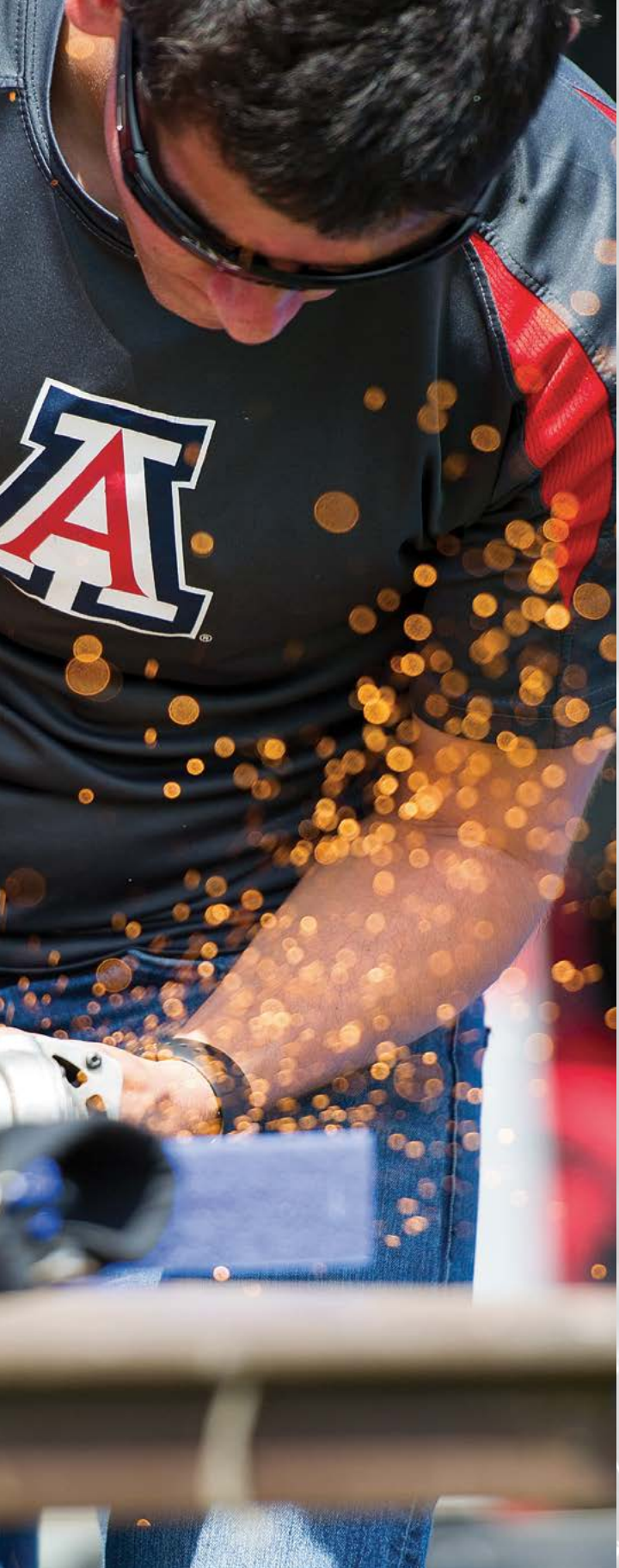

2017 ENGINEERING DESIGN DAY

CREATIVE SOLUTIONS FOR REAL PROBLEMS

AN INDUSTRY-UNIVERSITY PARTNERSHIP

THE UNIVERSITY OF ARIZONA
COLLEGE OF ENGINEERING
Engineering Design Program

2017 ENGINEERING DESIGN DAY

Welcome

This is the best day of the academic year! This is the day we show the world how engineers design solutions to societal problems and improve quality of life. In the Engineering Design Program at the University of Arizona, multidisciplinary teams of seniors work to solve problems identified by industry partners, faculty and student clubs.

This event only exists because of the hard work of students, mentors, faculty, and, importantly, the many individuals and organizations sponsoring projects and guiding student teams. On behalf of our students and faculty, thank you to all of the sponsors and industry partners whose contributions help make the program bigger and better every year.

This year we have more than 500 students from virtually every degree program offered by the College of Engineering demonstrating 100-plus projects, some of which will go on to be commercial products. Please enjoy the day and ask design teams about their projects. Our students are enthusiastic about their work and appreciate opportunities to explain how they intend to help change the world for the better.

Sincerely,

Jeffrey B. Goldberg

Dean, College of Engineering

DESIGN DAY
EVENT SCHEDULE

8:30-11:00 AM	PROJECT DEMONSTRATION FOR JUDGES
11:00 AM	DESIGN DAY OPENS TO THE PUBLIC
12:30-2:30 PM	AWARD JUDGING
4:00-5:30 PM	AWARDS CEREMONY

Projects are displayed in the Student Union Memorial Center Grand Ballroom and on the UA Mall south of the Student Union. The awards ceremony will be held in the Student Union Grand Ballroom.

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KEEP UP WITH DESIGN DAY EVENTS, TIMES, AND DEMONSTRATIONS WITH THE APP:

UA ENGINEERING DESIGN

GET IT ON Google Play

Download on the App Store

2017 ENGINEERING DESIGN DAY PROJECTS

INTERDISCIPLINARY ENGINEERING DESIGN DAY PROJECTS

500+ SENIOR ENGINEERING STUDENTS

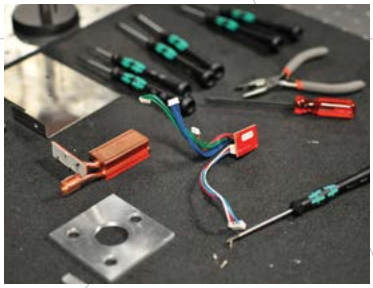
100+ SPONSORED PROJECTS

60+ CORPORATE AND UNIVERSITY OF ARIZONA SPONSORS

15 YEARS OF SUCCESS

"The success comes from years of continuous improvement in the engineering education at the University of Arizona"

Christopher Lynn
Tucson Electric Power



INTERDISCIPLINARY ENGINEERING DESIGN DAY PROJECTS (CONT.)

AEROSPACE ENGINEERING DESIGN PROJECTS

MINING ENGINEERING DESIGN PROJECTS

CHEMICAL ENGINEERING DESIGN PROJECTS

CIVIL ENGINEERING DESIGN PROJECTS

22 BIOMEDICAL PROJECTS

19 AEROSPACE PROJECTS

9 PUBLIC WORKS PROJECTS

2017 INDUSTRY SECTOR PROJECT HIGHLIGHTS

15 OPTICAL SCIENCE PROJECTS

20 ENVIRONMENTAL PROJECTS

2017 ENGINEERING DESIGN DAY AWARDS

RAYTHEON AWARD FOR BEST OVERALL DESIGN ($2,500)

While several designs may meet the judging criteria, this award is given to the design that does so the most effectively. The project that receives this award excels in many ways. The design is well thought out and its implementation is of high quality. It accomplishes all key design requirements and is supported by rigorous analysis and testing. Its poster and presentation are professional and easy to understand.

