Maximum Power Point Tracking Algorithm for a Photovoltaic Applicationg

Student: Cheaheng Lim
Advisor/Mentor: Dr. Woonki Na
Sponsors: Graduate Education Sponsorship Program, National Science Foundation, Edison International

Project Summary: In this research, Artificial Neural Network (ANN) is utilized to improve the efficiency of the Maximum Power Point Tracking (MPPT) controller in a photovoltaic (PV) system. The data used in this proposed ANN training are obtained from a fuzzy controller in the buck converter connected to a PV panels. The use of the combined ANN and the fuzzy controller allows the PV system to operate at its maximum power point in both full and partial irradiation condition more efficiently compared to conventional controllers such as perturb and observe (P&O), incremental conductance (IC), and genetic algorithms. The proposed algorithm is tested and validated through the MATLAB simulation and experiment.

3 Electronic Speed Controller for Brushless Direct Current Motor

Student: Marwan Alzahid
Advisor/Mentor: Dr. Woonki Na

Project Summary: An electronic speed controller for brushless DC motor that can deliver more than 100-watts of power using sensorless control method. A brushless DC motor completes one electrical revolution in six steps. In each step two phases are driven and the third is floating. By measuring the back-emf waveform in the un-driven phase and comparing it to the neutral point, the rotor position can be estimated. However, the back-emf voltage is not possible to be measured at very low-speed operation due to its low amplitude. Hence, the motor must start from standstill in open loop until sufficient back-emf is generated. The minimum speed at which the back-emf can be sensed can be calculated from the back-emf constant of the motor. The hardware design will include a three phase inverter using power n-channel mosfets along with the gate drivers, a back-emf detecting circuit including a low pass filter, and a shunt resistor for overcurrent protection.

4 Energy Harvesting for Wireless Sensor Networks

Students: Jasmine Lopez, Luis Ortega, Jared Sarajian
Advisors/Mentors: Dr. Woonki Na, Dr. Nan Wang
Sponsor: National Science Foundation

Project Summary: Wireless sensors can be used to monitor the surrounding environment of remote or difficult-to-reach areas. However, one drawback of these sensors is the limited lifetime of the sensor's battery. Our project intends to decrease maintenance for these sensors through the implementation of an energy harvesting network that will provide sufficient power from the surrounding ambient energy for the sensor to operate and charge a back-up battery in cases where the ambient energy, in this case solar, is not sufficient to power the sensor.

5 Laser Rangefinder

Students: Carter Dana, Matthew Stilwell
Advisor/Mentor: Dr. Gregory Kriehn

Project Summary: The laser rangefinder detects the distance between the user and a given target by transmitting laser pulses at a specific frequency. The system determines distance by measuring how long it takes the light to hit the target and rebound back to the photodiode receiver, also known as the "Time of Flight" method. An 808 nm wavelength laser diode is used to send the infrared laser pulse and is detected with an 840 µm diameter active area PIN photodiode. A useable capture of the transmitted pulses is acquired using a circuit designed to filter out black-body radiation. After the signal is captured, the distance is calculated and displayed for the user.

6 Milly's Organics Automated Bottling System

Students: Alfonso Saul Sanchez Arellano, Miguel Octavio Lozano
Advisor/Mentor: Mr. Roger Moore, Dr. Aaron Stillmaker

Project Summary: Automation engineering is a widespread field that aims to automate strenuous, repetitive tasks with high accuracy and speed using electro-mechanical components. An automated bottling system was created for Milly's Organics to bottle salad and fruit dressings with minimal human input. The bottling system will convey, fill, cap, heat-seal, and label the dressing bottles with desired product of various flavors and three different bottle sizes. A programmable logic controller (PLC) will be the main component of the project. It will be programmed in ladder logic and used to monitor and control: sensors, actuators, and other controlling mechanisms to operate the system. Additionally, a human-machine interface (HMI) will be used so that the user can adjust the system parameters for any dressing type and bottle size through a digital screen.

7 Musical Tesla Coil

Students: Ratchata Inpan, Marco Orozco, Jasdeep Shergill
Advisors/Mentors: Dr. Kerry McBee, Dr. Aaron Stillmaker

Project Summary: A Tesla coil provides wireless transmission energy by the use of electromagnetic properties which gives high voltage output, low current and creates noisy sparks. Improvements to the original design were implemented to guarantee an efficient Tesla coil. A Musical Tesla coil was designed by utilizing insulated-gate bipolar transistors (IGBTs), resistors, capacitors, and diodes to drive power through the circuit at the desired frequency to generate musical tones. A microcontroller is used to generate a pulse width modulated signal (PWM) square wave signal to the power circuit at a specific frequency. The precise pulses of current through the coil will produce sparks at the Tesla coil's breakpoint which will be interpreted by the human auditory system as music.

8 Optical Communication System

Students: Nathan Dondlinger, Carlos Navarro
Advisor/Mentor: Dr. Gregory Kriehn

Project Summary: The goal of our project is a technological demonstration of fiber optic communication. Using two optical transceivers (transmitter-receivers), data is sent across the communication link. The signal, analog (voice, audio, etc.), is converted into digital information via an analog-to-digital conversion. The digital information is encoded and fed into the transmitter which converts the digital information into pulses of laser light. The light pulses travel across the optical fiber to the receiver. The laser pulses are received by a photodiode and converted back into a digital signal. The received digital data is used to recover a clock signal which is used to decode the data. The digital data is then converted back into analog voltage levels and the signal is reconstructed.

9 QuadPlane

Students: Carter Dana, Erik Martinez
Advisors/Mentors: Dr. Gregory Kriehn, Freddy Lopez
Sponsors: Fresno State All Students, Inc (ASI), IRA, ASI Impact Grant, NASA, Lyles College of Engineering

Project Summary: The QuadPlane is a long-range aerial platform for use in agricultural data gathering and takes images of crops with a multispectral imaging sensor. Design of the fixed-wing multirotor hybrid unmanned aircraft features vertical take-off and landing capabilities which allow for high maneuverability and significantly greater speed than an equivalent multirotor aircraft. Four vertically facing propellers and a horizontally facing propellor allow the aircraft to smoothly transition from a hover to fixed-wing flight then back to a hover. The flying wing airframe is comprised of an expanded polyolefin material, has a wingspan of eight feet, and is bolstered by a carbon fiber support structure.

ELECTRICAL AND COMPUTER ENGINEERING

10 Smart Door Locking System

Students: **Bryan Cha, Jose Tello, Johnson Vang**
Advisors/Mentors: **Dr. Peter Kinman, Dr. Aaron Stillmaker**

Project Summary: The objective of this project is to create a ubiquitous computing system that is geared towards allowing a user to gain entry through a doorway via Bluetooth. The user will be allowed access through the door by having their cell phone transmit a Bluetooth signal from a developed phone application to an HC-05 Bluetooth module. This module is connected to a DE1-SoC microcontroller, which acts as both a receiver and controller by processing the information and activating the locking mechanism. Only the appropriate Bluetooth signal, that is within range, will be able to activate the receiver and allow access. Once the user has entered, the locking system will then self-lock when a sensor communicates with the microcontroller notifying it that the door has been closed. This project offers a seamless point of access for users in a method of computational Bluetooth communication.

11 Smart Eraser

Students: **Juan Colin, Heather Libecki, Chris Quesada**
Advisor/Mentor: **Dr. Hovannes Kulhandjian**
Sponsor: **DPS Telecom**

Project Summary: The Smart Eraser is an apparatus that will scan, detect, and intelligently erase markings on a whiteboard. A camera at a fixed location facing the board will record an image and send it wirelessly to a microcontroller where image-processing will be performed in order to locate the markings on the whiteboard. Another programmed algorithm then determines the quickest path to erase all markings on the board, and creates instructions that are sent wirelessly to the x-y axis stepper motors. These motors are attached to the pulleys that move the linear tracking system, which allows the eraser to move across the whiteboard to the marking locations.

12 Smart Glass

Students: **Matthew Cagle, John Kelley, Efren Reyes Medina**
Advisor/Mentor: **Dr. Gregory Kriehn**

Project Summary: Smart Glass can respond to its environment, help reduce inside temperature, and defend against intruders. This project interprets information from the following sensors: ambient light, motion, temperature, and touchscreen. The information will be used to control the amount of tint on the glass. The motion sensor has security applications detecting unexpected motion and engaging the tint. Ambient light and temperature are manipulated by the tint to control how much light and heat leak through the glass. The touchscreen gives user the ability to control specific sections of the tint similar to opening a single blind to see who is at the door.

13 Smart Home Irrigation System

Students: **Chad Franklin, Heath Zweifler**
Advisor/Mentor: **Dr. Aaron Stillmaker**

Project Summary: The concept for this project is to design and implement an automated home irrigation system to be used for small backyard vegetable gardens, patio potted plant gardens and the like. It consists of sensors to individually monitor the soil moisture content at multiple locations. These sensors are each paired with their own water solenoid valve that can be actuated when the soil moisture content for a specific location falls below a predetermined threshold. Different types of plants have different soil moisture content requirements for optimum growth so the threshold for each location can be set by way of an integrated LCD screen allowing the user to provide a precise amount of water to each location. This will eliminate the over/under watering pitfalls that many home gardeners face while helping to reduce their overall water consumption.

14 Solar Photo Voltaic Panel and Alkaline Electrolyzer System

Students: **Ehsan Alali, Marwan Aljohani, Mohammed Basahel**
Advisor/Mentor: **Dr. Woonki Na**

Project Summary: Hydrogen is a potential future energy storage medium to supplement a variety of renewable energy sources. It can be regarded as an environmentally-friendly fuel, especially when it is extracted from water using electricity obtained from solar panels. Combining the DC supply that is provided by PV modules and converting it into an AC supply. The conversion from DC to AC is carried out with an inverter. The energy released by sun is referred as a solar energy which will not decay and this energy is utilized in many applications where power supplies are absent. So here microcontroller is used for optimal battery charging that is used in solar powered. The DC- DC Converter that is used after solar panel is to regulate/control the voltage and current coming from solar panel by adjusting the duty cycle of converter as the voltage that is coming from battery is stable.

15 Solar-Powered Self-Sustainable Automobile Cooling System

Students: **Elias Karam, Michael Merzoian**
Advisor/Mentor: **Dr. Hovannes Kulhandjian**
Sponsor: **DPS Telecom**

Project Summary: The goal of this project is to provide a fully sustainable and self-powered cooling option for your automobile. During the peak summer months, the interior temperature of a vehicle can reach astonishingly high values, sometimes even becoming hotter than the outside temperature. This cooling system would ideally be used while your vehicle is parked and not running. It would ensure that your car temperature is at a reasonable level by the time you return to the automobile. The main system is comprised of a series of solar panels, a DC fan, solar charge controllers, rechargeable batteries, and a microcontroller. Its basic operation involves the solar panels charging a set of batteries that then powers the indoor fan, while also expelling the warmer air from the vehicle. The microcontroller has Bluetooth compatibility and allows you to control the system from your mobile device.

16 Wireless RF System for Non-Invasive Glucose Monitoring

Student: **Chaithanya Sreenivas**
Advisor: **Dr. Soumyasanta Laha**

Project Summary: The goal of the research is to verify the feasibility of non-invasive blood glucose monitoring using the electromagnetic (EM) wireless approach. A Programmable System on Chip (PSoC) 6 MCU unit which has a built-in Bluetooth Low Energy (BLE) wireless module and on-chip antenna will be used for the transmission and reception of the EM wave. Initially, a 2.4 GHz electromagnetic wave will be transmitted wirelessly in-vitro through different glucose solutions of varying concentrations. The transmissive signal will be received at the other end to study the correlation of blood glucose concentration with the transmission coefficient.

MECHANICAL ENGINEERING

1 3-D Plasma CNC Machine

Students: Chris Doda, Elvis Pizano, Bryant Pennebaker, Calvin Jarrod Smith, Zachary Stewart, Sam Clark
Advisors/Mentors: Dr. Aaron Stillmaker, Dr. Yuanyuan Xie
Sponsor: Mechanical Engineering Department in the Lyles College of Engineering

Project Summary: The 3-D Plasma CNC Machine is a joint effort between Mechanical Engineering and Computer Engineering students. The project was created to provide the Mechanical Engineering department with a low-cost CNC machine for use by the department. The Mechanical Engineering team was responsible for creating a robust platform to support the weight of stock materials and components. The system converted rotary motion to linear smoothly and accurately, utilizing rack and pinion gears for the horizontal axis and screw gears for the vertical axis. Safety features included were an emergency shutoff button to protect the user and a water table to extinguish burning debris. The Computer Engineering team was responsible for taking a CAD file, extracting the Cartesian coordinates, and passing the coordinates to a microcontroller that controlled the three stepper motors. An ac to dc power supply with full-bridge drivers was also created to power the microcontroller and stepper motors.