MICROSOFT AWARD FOR BEST SYSTEM SOFTWARE DESIGN ($2,500)

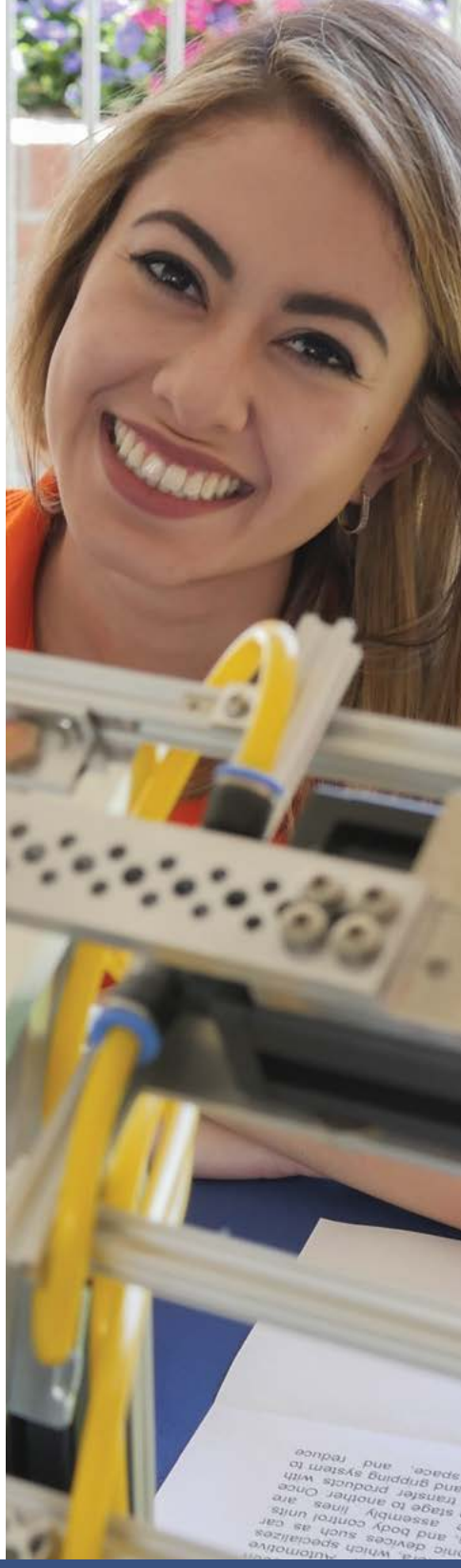
Software has become a critical part of the operation, management, and control of complex systems comprising mechanical, electrical, electronic, and biomechanical elements and other components and subsystems. As a result, in today's world, software is an integral part of the design of complex systems. This award recognizes the best use of software in the process of designing systems for operation, management, control, and usability. Teams will be judged on the reliability, robustness, maintainability, reusability, originality, and testability of software embedded in their designs.

BLY FAMILY AWARD FOR INNOVATION IN ENERGY PRODUCTION, SUPPLY, OR USE (1ST PRIZE $1,500; 2ND PRIZE $500)

This award recognizes the best project related to sustainable, cost-effective, and environmentally friendly energy production, distribution, or use. Winning projects could focus on developing new energy sources, reducing energy costs, improving efficiency, or reducing cost of energy distribution, adapting existing energy distribution methods to better integrate new energy sources, and increasing efficiency of energy use.

THORLABS PHOTONICS IS THE FUTURE AWARD ($250 PER PERSON, UP TO $1,750)

This award recognizes the most innovative use of optoelectronics and optomechanics in a design.



$25K+

AWARDED IN CASH PRIZES

24

AWARDS SPONSORED BY INDUSTRY

FRANK BROYLES ENGINEERING ETHICS AWARD ($1,500)

Increasingly, businesses are adopting cultures that emphasize ethical conduct, driven in part by the dollar value that financial markets place on reputation. Questionable shortcuts to save cost or time can have catastrophic consequences. Similarly, the marketplace can punish a business that ignores or inappropriately resolves conflicts. A team might experience a significant conflict between team members, or between the team and its sponsor or mentor. This award is designed to reward the team that best recognizes and resolves a significant ethical issue, whether that issue concerns a tempting shortcut, a conflict or another factor.

RINCON RESEARCH AWARD FOR BEST PRESENTATION ($1,500)

This award reflects the quality of the overall verbal and poster presentations. Verbal presentations should be well structured to describe efficiently the overall problem being solved and the specifics of how the team accomplished its design. Answers to questions should be direct and demonstrate mastery of the project. Presenters should speak in a clear and easily audible voice, making good eye contact with the judging pod. The poster should be visually interesting and graphically well organized to tell a standalone story of the project.

VENTANA AWARD FOR INNOVATION IN ENGINEERING ($1,500)

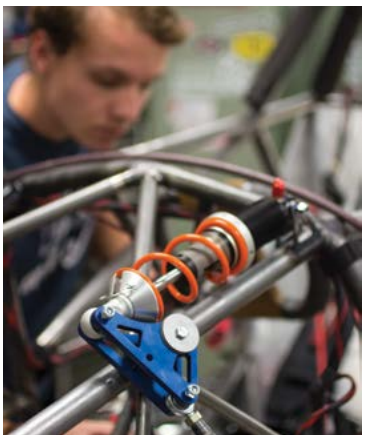
Innovation may include the novel use of existing components or the creation of entirely new components to meet customer requirements. The most innovative design will not only be a creative solution to a problem but also an effective solution that is well implemented. This award recognizes the team that has created or made use of components in the most innovative way, demonstrated excellence in the implementation of innovative design in its project, or both.

ACSS/L-3 COMMUNICATIONS AWARD FOR MOST ROBUST SYSTEMS ENGINEERING ($1,000)

This award goes to the team that most robustly addresses all aspects of the project from the systems perspective. Criteria include requirements capture and flow down, technical risk identification and mitigation, manufacturability, integration, and test plan. Judges will look holistically at the program to determine overall effectiveness of the systems process.

TECHNICAL DOCUMENTATION CONSULTANTS OF ARIZONA AWARD FOR BEST DESIGN DOCUMENTATION ($1,000)

Successful implementation of any innovative design requires that all members of the design and production team communicate effectively. Design intent must be communicated from the design activity to the rest of the team using design documentation with a clear map for others to reproduce the design based on documentation only. The mechanical portion of the design is evaluated on the use of drawings with geometric dimensioning and tolerancing, solid models, illustrations, and presentations that can be used to manufacture and inspect design hardware. Software and other systems are evaluated on the use of documentation that clearly and fully describes the system.



AWARDS (CONT.)

TEXAS INSTRUMENTS ANALOG DESIGN CONTEST AWARD ($1,000)

Regardless of whether a design project is sponsored, who is sponsoring it, or what is being designed, analog integrated circuits are often required. Teams using three or more TI analog ICs in their designs are invited to enter the TI Analog Design Contest. Projects are judged on originality of design, quality of design, creativity of design, level of engineering analysis, and a written description of how each TI analog chip benefited the design.

TRAX INTERNATIONAL AWARD FOR BEST IMPLEMENTATION OF AGILE METHODOLOGY ($1,000)

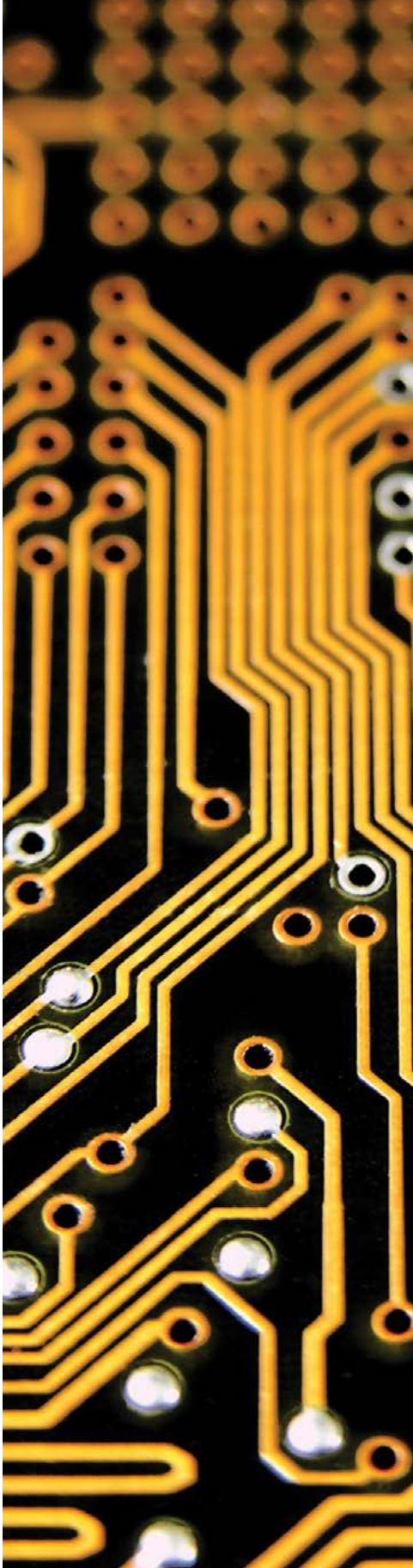
The design project that wins this award is executed using a flexible and incremental approach, otherwise known as Agile Methodology. Final project outcomes are achieved through several test and evaluation iterations in collaboration with the customer. The project team should continuously review and assess results, and quickly adapt to any changes or problems encountered.