2 3-D Printed Educational Tools

Students: Spike Roseman, Jaklin Rowley, Evan Toland, Timofey Volkov
Advisor/Mentor: Dr. Wei Wu

Project Summary: This project concentrates on increasing fundamental knowledge that is learned in engineering, through 3-D printed models. This can be assimilated through passing rates, test scores, and deduction in major changes. This project will first take the form of development. The models will be generated using Solidworks, a digital designing software in which to created digital versions of 3-dimensional objects. When a design has been optimized and our team has chosen the models, they will be printed. The next step is researching whether or not the models do increase their understanding and retention of information. The models will be brought to professors, and these professors will be asked to participate by using the models in class. They will then be asked to note whether they believe the models are working in the classroom, both in understanding and student engagement. After students take their first test, we will ask professors if there was an increase in the passing rate, and by what percentage.

3 Aerodynamic Drag Measurements in a Wind Tunnel Setting

Student: Troy Watson
Advisor: Dr. Deify Law
Sponsors: Lyles College of Engineering Research Award

Project Summary: The purpose of this project is to measure the aerodynamic drag of a cylindrical rod in a wind tunnel setting. Drag is the force felt by the rod in the direction that the air is moving. Drag is measured using a strain gage, which is a sensor that converts force into an electrical resistance that varies based upon the applied force. The strain readings along with the wind speed and rod dimensions are used to calculate the drag coefficient of the rod. The drag coefficient is a dimensionless quantity used to represent drag on an object. The experimental drag coefficient of the rod is estimated to be 2, while the published data suggests a theoretical value of 1.5. In conclusion, this project demonstrates that the drag measurement system is functional and the measured drag coefficient is in good agreement with the published drag coefficient.

4 Aerodynamic Enhancement of Driver Golf Club Head

Student: Austin Bain
Advisor/Mentor: Dr. Deify Law
Sponsors: Edison International, Lyles College of Engineering Research Grant

Project Summary: As technology and material advancements continue, the game of golf is also transforming. With the possibilities of these new technologies golf equipment can be greatly improved upon. Nonetheless, club manufacturers have begun to hit a design block with driver golf clubs as the United States Golf Association (USGA) has created limiting factors of the golf club size, general shape, and overall energy transfer to the ball. The energy that transfers from the golf club head to the ball is referred to as the 'smash factor' in the game of golf. Many club manufacturers have created golf club drivers that can achieve the maximum USGA allowed smash factor of 1.50. Thus, they cannot continue to produce golf clubs that hit the ball further unless they can get golfers to swing the club faster. This aerodynamic study will attempt to increase club head speed with improved aerodynamics.

5 Anterior Tilt Wheelchair Mechanism

Students: **Malek Almobied, Melina Munton, Arnold Park, Britten Smith, Steven Wood**
Advisor/Mentor: **Dr. Thế Nguyen**
Sponsor: **Sunrise Medical**

Project Summary: The anterior tilt wheelchair project is a product aimed at improving the quality of life of wheelchair users by assisting them to get in and out of the chair. For those with limited mobility, getting in and out of a wheelchair is a strenuous task, and can be a deciding factor in whether or not they participate in an activity. There are other assistive methods for getting in and out of a wheelchair that are available, but pose can pose problems. Many are expensive, require the user to have a lot of upper body strength, and are hard to transport. This project is designed to overcome these challenges by being reasonably priced, motorized, lightweight, and able to fold for transport. This project accomplishes these things through the use of simple mechanisms and common materials.

6 Batteries on Wheels

Students: **Omar Aljohani, Matthew Dansereau, Yoftahe Petro**
Advisor/Mentor: **Dr. Ajith Weerasinghe**

Project Summary: A mobile solar powered battery bank designed to be charged outdoors. This system converts solar energy to electricity and stores it in a mobile battery bank. A mobile battery bank can then be transported to remote locations and provide enough electricity to power a music festival or homes for an extended time period. This project explores the limits of batteries and battery storage, solar panels as well as the cost of manufacturing, maintaining and recycling the batteries throughout the entire lifespan of the solar powered battery bank.

7 Battery Swapping Mechanism

Students: **Samuel Aleman III, Adrian Avila, Thomas Mertens, Karina Meza, Aaron Patterson**
Advisors/Mentors: **Dr. Yuanyuan Xie, Dr. Aaron Stillmaker, Dr. Hovannes Kulhandjian, Roger Moore**
Sponsors: **Dr. Ajith Weerasinghe, Assistant Professor of Mechanical Engineering and Mr. Nils Tellier from EPSIM Corporation**

Project Summary: With current technology today, electric vehicles (EV) are struggling to take over the market due to their limited range and high price tag. Internal combustion (IC) engines that operate on either gasoline or diesel have the advantage of range and price. ICs greatest advantage deals with the problem the project can solve, refueling. The solution to this problem is to implement battery switching stations for EVs to swap depleted battery packs with an energized battery pack on Fresno State's utility cart. The focus of this project is to develop a battery switching mechanism which can complete one cycle within 3 minutes. The project will also consist of a phone application that will be used to provide a user interface and communication with a server to store received data. With the development of the two devices users will be capable to locate the nearest battery pack swap station and a successful battery pack exchange.

8 Central California Food Bank - Packing Line Project

Students: **Faris Alsulaim, Taylor Ford, Joshua Lopez, Juan Ramirez Ibarra, Sean Singh, Rick Varela, Verana Joshua**
Advisor/Mentor: **Dr. Thế Nguyen**
Sponsors: **Central California Food Bank**

Project Summary: California Food Bank requires a packing line that takes up to 1,200 pound bins of fresh produce, sends the produce through a sorting station where volunteers can easily remove the bad produce, then sends through a washing and drying station, and lastly sends to either similar sized bins for packing or to more volunteers for individual packing in much smaller containers. The desired output is at least 150,000 pounds per quarter. The line also needs to utilize up to 15 inexperienced volunteers. Costs are to be kept to a minimum since the budget is initially $20,000 for the entire system, with the possibility of additional funding later on. We are working with senior engineer Sam Parnagian from Fowler Packing Co to verify designs and for possible donations to the packing line.

MECHANICAL ENGINEERING

9 Concept Transporters: Lift Gate Redesign

Students: Jacom Walls, Roshan Tissera, Jenny Thao, Andrew Lute
Advisor/Mentor: Dr. Sankha Banerjee
Sponsor: Concept Transporters

Project Summary: The objective of this project is to re-design and fabricate a feasible lift gate system for Concept Transporters that costs less than their current designs. The design for their current liftgate system takes up to 250 hours of manual labor and carries a cost of $10,000 to $12,000 in materials. Combined, these factors result in an assembled cost of approximately $30,000. Our goal is to design and fabricate a system that will cost less than $30,000 that is easier to assemble, scalable for various mounting applications, and has a reduced allowance for user error.

10 Design and Development of an Interchangeable Corona Discharge Apparatus

Students: Arshdeep Bhatti, Abdullah Almarri, Tatiana Overturf, Faisal Alhajri, Markus Powell
Advisors/Mentors: Dr. Sankha Banerjee, Dr. Saquib Ahmed
Sponsors: U.S. Department of Defense, SUNY Buffalo

Project Summary: The main processes of the apparatus are to treat contaminated water using negative DC corona discharge and to perform plasma surface modifications. A pump is used to move water from the contaminated source to the PVC pipe. The PVC pipe is attached to four 20-gauge hypodermic needles in parallel. Water will flow through the needles and will be treated by the corona discharge. The needles will be charged, from a high voltage source. The discharge will occur between the tip of the needle and the corner of the ground block. The hypodermic needles will act as an electrode and the titanium block will act as the ground. The material used for the ground was titanium, this was done in order for the ground to be cathodic and to ensure a negative discharge. The apparatus serves dual functions of water purification and surface modification.

11 Design and Development of a Sorting System for Small Packages

Students: Emily Regan, Dallas Ruth, Abdullah Alhajri
Advisors/Mentors: Dr. Sankha Banerjee, Justin Neece, Toma Tacescu
Sponsor: Serpa Packaging System

Project Summary: Serpa Packaging would like to tap into a new packaging solution market by developing a machine that can produce a line of product (e.g. sachet's, which are small wrappers typically used for ketchup packets, sugar packets, etc.) from a bulk product. This machine will handle bulk product and orient it in the correct position for spacing in a single line. In order to ensure a successful conveyor, the vacuum chamber-which holds the sachet against the inverted conveyor-went through many iterations to allow machinability and constant air flow. A cost analysis was used to detail the final cost of one unit while a feasibility analysis was used to ensure that this design can compete with current packaging solutions using the same technologies.

12 Design and Fabrication of Sn Based Perovskite Solar Cells

Students: Shelby Sturgeon, Hector Navarro, Alan Pizano, Ali Aldarwish
Advisors/Mentors: Dr. Sankha Banerjee, Dr. Saquib Ahmed
Sponsors: U.S. Department of Defense, SUNY Buffalo

Project Summary: Lead based perovskite solar cell have exhibited prominent results, but due to their unstable nature and toxicity, there has been a development of lead-free organic- inorganic halide perovskite solar cell; therefore, they are the center of research in the market of renewable energies. Ideally, a renewable energy source must be atmospherically stable and non-toxic. This design efficiently integrates the perovskite crystalline structure which constructed by using the properties of Phenylethylammonium Formamidinium Tin Iodide. Among the various alternatives to lead, Tin(Sn) posses great potential in the form of HPSCs perovskite material as it displays excellent optical and electrical properties. Recently, tin based HPSCs have displayed a commendable PCE (Power Conservation Efficiency) of 9%. The device will be fabricated defining the layers from front to back as FTO coated glass/TiO2 Blocking layer/TiO2 compact layer/perovskite layer/P3HT hole transfer layer/Palladium back contact layer.

13 Designing a Tabletop Anechoic Chamber for Acoustic Absorption Characterization of Composite Devices

Students: Harrison Smith, Pasan Liyanagama, Turki Alghunaimi, Savannah Giordiano
Advisors/Mentors: Dr. Sankha Banerjee, Dr. Thế Nguyen
Sponsor: U.S. Department of Defense

Project Summary: Testing of devices' resonant frequencies is often necessary in the aerospace industry to keep vibrations from escalating to dangerous levels through constructive interference. When small devices are designed, it is often a big inconvenience to take them to an anechoic room for testing. Instead of traveling with the newly designed device for testing, a tabletop anechoic chamber allows for cost effective testing within the lab. This five-foot, two-inch long table top anechoic chamber has attachment slots to hold an impedance tube or attach any other testing equipment required. This cost effective alternative to a full anechoic room can test most small devices with an inside volume of nearly nine-and-a-half cubic feet. With connections for up to four BNC cables and two 4mm banana plugs, many different types of testing equipment can be used. This anechoic chamber brings high quality test results to the smallest labs.

14 Development of a Plasma Based 3D Printing and Sintering Device

Students: Yerli Cervantes, Emily Jackson, Faisal Gunaid, Cody Dahlgren, Saleh Abdu, Ravi Shah
Advisors/Mentors: Dr. Sankha Banerjee, Dr. Aaron Stillmaker
Sponsors: U.S. Department of Defense, SUNY Buffalo

Project Summary: An important goal for this project is to increase the material strength in the Z-axis direction of the model and eliminating post processing. This will be done by retrofitting a 3D printer with a micro plasma device (jet plasma). The atmospheric plasma will be used to increase the adhesion between layers allowing for stronger prints capable of being end products. This printer will also be capable of sintering composite bio-compatible materials. Open source software will be used to develop a universal print job. The model will solely be made by the 3D printer while the plasma jet will cure the model. Another goal to this project is the ability to develop a controller that integrates the motion of 3D printer and plasma jet so that they may work together.

15 Drum Styled Seasoning

Students: Johnny Armanino, Mia Bentzien, Jesus Rodriguez, Abdulaziz Alshehri
Advisor/Mentor: Dr. Sankha Banerjee
Sponsor: Johnny Armanino

Project Summary: The proposed seasoning mixer is designed to mix up to 50 pounds of dry-rub seasoning. The mixer operates by spinning a drum around a pivoted horizontal axis. Fins welded within the drum cause the seasoning to separate and improve the quality of the mix. A motor will power the entire device. This will allow the machine to be operated on a standard electrical outlet. The machine meets FDA food standards as it is fabricated from steel. Overall, the proposed seasoning mixer will enable consumers to mix large quantities of seasoning with minimal effort while delivering a thorough mix. Strategically placed fins will prevent seasoning from sticking together and ensure a proper mix of the dry-rub seasoning.

16 Fabrication of Activated Carbon and Graphene Based Hybrid Water Purification System

Students: Mengdi Zhao, Tatiana Overturf
Advisor/Mentor: Dr. Sankha Banerjee
Sponsor: U.S. Department of Defense

Project Summary: As the global population grows, the demand for access to clean and potable water will continue to increase. The current project involves the fabrication and optimization of an activated carbon and graphene based hybrid water purification system based on existing designs. For the potential usage on the consumer side, a small scale, low cost, pre-existing water filter container is modified to be integrated with alternating layers of plasma treated poly(methyl methacrylate) (PMMA) nanoporous films, activated carbon, and graphene nanoplatelets. The spin-casted PMMA nanoporous films is used to hold mixtures of the activated carbon and graphene within the water filter. The total dissolved solids (TDS) meter is used to measure the amount of organic and salt based contaminants before and after the filtration. UV-Vis and Raman spectroscopy are used to verify the composition and concentration of different contaminant species.