ARIZONA TECHNOLOGY COUNCIL FOUNDATION AWARD FOR BEST ENGINEERING ANALYSIS ($750)

This award recognizes the team with the strongest strategy, implementation and documentation of analyses supporting its design. Analyses vary from project to project, but may include market research and analysis, analysis of prior solutions to the design problem posed, trade studies that justify the final design selected from alternatives considered, system modeling to demonstrate that the final design is sound and should perform as desired, analysis of potential reasons for failure and a mitigation plan, and economic or other analysis of the benefits of the final design in its intended application. Criteria for judging include the completeness of the project analysis based on the above categories, thoroughness of the analyses, application of sound engineering principles and practice, a demonstrated understanding by team members of any tools or models used, reasonableness of all assumptions, and the quality of the documentation of the analyses.

ARIZONA TECHNOLOGY COUNCIL FOUNDATION AWARD FOR INNOVATION IN MANUFACTURING ($750)

This award is given to the team that displays the most innovative new or modified manufacturing method. Projects could include introducing a new technique for manufacturing, an innovative use of an existing technique, or new techniques that significantly reduce the cost of manufacturing and improve the quality of the product.



EDMUND OPTICS AWARD FOR PERSEVERANCE AND RECOVERY ($750)

Issues and roadblocks always occur during the engineering design process. Although they can cause panic and distress, they also represent great opportunities to learn and often lead to designs that would otherwise be impossible to conceive. This award recognizes a team's ability to learn and to overcome issues or roadblocks encountered during the design process. The award is judged based on the ingenuity of solutions to problems caused by issues or roadblocks and the features in the final design that contribute to recovery from them.

PHOENIX ANALYSIS & DESIGN TECHNOLOGIES AWARD FOR BEST USE OF PROTOTYPING ($750)

This award goes to the team that best uses a physical prototype model to understand and study the fit, form and function of the device or system designed. Teams are judged on the appropriateness of the prototyping technology used, how effectively prototyping is used to improve design, and how effectively the use of prototyping is communicated. Prototypes can be made using rapid fabrication technology, traditional manufacturing, or can be hand built.

RBC SARGENT AEROSPACE & DEFENSE VOLTAIRE DESIGN AWARD ($750)

The French philosopher Voltaire is credited with the saying "Le mieux est l'ennemi du bien," which means "the best is the enemy of the good." Similarly, Leonardo da Vinci is credited with the saying "Simplicity is the ultimate sophistication." This award recognizes the design team that best emulates these ideals and resists the temptation to overly complicate the design to yield a clean, simple, elegant, lowest-cost design that simply works well.

W.L. GORE & ASSOCIATES AWARD FOR MOST CREATIVE SOLUTION ($750)

This award honors the student team that has implemented a unique and creative solution within its project. It recognizes outside-the-box thinking that pushes boundaries and hands-on approaches to creative solutions. Projects are judged on the elegance and creativity of the technical solutions and their implementation. Teams should be able to communicate effectively their design and the processes they use for creativity.

DATAFORTH CORPORATION AWARD FOR BEST DESIGN USING A DATA ACQUISITION AND CONTROL SYSTEM ($500)

This award recognizes the design team that best implements a modern data acquisition and control system. Recognition is given for the use of the system to collect data that characterizes project performance and assists in project optimization and, ideally, uses the same data acquisition system to perform feedback and control operations.

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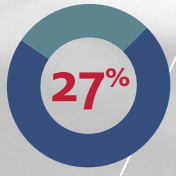
PROJECTS AT DESIGN DAY

INTERDISCIPLINARY PROJECTS



MAJOR-SPECIFIC PROJECTS

INDUSTRY-SPONSORED PROJECTS

UNIVERSITY-SPONSORED PROJECTS

AWARDS (CONT.)

HONEYWELL AWARD FOR EXCELLENCE IN AEROSPACE ELECTRONIC SYSTEM DESIGN ($500)

This award recognizes excellence in overall system design in a project that has an aerospace emphasis. Verbal presentations should be well structured to describe effectively the overall system and the specifics of how the team implemented its design project. A key feature of the presentation must be representative data that demonstrate how the system was thoroughly tested. Answers to questions should be direct and demonstrate a high level of team competency about the details of the electronic system for the project. The presentation should be shared among all members, displaying core values of teamwork and gracious professionalism.

HONEYWELL AWARD FOR TEAM LEADERSHIP (TWO INDIVIDUALS AT $250 EACH)

This award recognizes students who best exemplify teamwork skills, including the ability to work cooperatively with others to produce high-quality work, take the initiative, support and respect the opinions of fellow team members, give and receive feedback, demonstrate effective leadership, keep their team focused, and elevate the work of their fellow team members. Nominees for this award are selected by their teammates.

LATITUDE ENGINEERING AWARD FOR BEST PHYSICAL IMPLEMENTATION OF ANALYTICALLY DRIVEN DESIGN ($500)

Some engineering problems are straightforward: optimal solutions are found through the application of engineering best practices. Sometimes, however, the best design choices are not obvious, and only reveal themselves after a thorough analysis of the underlying physical principles. This award recognizes a design that could only have been arrived at after careful study and creative application of physics.

PROTOTRON CIRCUITS AWARD FOR BEST PRINTED CIRCUIT DESIGN ($500)

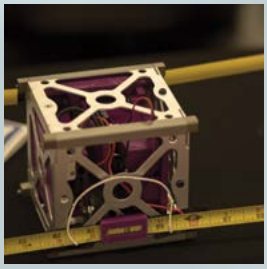
This award recognizes the team that has designed or used the most elegant and efficient electronic circuits in its project. Priority is given to best PCB designs or applications. Originality and manufacturability of the design are key criteria in selecting the winning team. Any team that has used circuitry in its project is eligible for consideration. In the absence of any original designs, the originality of the use of off-the-shelf products and the manufacturability of the overall design are used as selection criteria.

II-VI OPTICAL SYSTEMS AWARD FOR BEST USE OF OPTICAL DESIGN AND TECHNOLOGY ($500)

This award is given to the team that demonstrates the most thorough approach to the design and engineering of its optical system. This award recognizes complete understandings of the optical design, system requirements, tolerance analysis, and optical component usage. Important criteria are integration of optics into the overall system, novel use of optical components, creative use of commercial off-the-shelf items, verification of optical components, meeting system requirements, use of standard optical design software, and manufacturability of optical design and components.

KRISTY PEARSON FISH OUT OF WATER AWARD (1ST PRIZE $250; 2ND PRIZE $150)

The Fish Out of Water award congratulates students for successfully accomplishing a task that was not in their realm of expertise. The projects for senior design require skills from many disciplines, and students must sometimes learn a new subject or skill in an area outside of their major to help the team succeed. A student who not only learns this new subject or skill, but also uses it to effectively help the team thrive, shows dedication and initiative—traits that will continue to help them in an engineering career.

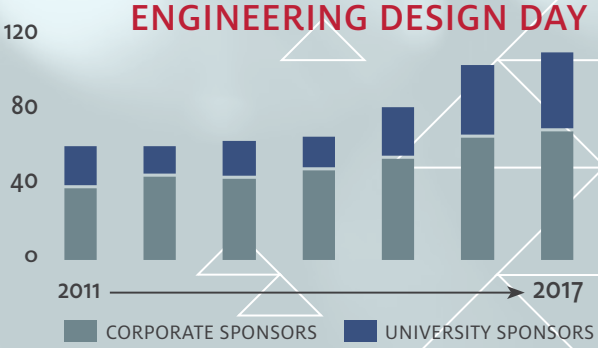


REAL PROJECTS—REAL SOLUTIONS

"Senior design projects were meant to help students get their feet wet when I was in college. Now students are working on real projects with potential applications."