17 Fabrication of Thin Film Solar Cells

Students: Justin Thomas, Harrison Nicholas, Victor Cha, Omar Aljohani
Advisor/Mentor: Dr. Sankha Banerjee, Dr. Ajith Weerasinghe

Project Summary: The goal of this project is to create a non-toxic solar cell made of earth abundant materials. Using these materials we will create different combinations of electrolytes in order to grow the layers of our solar cell onto FTO (fluoride doped tin oxide) glass as compared to standard solar cells which require specialized materials and purified metals in order to function and be put together. Using CZTS (copper zinc tin sulfide) and ZnS (zinc sulfide) as semiconductors and coating the CZTS layer with AZO (aluminum doped zinc oxide) as a back contact to finish out the solar cell. We will be using chronoamperometry to measure the current density of the different layers to determine their ability to conduct between the layers. Optical absorption tests to find optimal band gaps, Raman spectroscopy, and the differences between heat treated and normal materials and how it affects the performance.

18 Floating Photovoltaic Cells

Students: Dalton Uhlir, Harrison Nicholas, Elias Avila, Josh Lopez
Advisor/Mentor: Dr. Ajith Weerasinghe

Project Summary: California has two constant needs that can be improved upon: water and power. This project's goal is to improve on both of these needs. Within California there are many reservoirs for storing water for farming use. This space can be optimized through the installation of floating photovoltaic (FPV) cells which can produce electricity while also minimizing the loss of water due to evaporation. These floating cells are designed to reduce water evaporation by absorbing the heat from the sun, rather than the heat going into the water. In addition, they will also be used to generate power. These cells cannot be used on any reservoirs or major sources of drinking water however, as with current solar cells should any damage occur, one of the risks would be toxic chemicals leaking into the water supply.

19 Hybrid Wearable Devices for Non-invasive Real-time Monitoring of Blood Glucose

Students: Mohamed Muthana, Jodi Bishop
Advisors/Mentors: Dr. Soumyasanta Laha, Dr. Sankha Banerjee, Dr. Woonki Na

Project Summary: Diabetes is a chronic disease that affects a large part of the population in the United States and around the world. Real-time monitoring of blood glucose can detect early signs of diabetes by diagnosis of conditions such as impaired glucose tolerance. A wide range of analytical methods and techniques are being studied for non-invasive and real time testing/monitoring of blood glucose. These techniques include Optical Spectroscopy, Raman Spectroscopy, Photoacoustic Spectroscopy, Impedance Spectroscopy and Microwave based measurement methods among others. The following work deals with the analysis of a proof of concept hybrid monitoring system using a combination of optical and non-optical techniques such as Photoacoustic Spectroscopy and Impedance Spectroscopy. Data sets from the two methods are analyzed base on process parameters such as optical absorption, thermal expansion, acoustic velocity, specific heat, dielectric, and impedance characteristics.

20 Micro-plasma based enhancement in dielectric and piezoelectric properties of ZnO and BaTiO 3 based multifunctional composite thin films by surface modification: towards applications in touch based sensors and wearable devices

Students: Sidharth Mageshkumar, Mia Bentzie, Walker Tuff
Advisor/Mentor: Dr. Sankha Banerjee
Sponsor: U.S. Department of Defense

Project Summary: Atmospheric pressure and ambient temperature based micro-plasmas have been used in polarization and alignment of dipoles in ferroelectrics. The same phenomenon can be used to enhance the surface energy and surface characteristics of composite multifunctional thin films by means of surface modification. A significant increase in non-thermal atmospheric plasma applications, such as dielectric barrier discharge (DBD) and corona discharge plasmas have been steadily increasing in industry and in the research literature. The current work involves the use of corona micro-discharge for surface modification of ZnO/BaTiO -Epoxy- Graphene based multi-functional and flexible thin film devices towards enhancement in surface bonding characteristics and variation in surface wettability and surface energy characteristics.



21 Micro-Turbine Range Extender

Students: **Adrian Avila, Jose Mendoza, Karina Meza, Mahakpreet Sandhu**
Advisor/Mentor: **Dr. Ajith Weerasinghe**

Project Summary: Microturbines have the ability to provide stable and reliable power while producing less emissions compared to other technologies. Microturbine engines are small turbines that operate on the same thermodynamic cycle as large combustion turbines, braytons cycle. The most common fuel for microturbines is natural gas; however, microturbines can burn a variety of fuels, making microturbines useful for resource recovery applications. Due to the pros of microturbines, the concept of Micro-Turbine Range Extenders (MTRE) has been developed. MTREs are beneficial in overcoming the shortcomings of electric vehicles (EVs) by providing extended driving range as well as extending battery life. Unlike EVs which provide energy solely from a battery back, a vehicle equipped with an MTRE can recharge the battery pack, extending driving range. MTREs also reduce the amount of pollutant emissions compared to internal combustion engine range extenders.

22 Mobile Loading Crane Design

Students: **Garret Walker, Abdulrahman Monaqil, Miguel Lopez, Mia Bentzien**
Advisor/Mentor: **Dr. Sankha Banerjee**
Sponsor: **Garret Walker, Cencal CNC, Inc.**

Project Summary: For many, the need to find a way to move heavy and non-uniform objects easily is imperative to carry out their everyday work load. For this reason, a new type of mechanism needs to be easily accessible to the public and convenient to the ones that need it. That is why the collapsible lifting crane (or a suspended crane) is important for everyday use. The crane is maneuverable, compact, and affordable compared to the nearest competitors. In this report, we will look at its rigidity, cost, and the easy use of the collapsible lifting crane and how it can solve problems that many have.

23 Molecular simulation of evaporation/condensation in microscale heat pipes for efficient cooling of microelectronics

Students: **Edward Mendoza, Prabhdeep Kaur**
Advisor/Mentor: **Dr. Zhi Liang**
Sponsor: **Edison International**

Project Summary: Both students are performing MD simulations for different scenarios to study microscale thermal transport. MD simulations track the trajectory of gas molecules and count the number of gas molecules striking the liquid surface per unit time. These simulations determine the energy of liquid and gas molecules for a collision process which, in turn, finds the heat exchange efficiency between liquid and gas. Simulations are conducted for both heat conduction and evaporation/condensation. The simulation results will generate a database for future design of a microscale heat pipe in smartphones. Heat pipes can help to cool CPUs in smartphones, allowing them to operate at higher speeds.

24 Nanoscale Argon Heat and Mass Transfer Simulations with LAMMPS

Students: **Eric Bird**
Advisor/Mentor: **Dr. Zhi Liang**
Sponsor: **Edison International**

Project Summary: Heat and mass transfer phenomenon occurring at atomic scales is studied using molecular dynamics simulation package LAMMPS (Large-scale Atomic/Molecular Massively Parallel Simulator). The unique ability to monitor individual atoms in a simulation environment gives new insights into the behavior of argon during phase-change processes in equilibrium and nonequilibrium which would be impossible to gather using experimental methods. This research evaluates properties of argon across a liquid-gas interface such as pressure, temperature components, latent heat, and surface tension, and attempts to verify mathematical models by simulating the nanoscale behavior of argon atoms.

25 Optimization of Ammonia Refrigeration Systems

Students: **Brandon Galindo, Stephany Mejia, Erik Ruiz, Juan Ramirez Ibarra**
Advisor/Mentor: **Dr. Ajith Weerasinghe**

Project Summary: The purpose of this research is to develop optimization methods and improve safety practices in industrial ammonia refrigeration systems based on current issues and challenges encountered in California's Central Valley. Using ammonia as a refrigerant in the commercial industry has grown to be a standard as ammonia based systems are highly efficient and environmentally friendly compared to other refrigerants like chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) which are notoriously believed to damage the ozone layer and contribute to global warming. Besides ammonia being a better alternative for the environment, ammonia based refrigeration systems require less electricity to run therefore cutting down operating costs.

26 Parametric Modelling of a Carton Forming Tool Using C Sharp

Students: **Alfredo Flores, Subhan Mohammed, Trent Reynolds**
Advisor/Mentor: **Dr. Thế Nguyen**
Sponsor: **ADCO Manufacturing**

Project Summary: This is a parametric modelling project which involves parameterizing different parts and assemblies of the sponsor's carton forming tool and to be input those mathematical equations into a form of data entry. We are coding the parametric equations into C Sharp programming language and incorporating it with SolidWorks by creating an exclusive plug-in. The plug-in will allow the user to input different dimensions of the Carton itself and will output the relative parts and assembly files of the tooling.

27 Performance of World's Largest Wind Turbine

Students: **Mohammad Muhyieddeen, Hector Navarro, Roberto Orozco, Derek Riley**
Advisor/Mentor: **Dr. Ajith Weerasinghe**

Project Summary: The largest Wind Turbine has grown from 20 kW to 2MW from the 1980s-2000s. One of the primary reasons for this growth is the economic demand for renewable energy and lesser environmental impact brought by climate change. This growth, however, was not new as harnessing wind energy dated back to ancient civilizations. It started with a vertical axis design then moved to horizontal axis design which is seen in most of the wind turbines today. The industrial innovations in the 20th century have caused the rapid change in its ergonomic design. Large wind turbines have many downlines. One of which is its mechanical noise which is a detrimental factor when building a wind energy source. Another attribute is the wind force in the area. This project discusses the history of wind turbines, where it came from as well as a SWOT Analysis of the largest wind turbines.

28 Pumped Hydroelectric Energy Storage

Student: **Yerli Cervantes, Robert Tamez-Gadams, Shelby Sturgeon**
Advisor/Mentor: **Dr. Ajith Weerasinghe**

Project Summary: This project delves into using pumped hydroelectric power plants for energy storage. Pumped hydroelectric power plants work identically to a normal hydroelectric power plant, with the exception that it has solar powered pumps. Meaning that solar power collected during the day would be stored as high potential water when the pumps pump water back to the initial water reservoir. This project looks into the feasibility of this energy storage system. The feasibility of this system was determined by looking into the land usage, environmental issues, energy produced and efficiency of the pumped hydroelectric power plants for energy storage system.

29 Push Start Project

Students: **Robert Tamez-Gadams, Abdulkareem Fallatah, Mohammed Alharbi, Roberto Orozco**
Advisors/Mentors: **Dr. Sankha Banerjee, Dr. Ajith Weerasinghe**

Project Summary: The objective of the Push Start Project was to design an exercise device that has the capabilities to produce and store electrical energy. The most important customer needs that were determined was the energy storage and producing capacity and weight. Future work for the Push Start Project may include adding Bluetooth capabilities as well as an integrated app that can be used on a mobile device. Additionally, developing a modular system that can be mounted into existing exercise machines.

30 PV Solar Energy Storage for Industrial Buildings

Students: **Victor Cha, Cody Dahlgren, Emily Jackson, Dylan Joboian**
Advisor/Mentor: **Dr. Ajith Weerasinghe**

Project Summary: This project will be giving an insight on using batteries charged by solar panels to be used as a backup generator. The batteries should be able to store enough charge for buildings such as hospitals, shopping centers, etc. Once the batteries have been fully charged for backup purposes the extra power will be regulated so that it is being used in the building. This would help offset the TOU charges and prevent the batteries from being overloaded. Finding the balance of charge vs. usage will be one of the focuses of this project. The cost of maintenance, energy efficiency, and affordability will be reviewed in the selection process of solar panels and batteries that can be potentially used. Circuit design and battery regulation will also be implemented in the design of this project. Safety standards and regulations will also be reviewed.

31 Robotic Arm Based Materials Handling

Students: **Rossana Aguilar, Pablo McHenry, Bikash Prasad, Safiyya Rasuli, Mehakpreet Sandhu, Dalton Uhlir**
Advisors/Mentors: **Dr. Sankha Banerjee, Dr. Thế Nguyen**
Sponsors: **Mechatronics Club, Mechanical Engineering Department in the Lyles College of Engineering**

Project Summary: In a world built on developing technologies and the increasing demand for IC production, large manufacturing companies in the semiconductor industry are shifting towards automated materials handling. The purpose of this project is to develop, 3D print, and assemble a robotic arm that will be controlled to imitate similar experiments performed in the process of semiconductor manufacturing. The team consists of mechanical engineers that worked on the arm design, printing, assembling, and simulation of the robotic arm and a computer engineer focused on the operation and controls of the arm. Future objectives for this project is to incorporate Artificial Intelligence to use data gathering as a means to have the arm conduct a thorough procedure without any human assistance.

32 Solar Panel Air Conditioning and Refrigeration

Students: **Johnny Armanino, Andrew Lute, Jenny Lee Thao, Jacob Walls**
Advisor/Mentor: **Dr. Ajith Weerasinghe**

Project Summary: This project investigates power shifting during heavy loading cycles from air conditioning units utilizing compensatory solar energy systems. A variety of solar thermal and photovoltaic (PV) systems are compared for viability in the efficiency of load absorption during peak operating hours. Current studies show that the coefficient of performance (COP) seen in current solar powered refrigeration systems is relatively low and a point of contention among the energy providers and researchers. The goal of this research is to provide viable options with acceptable system efficiency under operation that will provide a reasonable return on investment (ROI).