Mary Turner
Edmund Optics
Senior Optical Engineer

ANNUAL PROJECTS AT ENGINEERING DESIGN DAY



120+
EXPERIENCED INDUSTRY JUDGES

50+
UNIVERSITY OF ARIZONA ALUMNI JUDGES

IMPLANTABLE UNIQUE DEVICE IDENTIFIER AND DETECTION SYSTEM USING MOBILE TECHNOLOGY

BARD | PERIPHERAL VASCULAR

TEAM 16002

Medical devices can be difficult to identify once implanted inside the human body. Adding a small unique device identifier, or UDI, allows medical staff to correctly identify the device after implantation and ensure its proper use. Information stored in the UDI can include device description, model number, catheter type, and compatibility with diagnostic devices, such as MRI.

The team developed an implantable UDI and a detection system that uses mobile phone technology. This allows UDI information to be scanned from outside of the body, creating a safe and cost-effective alternative to current techniques. Information is stored on an induction-powered radio-frequency identification tag positioned on the implanted device.

Medical personnel read the tag using an external device that connects via Bluetooth to a mobile phone. The external device can be programmed using a mobile application running the Android operating system.

SPONSOR MENTOR/ADVISOR: Andre Chanduszko
PROJECT MENTOR: Sharon O'Neal
TEAM MEMBERS: Kyle Bodnicki (EMG), Long Chen (ECE), Lenny Eduardo Lopez (ECE), Jesse David Lowery (SYE), Genevieve Messina (BME), Colton Taylor Skillings (MSE)

ANTI-DRONE DEVICE

Raytheon

TEAM 16003

Drones used in intelligence gathering and espionage are a threat to military personnel and national security, which creates demand for a device that can disable drones without risk to life.

Built specifically for the Navy, the Anti-Drone Device is designed to detect and disable drones autonomously. It consists of a microcomputer, LCD screen, Wi-Fi antenna and protective case designed to withstand the elements, such as rain, wind and humidity.

Once a drone is detected, the device automatically connects to the Wi-Fi access point of the drone and sends commands via Telnet to shut it down.

SPONSOR MENTOR/ADVISOR: Shayla Austin
PROJECT MENTOR: Sharon O'Neal
TEAM MEMBERS: Sydney Alexandra Clark (ECE), Jessica Bingxin Cheung (ECE), Evan DeForest (MEE), Ivan Cordoba-Herrera (ECE), Justin Larimore (BME), Shivani Hasmukh Patel (SYE)

3-D PRINTER FOR FULL-SIZE FLIGHT VEHICLE STRUCTURES

TEAM 16004

The goal of this project is to design and fabricate a large-scale prototype 3-D printer capable of printing parts as large as 50 by 50 by 25 inches and of reaching and maintaining temperatures required to print high-grade thermoplastics such as Ultem.

The design focused on system robustness and longevity and on the safety of the operator and bystanders. The system was built mostly using off-the-shelf components with provisions for an insulating enclosure for high-temperature printing. The extrusion system was designed to use any filament on the market, and the bed can support a print job of over 350 pounds.

Nozzles of various sizes allow the user to adjust for different part sizes, accuracy, and printing speed. The prototype includes a software interface for customizing and estimating print times and materials needed.

SPONSOR MENTOR/ADVISOR: Scott Rowland
PROJECT MENTOR: Chris Donat
TEAM MEMBERS: Brit William Briggs (ECE), Brandon Cy Doty (MEE), Alexander James Harnack (AEE), Irene Paulina Moreno (MEE), Dominique Stanley Stephens (ECE)

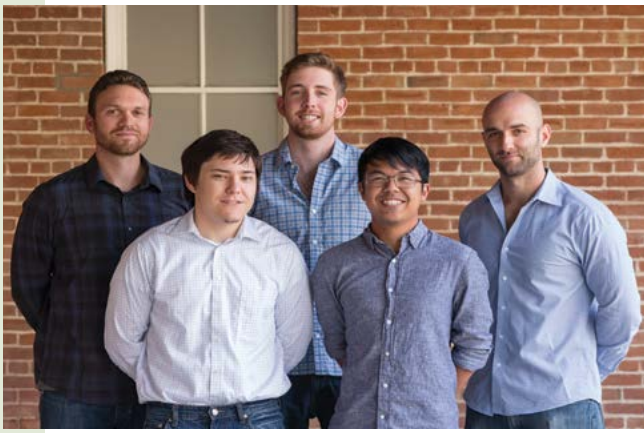
COMPACT SELF-REGENERATING DESICCANT BREATHER

TEAM 16006

Replacing desiccant cartridges is costly and time-consuming and desiccant breathers tend to be discarded after a single use when the desiccant is saturated with moisture.

The goal of this project is to design a self-regenerating desiccant breather that eliminates the need to replace desiccant cartridges.

The Infinity Breather is a small device that can self-regenerate while maintaining an air volume of 1 cubic foot with a dew-point temperature of -20 degrees Celsius.



SPONSOR MENTOR/ADVISOR: Eric Zuercher
PROJECT MENTOR: Steve Larimore
TEAM MEMBERS: Philip James Ciuffetelli (MEE), Riley Magsino (ECE), Brent Allan Miller (BME), David Joseph Selby (MEE), Andrew Whiteside (EMG)

ROBOTIC SOFTBALL UMPIRE

TEAM 16007

RoboUmp is designed to evaluate whether a pitch is a strike more accurately and consistently than a human umpire. The design uses vertically oriented light detection and ranging, or lidar, sensors to measure the height of the ball above home plate, and microcontrollers process the sensor data to determine whether the ball is in the strike zone.

The system incorporates three strike zones for players in different height ranges. If the lidar detects a ball in the strike zone, the microcontrollers relay the strike call to the umpire via an LED display.

The system is accurate to within 1 inch vertically and 0.5 inches horizontally at ball speeds of up to 60 miles per hour. RoboUmp can be moved easily and installed without interfering with the players or the game.

SPONSOR MENTOR/ADVISOR: Danielle Craig
PROJECT MENTOR: Rodger Elkins
TEAM MEMBERS: Jeffrey Thomas Bragg (EMG), Emma Catherine Landsiedel (OSE), Anthony Joseph Sabatino (SYE), Ryan Steven Trumpinski (ECE), Andrew Samuel Wien (SYE)

CIRCUIT CARD AUTOCALIBRATION FIXTURE

TEAM 16008

Not all circuit cards received by the project sponsor are properly calibrated, so the goal of this project is to design and build a circuit card calibration device that tests card integrity quickly and easily at the sponsor's manufacturing facility.

Specifically, the output voltage of the cards needs to be verified at various operating temperatures. The design was a 7 by 14 by 4 inch device that uses a microcontroller to take periodic voltage readings from a circuit card placed in a temperature chamber cycling between -55 and +70 degrees Celsius.

The microcontroller exports the voltage and temperature data to a microSD card for transfer to a computer at the manufacturing facility. This solution is fault-tolerant, easy to use, and will reduce cycle times and manufacturing costs.

SPONSOR MENTOR/ADVISOR: Benjamin Paulson
PROJECT MENTOR: Clayton Grantham
TEAM MEMBERS: Austin William Smith-Bartlett (SYE), Jacob Grendahl (MEE), Mari Elizabeth McCarthy (ECE), Adam New (MEE), Cinthya Tang (ECE)

IMPROVED ACCURACY OF POWER PLANT FUEL MEASUREMENT AND PROCESS EFFICIENCY

TEAM 16009

There was a discrepancy between natural gas usage recorded by the sponsor at its power plants and what it was being billed by its suppliers. Fuel usage and measurement are critical to accurate operations and cost management, and the goal of this project is to assess the sponsor's fuel measurement system in order to locate the source of the discrepancy.

After mining large amounts of data supplied by the sponsor and finding a correlation to explain the discrepancy, the team developed a correction factor that aligned sponsor and supplier measurements. The team then integrated this correction factor into the power plant data management software to ensure that it recorded valid fuel usage.

SPONSOR MENTOR/ADVISOR: Vy Kieu
PROJECT MENTOR: Gregory E. Ogden
TEAM MEMBERS: Mingjie Li (MEE), Abdul Hannan Rana (ECE), Nicole Ruggiero (SYE), Avinash Tiwari (ECE), Carlos Ivan Villasana (MEE)

NASOGASTRIC TUBE PLACEMENT VERIFICATION SYSTEM

TEAM 16010

The Nasogastric Tube Placement Verification System was designed to determine the proper placement of a nasogastric tube in the stomach for tube feeding. Every year, many fatalities occur due to misplacement of nasogastric tubes.

Current verification methods include X-ray and indirect verification. These methods are either expensive or inaccurate, and require a medical professional, creating a great need for a system that accurately indicates the correct placement of the tube in the stomach.

The team designed a sensor, based on galvanic cell electrochemistry, that recognizes the acidic stomach environment. As the sensor enters the stomach, a chemical reaction produces a current that correlates to the pH of the solution. This current is processed by a microcontroller and indicates to the user whether the tube has been correctly placed. This system is specific, cost-efficient, and easy to use, allowing caregivers outside of the hospital to properly feed their patients.

SPONSOR MENTOR/ADVISORS: Katrina DeCook, Paul Melnychuck, Hilda Slanina
PROJECT MENTOR: Rodger Elkins
TEAM MEMBERS: Kevin Brinkman (BME), Sandra Araiza Cruz (BME), Dalton J. Hirst (ECE), Fermin Prieto (BME), Alejandro R. Thompson (ECE)

SMART WORK ENVIRONMENT AND APPLICATION OF AUGMENTED REALITY OVERLAY FOR MANUFACTURING

Raytheon

TEAM 16011

The goal of this project was to investigate opportunities to increase efficiency by implementing Industry 4.0 "smart factory" technology, which centers on automation and data exchange, into the sponsor's manufacturing facilities.

The project also uses augmented reality, in the form of Microsoft HoloLens technology, to further improve manufacturing capabilities. The sponsor's factory workers and engineers will be able to use the augmented reality system to view visually guided instructions for the assembly and manufacture of small satellites.

The team also produced a trade study for the sponsor that analyzes Industry 4.0 and "smart factory" technology factors of interest to the sponsor, such as equipment cost and training time.

SPONSOR MENTOR/ADVISOR: Bryan Bergsma
PROJECT MENTOR: Sharon O'Neal
TEAM MEMBERS: Alexandra Kay Beresford (EMG), Nicole Angelina Chellman (INE), Jonah Matanky (MEE), Bradley Michael Roybal (EMG), Seth Werly (ECE), Nicholas Yonke (BME)

TURBULENCE-COMPENSATED TABLE MECHANISM

B/E AEROSPACE

TEAM 16012

The goal of this project is to design a mechanism to compensate for vibration of aircraft passenger seat tables caused by turbulence.

The system design includes three actuators, capable of handling turbulence up to 1G of acceleration, that move in up-and-down, rolling, and side-to-side directions. Sensor data from table movement and location is acquired by accelerometers and distance and weight sensors, and processed by an Arduino Zero, which tells the actuators when and where to move.

The table is mounted on a credenza that keeps the table hardware in place and holds all the electronics, including the power source and cables.

SPONSOR MENTOR/ADVISOR: Ian Frost
PROJECT MENTOR: Brian O'Cain
TEAM MEMBERS: James Ellis Beulke (ECE), Abigail Maria Francis (ECE), Taha Hasan (EMG), Davis James McGregor (MEE), Andrew William Walsh (MEE), Qiang Zhang (MEE)

ILLUMINATED PRINTED TOUCH CONTROL

TEAM 16013

The goal of this project is to develop an indiscernible button to perform a specific function to enhance airline passenger experience in super first class suites.

This system can be used to adjust passenger seats, open and close window shades, or turn the in-flight entertainment system on and off.

The new system improves upon current button design by introducing a fabric with electroluminescent paint that helps reduce failure due to accidents and reduces total system footprint. The paint doubles as a light source illuminating the buttons concealed under the fabric.

SPONSOR MENTOR/ADVISORS: Ian Frost, Joe Warren
PROJECT MENTOR: Steve Larimore
TEAM MEMBERS: Jarrah Abdulaziz Albassam (INE), Farah Ahmed Alghurab (INE), Rong Ban (MEE), Nicholas M. Carter (ECE), Ling Bin Lu (MEE), Garrett Mychal Veasey (SYE)

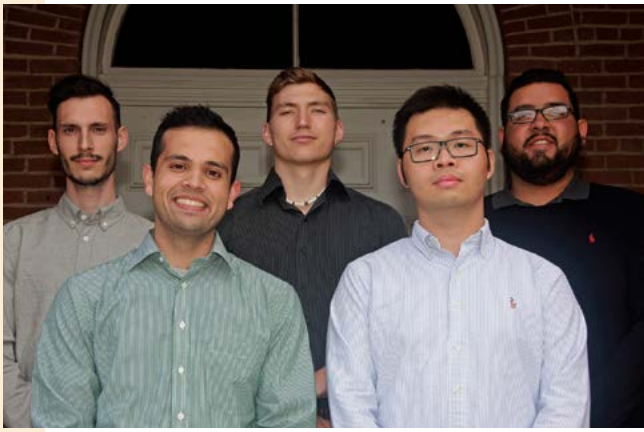
3-D LASER SCANNER

TEAM 16014

Although 3-D printing has become increasingly popular in industry, particularly in rapid prototyping for product development, 3-D printers are still lacking as standalone devices.

To improve upon this technology, the team created a 3-D scanning system capable of analyzing plastic objects with dimensions up to 100 by 100 by 100 millimeters. Data is collected using phase-based, time-of-flight sensors, then analyzed and processed via a MATLAB-based program included with the scanner.

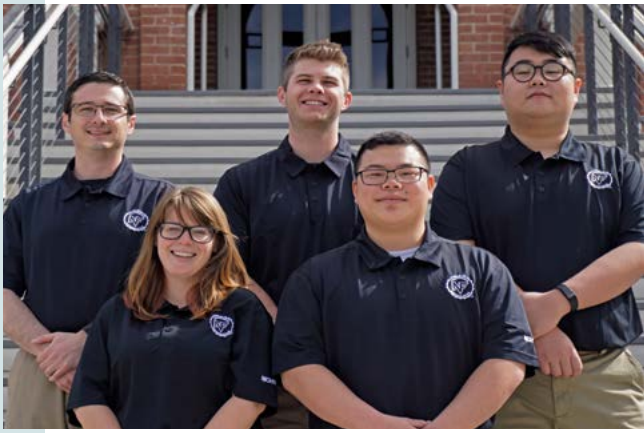
This program allows the user to export a computer-aided design stereolithography file of the scanned rendering, which can be redirected into any 3-D printer for fabrication.



SPONSOR MENTOR/ADVISOR: Malcolm Minty
PROJECT MENTOR: Rodger Elkins
TEAM MEMBERS: James Hernandez (OSE), Long Hai Le (INE), Matthew Gregory Nielsen (ECE), Nicholas Ray Pehrson (MEE), Hector Manuel Valdez (MEE)

OPTICAL SUBASSEMBLY ALIGNMENT STATION

TEAM 16015



The objective of this project is to develop a system to align optical lenses within a riflescope subassembly during production. The designed optical assembly station allows alignment, in less than 20 minutes, of the target assembly to within specified tolerances.

To meet all the requirements presented, a nontraditional approach to optical alignment was adopted. The station projects an expanded laser beam through a refractive axicon lens, which transforms the beam into a ring that is sent through the bore-aligned lens barrel into a camera with complementary metal-oxide semiconductor sensors.

Misalignments of a scope lens within the barrel, such as tilt and decenter, cause changes to the thickness of the projected light ring and to the position of its center, which are detected by the camera. This data is used to adjust the lens until the error is within the acceptable tolerance for the target assembly.

SPONSOR MENTOR/ADVISOR: Brian Bellah
PROJECT MENTOR: Mike Nofziger
TEAM MEMBERS: Cori Yau-chun Cheung (MEE), Anthony Vincent Monteleone (MEE), Emily Mrkvicka (OSE), Jiang Peng (SYE), Devin Vorel (MEE)

3-D PRINTING OF SOFT TISSUES

TEAM 16016

The goal of this project is to design, build and validate a 3-D soft tissue printer for the Arizona Simulation Technology and Education Center.

The printer uses a silicon-based material-extrusion system that connects to a nozzle feed for the printing operation. Stepper-motor-driven axial motion is controlled by a Raspberry Pi microcontroller.