33 SpiderBot

Students: **Isaias Gonzalez, Leonard Wilson, Rizaak Mohammad**
Advisor/Mentor: **Dr. Thế Nguyen**

Project Summary: Spiderbot is a project found to hold various applications for the user. Whether to transport objects or supplies, to utilizing its shape and legs for traveling through tight spaces, this hexapod can be a tool for accomplishing many tasks. The purpose is to create a crawler that can navigate through rough terrain while carrying a payload with a maximum weight of 20 lbs. attached to its back. Dynamics plays a major role in designing the legs for proper movement across these treacherous environments. By using kinematic equations, we can trace the necessary movements of the legs for programming an ideal walking pattern. With a given speed and acceleration, we determined the amount of torque each leg will undergo and based our designs through those calculations. In addition, by using straps anchored to the body, it limits any shifts the payload would undergo to create a more controlled dynamic robot.

MECHANICAL ENGINEERING

34 Victor E. Bulldog III Stage

Students: Elias Avila, Austin Bain, Stephany Mejia, Steve Soares
Advisor/Mentor: Dr. Thế Nguyen
Sponsor: Fresno State Alumni Association

Project Summary: Our stage provides a safe and aesthetic method of displaying Fresno State's live mascot, Victor E. Bulldog III. This project features sponsorship recognition, public safety, and a portable design. The stage will allow Victor E. to sit, lie down and be elevated comfortably, making it easier for photo opportunities with people standing by his side, especially the elderly. The stage must also be compatible for vehicle storage and adjust to various heights and able to stand straight on uneven surfaces.

35 USGS High Pressure Testing Chamber Enhancement

Students: Emily Regan, Dallas Ruth, Abdullah Alhajri
Advisors/Mentors: Dr. Sankha Banerjee, Gerry Hatcher
Sponsor: United States Geological Survey

Project Summary: The purpose of this project is to enhance the high pressure testing chamber at the United States Geological Survey Pacific Coastal and Marine Science Center (PCMSC). The PCMSC is a federal government research organization located in Santa Cruz, CA. It conducts multidisciplinary scientific research in the coastal and offshore areas of California, Oregon, Washington, Alaska, Hawaii, other U.S. Pacific Islands and waterways. In order to conduct research for certain underwater projects, researchers and engineers at the PCMSC deploy underwater instrumentation at depths exceeding 1000 meters below the surface of the ocean. The high pressure testing chamber at the PCMSC allows the engineers who work there to test small pressure housings for design integrity and/or pre-deployment water tightness. Having this device onsite saves the PCMSC time and money.

36 Wearable Multiphasic PVDF-Based Energy Harvesting Fabrics

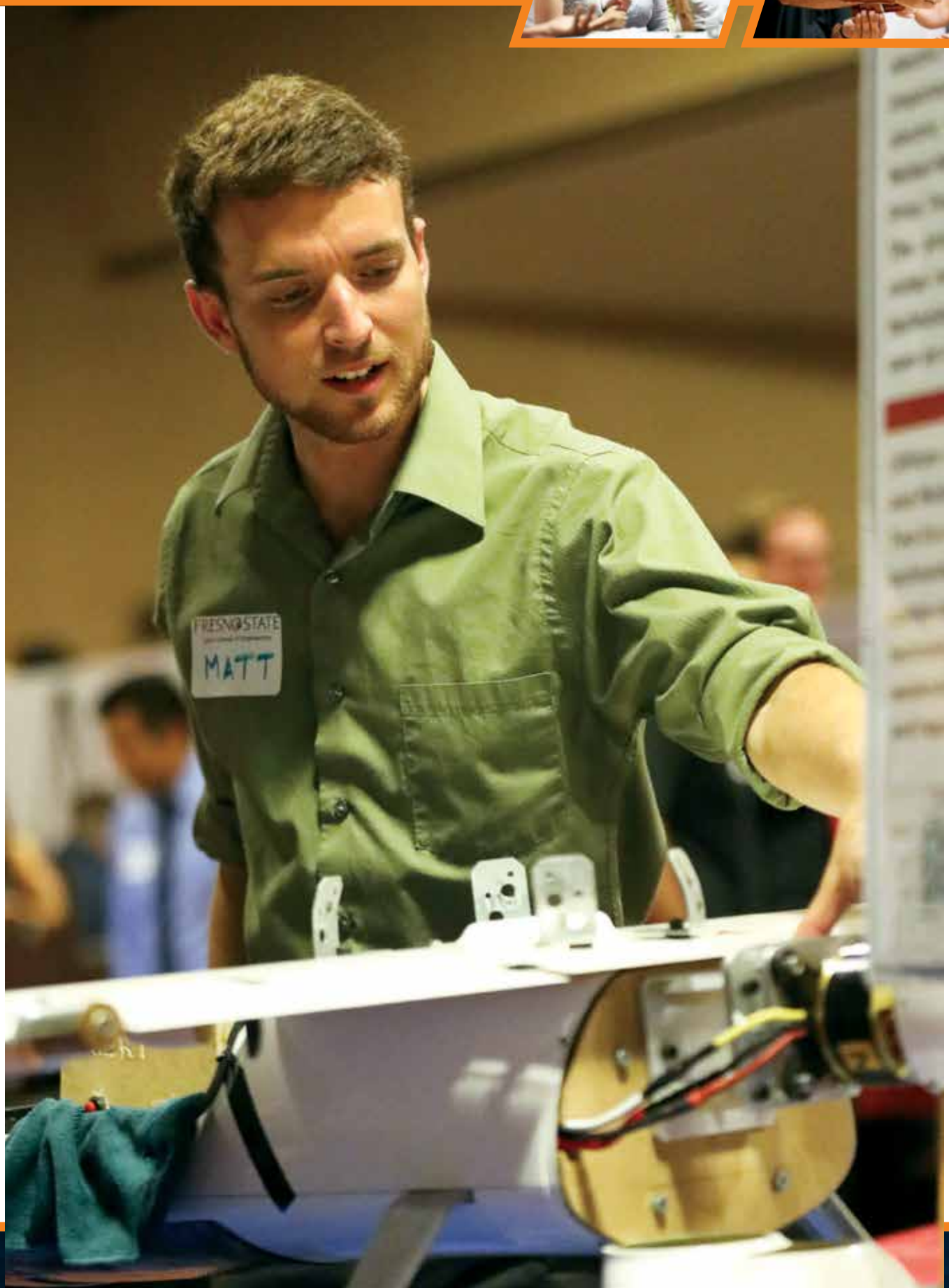
Student: Walker Tuff
Advisor/Mentor: Dr. Sankha Banerjee
Sponsor: U.S. Department of Defense