Computer-aided design stereolithography models are loaded onto the printer via microSD card. The printer includes a heated bed for the additive manufacturing process. The primary use of the printer is to print medical models for medical procedure training.

SPONSOR MENTOR/ADVISOR: Allan Hamilton
PROJECT MENTOR: Brian O'Cain
TEAM MEMBERS: Ryan Arthur Bouchard (EMG), Alexa Camille Irons-Castro (BME), Maggie Gauthier (BME), Bryce Kenneth Hodson (ECE), Ashton Carolyn Pagan Ortiz (BME), Jonathan Jacob Palafox (MEE)

COMPARATIVE ANALYSIS OF UNMANNED AIRCRAFT

Raytheon

TEAM 16017

The objective of this project is to perform a customer-based analysis of camera-equipped prosumer drones, the median-priced unmanned aerial vehicles used by hobbyists and professionals alike for photography and videography.

The team conducted cost, customer and feature analyses and hardware testing for three drone models manufactured by Yuneec. Results were combined to develop a comparative model of the drones and to identify areas of possible optimization.

The final comparative model encompasses test and analytical results plus evaluations of "smart" features such as sonar collision avoidance, autonomous flight modes, and indoor/outdoor positioning systems. The team also used data gathered during test flights to assess the drones' camera performance.

SPONSOR MENTOR/ADVISORS: Dean Booher, Mark Davey
PROJECT MENTOR: Bob Messenger
TEAM MEMBERS: Michael Edmund Arpaia (MEE), John Michael Stephens Hines (INE), Rachael Lanae Jacobi (EMG), Nathan Lee Mills (SYE), David Didier Sorkin (SYE)

DISPENSE VOLUME VERIFICATION TOOL

VENTANA
A Member of the Roche Group

TEAM 16018

Tissue staining for cancer diagnosis uses chemicals that must be controlled. Much of the staining waste stream is noncontrolled but no method exists to determine how much of the waste stream needs to be controlled as hazardous waste. Environmental impact and cost make this a significant problem.

The goal of this project is to design a system to automatically detect and sequester controlled substances above their specified control levels. Sequestration reduces generation of controlled waste and prevents it from mixing with noncontrolled waste.

Prototype sensors use ultraviolet and visible light spectra to detect hazardous chemicals and provide control signals that direct the system to align the flow path to either controlled or noncontrolled waste paths, as applicable. This allows the waste to be monitored continuously with little operator action.

SPONSOR MENTOR/ADVISORS: Kenyon Kehl, Dianne Pistone
PROJECT MENTOR: Chris Donat
TEAM MEMBERS: Trace Ayotte (BSE), Marcus Clay Hunt (SYE), Alex Levine (ECE), Alexander Joseph Marshall (SYE), Luke Smeilus (ECE)

ADHESIVE SINGLE-SLIDE DISPENSE PACKAGING SYSTEM FOR COVERSLIPS

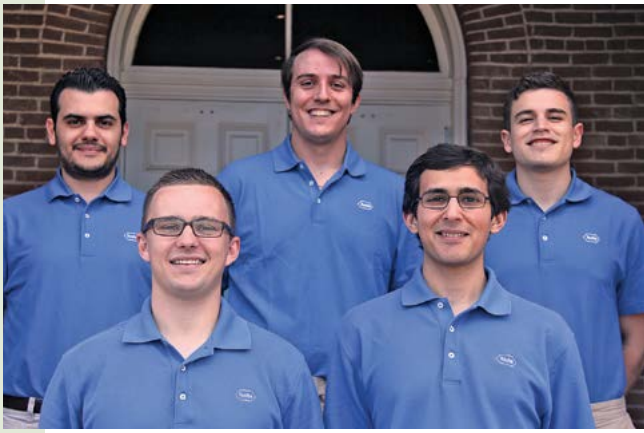
VENTANA
A Member of the Roche Group

TEAM 16020

The project's goal is to design a single-serve consumable adhesive package and adhesive dispense system. The ultimate aim is to reduce the sponsor's reliance on a single distributor and to lower the cost per test.

The single-serve consumable was designed to dispense a required volume. Additionally, an adhesive dispense system was designed and built specifically to be compatible with the single-serve consumable adhesive package.

The system automates the dispense process after a slide and consumable are loaded, and presents a slide with adhesive applied that is ready for manual coverslipping.



SPONSOR MENTOR/ADVISOR: Chirayu Patel
PROJECT MENTOR: Chris Donat
TEAM MEMBERS: Feras Antoun (SYE), Caleb Daniel Canchola (MSE), Nazar Cem (MEE), Brett Joseph Deitering (MEE), Timur Taljanovic (MEE)

TISSUE IMAGING AND SELECTIVE REAGENT DISPENSE SYSTEM

VENTANA
A Member of the Roche Group

TEAM 16021

The team was tasked with developing a system to detect the presence of tissue on a glass microscope slide and dispense a minimum volume of reagent to completely cover the tissue. The sponsor uses expensive reagents in its tests and wants to reduce costs and liquid waste by developing a system that can selectively dispense fluid reagents.

The designed system uses a camera to collect an image of the tissue on the glass slide, which is then converted into a binary image. Once the tissue's location, shape and size are determined, linear stages move the dispense system above the tissue to apply an appropriate amount of reagent.

A graphical user interface is implemented using a touch screen and an Arduino microprocessor, which allows the user to collect information about tissue location, dispenser location, and dispense volume.

SPONSOR MENTOR/ADVISOR: Kenyon Kehl
PROJECT MENTOR: Chris Donat
TEAM MEMBERS: Adam O. Abdelatif (OSE), Oksana Carlson (BME), Christopher Nguyen (OSE), Eduardo Ramirez (MEE), Jordan Stupka (BME)

BIFURCATED FIBER OPTIC CABLE SYSTEM FOR ORION SPACECRAFT HEAT SHIELD SPECTROMETER

THE UNIVERSITY OF ARIZONA College of Engineering

TEAM 16022

The Unbreakable Fiber Optic, or UFO, is a custom fiber-optic cable assembly intended for use in the upcoming NASA Exploration Mission 1 to test Orion spacecraft reentry capabilities.

The UFO system will be attached to the Orion's heat shield to propagate spectral data through a sapphire rod to a spectrometer so the data can be analyzed on the ground to provide information about the chemistry of the ionized gases and ablated heat shield material.

The design uses a bifurcated, space-rated and verified broadband transmission optical fiber that has two loose outer jackets supported by aluminum cable clamps lined with silicone foam. The cable and its method of attachment to the spacecraft were designed, analyzed and tested to ensure that it would survive launch, space and reentry conditions. The prototype provides a verified space-rated cable that will survive the mission past low-earth orbit and back.

SPONSOR MENTOR/ADVISOR: S. Douglas Holland
PROJECT MENTOR: Doug May
TEAM MEMBERS: Laura Haferkamp (MSE), David Greif (MEE), Giuseppe Lo Voi (ECE), Kyel Powell (SYE), Andrew Daniel Rocha (OSE)

BEAM-POINTING STABILITY TEST BENCH

Edmund optics | worldwide

TEAM 16023

Mechanical shock experienced by the sponsor's lenses during shipment can cause imaging problems, such as a change in beam pointing, that burdens customers with costly and time-consuming recalibration of their imaging systems.

The sponsor developed ruggedized lenses that resist these misalignments and wants to develop a specification for lens beam displacement following a shock of 15g or more.

The team's goal is to develop an optical test system for the ruggedized lenses that collects the data needed to create the specification. The test system designed is split into two separate test benches: one induces a 15g mechanical shock and the other measures preshock imaging and any postshock shift in image location.

SPONSOR MENTOR/ADVISOR: Jeremy Govier
PROJECT MENTOR: David Gilblom
TEAM MEMBERS: Marcus William Braatz (MEE), Lane Thomas Douthit (ECE), Ronald Mark Ernst (MEE), Eduardo Gonzalez (OSE), Frederick Karl Riess (MEE)

TRADE SHOW DISPLAY TO DEMONSTRATE FLOW AND PRESSURE CONTROLLER PERFORMANCE

TEAM 16024

The goal of this project is to create a booth display piece that is the graphic part of a graphic audio equalizer. The display device uses a mass-flow controller to adjust the extension of a spring-loaded air cylinder and demonstrate pressure differences in physical movement.

Air flows from the air compressor into the device, which regulates the air pressure going into the air cylinder. As the device regulates the air pressure, the arm of the air cylinder rises and falls, creating a seismograph-like drawing system that uses a dry erase marker to continuously write on a rotating spool of whiteboard paper, which shows pressure transients and stable pressure levels.

This paper is rotated continuously around two spools powered by a direct-current motor controlled by an H-Bridge and software to adjust speed. The drawn image represents mechanically the electronic data represented in the software and produces an eye-catching trade show display.

SPONSOR MENTOR/ADVISOR: Ben Ramirez
PROJECT MENTOR: Chris Donat
TEAM MEMBERS: Adam Brier (MEE), Sivan Geyra (MSE), Sultan Adel Omair (ECE), Grace Ritchey (MEE), Justine Marie Saugen (ECE)

CONSUMER-AUGMENTED REALITY DEVICE

TEAM 16025

The prototype Vidi VR headset creates a 3-D environment using original optics, hardware and software designed from scratch by the team. The integrated camera system and gesture-recognition software allow users to send commands to their existing wearable 3-D camera.

The design uses off-the-shelf optical components and 3-D-printed parts to reduce cost and simplify configuration. The hardware includes three Raspberry Pi Zero microcontrollers equipped with Wi-Fi adapters to streamline functional development and support external applications.

The software combines C++, OpenCV, BabylonJS and Python to process user gestures and display content. This prototype is the first iteration of a new augmented reality product for the sponsor's company, and will serve as an adaptable base for future development.

SPONSOR MENTOR/ADVISOR: Brian Herrera
PROJECT MENTOR: Sharon O'Neal
TEAM MEMBERS: Bryan Jacob Eberson (MEE), Mark Ross Fleckenstein (SYE), Jacob Garan (OSE), Michael Dean Hailwood (SYE), Steven Pierre Hicks (OSE)

COMPUTER VISION SYSTEM FOR AUTONOMOUS VEHICLE

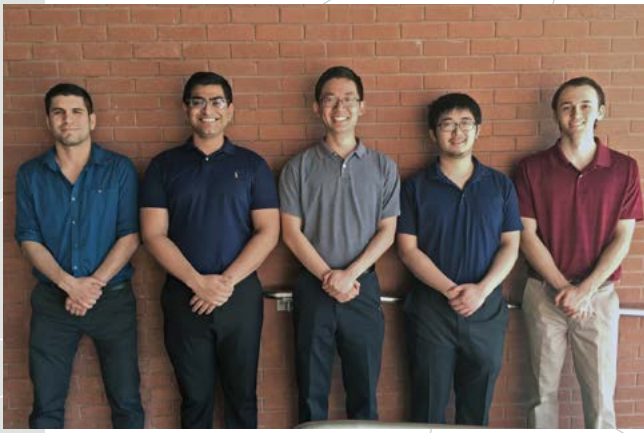
COLLEGE OF ENGINEERING
Electrical & Computer Engineering

TEAM 16026

The team's goal is to develop a computer vision system that can be mounted on an unmanned aerial vehicle, or UAV, to detect, localize and classify ground targets. The UAV will compete in the Association of Unmanned Vehicle Systems International Student Unmanned Aerial Systems competition and be required to search for objects and identify attributes such as shape, color, and letter.

This is often done by an operator monitoring an image feed, which limits the versatility and scalability of the system. The designed system eliminates the human operator and automates the imaging while minimizing hardware requirements through use of a hybrid onboard-offboard processing architecture.

The onboard system uses a single-board computer to detect objects, which reduces the communication bandwidth required, and the offboard ground-based system uses machine-learning algorithms such as convolutional neural networks to classify received images.



SPONSOR MENTOR/ADVISOR: Michael Marcellin
PROJECT MENTOR: Rodger Elkins
TEAM MEMBERS: David Hung (ECE), Kennon Douglas McKeever (ECE), Milap Patel (ECE), Ricardo Ramirez (ECE), Rongguo Ruan (ECE)

TOUCHSCREEN MULTIUSER DETECTION

elo

TEAM 16027

The team was charged with developing and building a system that identifies touch events on a touch screen by four individual users. The team's solution is an amplitude-modulated bit-sequence injected through the user's hand using a programmable signal generator.

The signal propagates into the screen as the user interacts with the touch device. Once detected, the propagated signal is decoded and associated with a unique ID that corresponds to one of the four users touching the screen. The final system comprises two function generators that send the designed signals, a touch screen provided by the sponsor, and a laptop to run the code written by the team.

This technology can be easily integrated, using software programs such as C++ and Matlab, into touch-screen applications such as those used in corporate collaboration and in the gaming industry.

SPONSOR MENTOR/ADVISOR: Gazi Ali
PROJECT MENTOR: Sharon O'Neal
TEAM MEMBERS: Abdullah Nasser A. Aljawini (INE), Rohin Galhotra (ECE), Benjamin Richard Colburn Johnson (ECE), Vladyslav O. Kovalsky (ECE), Qasim Mahmood (ECE)

METHOD AND SYSTEM FOR AIR VELOCITY GENERATED ELECTRICAL POWER

JP GREEN ENERGY

TEAM 16028

The project's goal is to develop an optimized wind turbine prototype to generate electrical power.

The prototype's size, pitch, shape and insertion depth were all considered in order to optimize for minimum air resistance and maximum power generation from a typical heating, ventilation and air conditioning duct air stream with a velocity of 750-1000 feet per minute.

Maximum power generation was accomplished by modifying the blade design, adding a more efficient generator, and optimizing the system as a whole.

SPONSOR MENTOR/ADVISOR: Pierre Abou-Zeid
PROJECT MENTOR: Doug May
TEAM MEMBERS: Thomas Joseph Deranek (INE), Austin Karl Hoepfner (MEE), Hannah Elizabeth Ingle (ECE), Heidi Lynn McCook (ECE), Fabian Javier Medina (MEE)

GROUND-ENGAGING TOOL IMPROVEMENT

CATERPILLAR®

TEAM 16029

The project's objective is to design a mechanism for changing ground-engaging tools used on earth-moving equipment. A ground-engaging tool is the removable edge on the bottom of the blade of a machine such as a bulldozer.

These edges are designed to wear and to be replaceable so the blade lasts longer. Key design requirements are safety and ease of replacement. The mechanism designed attaches to a forklift and the edges are held in clamps designed for three edge types.

The clamps can be rotated about a rod using a manual gearbox, which allows the new edge to be oriented at the correct angle for attachment to the machine. The gearbox has a ratio of 50:1 for ease of rotation, and the mechanism is made out of 1020 steel for safety.

SPONSOR MENTOR/ADVISOR: Shawn Roberts
PROJECT MENTOR: Steve Larimore
TEAM MEMBERS: Adnan Mohammed Alqallaf (MEE), David William Beck (MEE), Brian Allen Fugett (INE), Kevin Andres Gutierrez (MEE), Corey Joseph Taylor (MEE)

IMPLEMENTATION OF PARTIAL TURNS ON A HIGH-POWER AUTOTRANSFORMER

Honeywell

TEAM 16030

The team was asked to model, design and build a partial-turn transformer that meets the high tolerances specified by the sponsor. Transformers are widely used in electrical appliances that plug into a wall outlet and are designed by winding a conductive wire around a magnetic core.

The input winding is referred to as the primary winding, and the secondary winding outputs to the rest of the circuit. The ratio of the number of primary windings to the number of secondary windings determines the "transformation" capability of the device. With partial turns, the transformation capability of existing devices can be replicated at a fraction of the weight. However, partial turns are associated with high levels of leakage inductance, which inhibits transformation capability.

Modeling different system parameters in ANSYS Electronic Studio with the intent of minimizing leakage inductance determined the optimal design for the prototype, which was designed and machined using Solidworks and delivered to the sponsor.