Project Summary: Piezoelectric composites have been extensively studied for their energy harvesting applications, but there has been limited research into noninvasive wearable piezoelectric energy harvesters of human motion. Therefore, lead-free wearable polyvinylidene fluoride (PVDF)-based energy harvesting fabrics are investigated in this work. An electrospinning method was used to fabricate PVDF, PVDF-barium titanate (PVDF-BT), PVDF-graphene, and PVDF-BT-graphene fibers. The volume fractions of BT and graphene were varied from 0.01 to 0.10, and a loom was used to weave the fibers into a fabric for testing. The properties of the textiles were measured before and after exposure to a contactless corona-discharge plasma to determine if additional pooling enhanced the performance of the fabrics.

37 Wireless Power Transmission in Space

Students: Zachery Bolderoff, Jeremiah Folia, Eduardo Salmeron, Isuru Wickramarachchi
Advisor/Mentor: Dr. Ajith Weerasinghe

Project Summary: This project applies previous research on microwave power transmission to the development of solar power in space. Using breakthrough Japanese and Indian research, the transmission system is analyzed - clarifying optimum wavelength and minimizing satellite power usage to send maximum power to earth wirelessly. From satellite implosion, satellite explosion, laser degradation to conservation and reuse of the system - the project is culminated in an analysis and suggestion of new safe recycling processes for the space solar system. The objective of this implementation is to sustain a viable solution to the growing need for substantial renewable energy with the ever growing industry and public demand.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VALLEY INDUSTRY PARTNERSHIP FOR COOPERATIVE EDUCATION

1 Pump Specification Guide

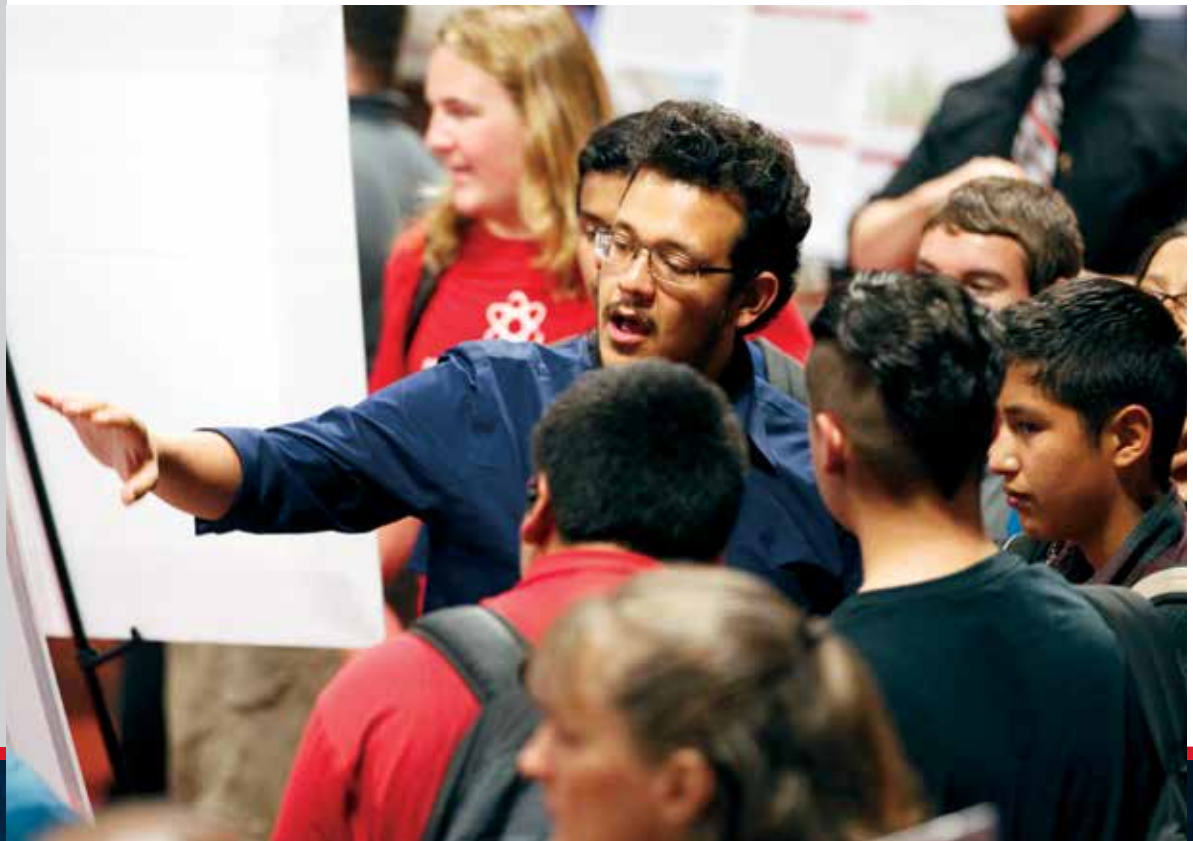
Student: Tanmay Parkar
Advisor/Mentor: Mr. David Shoenhair
Sponsor: Valmetal Inc. and U.S. Farm Systems

Project Summary: A 'Pump Specification Guide' is used to help salespersons correctly identify and assign pumps to customers. It can be used to find an appropriate pump product, calculate the specifications and identify additional items necessary to go along with the pumps. It aims to save time and provides a step by step transparent method. A sample is provided in the guide to make it easier for the reader to comprehend and fill it out. The guide contains tables, charts and graphs to enhance easy understanding. A series of pump curves were created as part of the guide to be able to use them while selecting the right pump. For instance, an input of 1000 US GPM and 32 feet total height would result in a curve with 20 horsepower output. Once the appropriate setting has been found, the sales manager can be directly contacted for further negotiations.

2 Safer/Easier Belt Tensioner Design

Student: Jack Kuzminsky
Advisors/Mentors: Greg Beyersdorf, Stephen Chism
Sponsor: Leprino Foods

Project Summary: The goal of this project is to design and implement a safer and easier method to release and add tension to a conveyor belt. Tension is released and applied to the belt daily for sanitizing and the current design uses a lever on a four bar link and requires too much force to operate which can be dangerous for operators. The method has to also be cost effective as it will be implemented on many conveyors if it is successful. Since the conveyors are in a food production area, the design also has to be sanitary and be resistant to corrosion from chemicals used in the sanitizing process.



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