SPONSOR MENTOR/ADVISORS: Cristian Anghel, Keming Chen, Jens Gehrke
PROJECT MENTOR: Brian O'Cain
TEAM MEMBERS: Eric Scott Andrews (ECE), Travis Jefferies (EMG), Dario Andrade Mendoza (MEE), Adam Raabe (MEE)

LOW COST ULTRAFINE PARTICLE DETECTOR

Honeywell

TEAM 16031

Exposure to elevated levels of ultrafine airborne particulates may result in severe health effects, such as asthma. This establishes a need for a standalone air-quality detector that provides early warning of high concentrations of ultrafine particles in the air conditioning systems of buildings, public transportation, and aircraft.

The objective of this project is to design a low-cost ultrafine particle detector that senses air particulates with a diameter of 10-200 nanometers at a concentration of 10,000-1,000,000 particles per cubic centimeter with greater than 80 percent accuracy. The detector designed consists of a 3-D printed body, blue LED, photodiode sensor, aspheric lenses, carbon filter, and a Raspberry Pi microcontroller. 3-D software such as SolidWorks and FRED was used to run simulations and model the optical geometry of the detector.

The designed detector is smaller, lighter and more affordable than currently available ultrafine particle detectors, and can operate continuously while maintaining nanometer-level accuracy.

SPONSOR MENTOR/ADVISOR: Richard Fox
PROJECT MENTOR: David Gilblom
TEAM MEMBERS: Tiange He (MEE), Sean Matthew Parker (MEE), Lauren Christine Rimsza (BME), Bryan Shane Rogers (ECE), Sarah Megan Shepis (MSE)

FREE- VERSUS FORCED-VORTEX PRESSURE RISE IN A TURBINE DISC CAVITY WITH PUMPING VANES

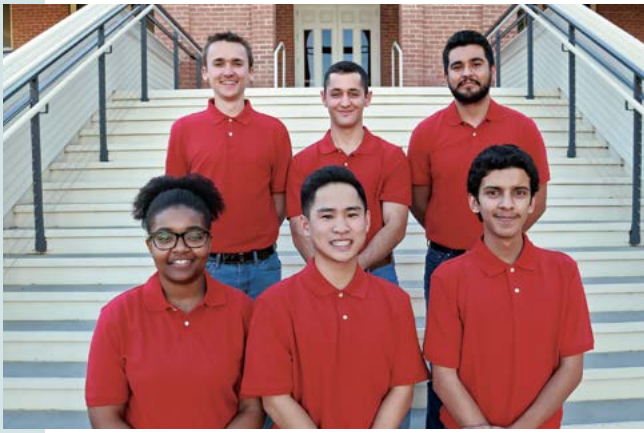
Honeywell

TEAM 16032

The project team analyzed the effects of free versus forced vortex flow in a jet engine. To conduct the analysis, cooling vanes and blades were integrated on the stationary and rotating discs of a mock jet turbine engine.

The blades and vanes were adjusted during the integration to achieve different aerodynamic properties that resulted in changes to internal cavity pressure and velocity. Data collected using airflow velocity anemometers and pressure transducers was analyzed to determine internal cavity behavior in a free or forced vortex relationship.

The relationship between the integrated blades and vanes and the vortex discovered during testing provides critical data for optimizing turbine main cavity pressure, and for maximizing overall engine efficiency and performance.



SPONSOR MENTOR/ADVISORS: Nicole Conklin, Alexander Mirzamoghadam
PROJECT MENTOR: Brian O'Cain
TEAM MEMBERS: Eid Aldaihani (MEE), Matthew Ryan Grijalva (MSE), Eduardo Padilla (MEE), Henrik Anthony Svensson (EMG), Ty'Dria A. Wright White (EMG), Peng Zhang (EMG)

VIBRATION PLATFORM

WITTENSTEIN

TEAM 16033

The sponsor's effort to improve its rotary aircraft simulation suite includes investigating how vibration is induced in its simulator. This entails expanding the system from vibrating the seat to vibrating the entire simulator platform.

Adding vibration feedback will better prepare pilots in training for the rotor feedback they would feel in a real aircraft. The goal of this project is to research existing vibration platforms and develop a new vibration system for the sponsor.

The system designed performs at or beyond the required performance standards while providing a marketable product for the sponsor to package with its simulator. Components of the design were stress-tested in SolidWorks; the design was finalized and test methods were written for the system, were it to be constructed.

SPONSOR MENTOR/ADVISORS: Daniel Dittmar, Gregory Poe
PROJECT MENTOR: Doug May
TEAM MEMBERS: James Thomas Fagan (MEE), Alfred Herbert Goodwin (MEE), Kenneth Michael Green (SYE), Ryan Ernst Jensen (MEE), Regdy Vera (SYE)

TEST RIG FOR VALIDATING LABYRINTH SEAL PERFORMANCE AT DIFFERENT TOOTH TIP GEOMETRIES

Honeywell

TEAM 16034

The labyrinth seal testing rig measures how efficiently different geometries of labyrinth seal reduce airflow leakage. The goal of this project is to validate existing simulated static data and evaluate toothed labyrinth flow statically.

The testing rig measures flow into the labyrinth seal and the pressure before the first and after the final teeth of the seal. The data collected from the flow meter and the two pressure sensors is used to create pressure ratio versus flow rate curves. These experimental curves are then compared to the simulated curves.

The rig rotates, but only static data was collected. One toothed cylinder was produced for this year of the project; cylinders produced in future years will be easily interchangeable.

SPONSOR MENTOR/ADVISORS: Nicole Conklin, Alexander Mirzamoghadam
PROJECT MENTOR: Gary Redford
TEAM MEMBERS: Abdallah Ben Haj Abdallah (MEE), Bailey Jane Calciolari (EMG), Nohe Sebastian Garcia (EMG), Andrew Bryan Hartman (MEE), Wenyuan He (EMG)

ROBOTIC DATA CENTER

Microsoft

TEAM 16035

The goal of this project is to create a universal model for automated data centers in Power BI software. The model allows users to input specifications for a desired datacenter, such as size and location, and outputs optimal design specifications, projected costs and a 3-D SolidWorks representation of the data center.

The model performs its calculations by retrieving official data from the internet and combining it with input and previously saved data. The model is designed to help Microsoft plan future data centers, which will include features such as robotic maintenance, and to provide the ability to compare cost and performance of various data center configurations.

SPONSOR MENTOR/ADVISOR: Mike Helsel
PROJECT MENTOR: Sharon O'Neal
TEAM MEMBERS: Abdulrahman J FJ M F Alrashidi (INE), Daniel Bird (MEE), Marco Alejandro Tipitto Cerruti (MEE), Jennifer Marie Dye (ECE), Dako Stephen Lesman (SYE)

MULTIFREQUENCY ANTENNA MAST SYSTEM FOR LARGE MINING TRUCKS

CATERPILLAR®

TEAM 16036

Mine sites around the globe use the sponsor's 793F mining truck, which requires several antennas for everyday operation. The existing antenna configuration consists of multiple antenna mounting locations and an underused mast structure.

The mast structure is difficult to maintain and supports only a single antenna, so the team's goal is to design and test a telescoping mast system that supports multiple antennas while being easier to safely maintain. The team's solution is a lightweight, cost-efficient design featuring a highly integrated antenna mast system.

The new antenna mast system is raised and lowered by an electronic motor that allows technicians to perform maintenance safely. Multiple antennas can be mounted on the new mast, which is made of carbon fiber for high strength and low weight.

SPONSOR MENTOR/ADVISORS: Adam Hales, Joe Tabor
PROJECT MENTOR: Steve Larimore
TEAM MEMBERS: Robert Samuel Bloom (MEE), Zicheng Cai (MEE), Wyatt James Pena (EMG), Miguel Angel Vasquez (EMG), Brian Edward Wargaski (MEE)

INLINE SWIRL PARTICLE SEPARATOR

Honeywell

TEAM 16037

The goal of this project is to design a system that uses centrifugal force to remove as much dust as possible from a flowing air line with minimal loss of pressure.

The designed centrifugal particle separator removes fine dust (1-100 microns in diameter) remaining in a high-pressure air line after the air has passed through a filter. Parameters modeled and tested include number of swirl blades, blade length, and migration length.

SPONSOR MENTOR/ADVISOR: Nicole Conklin
PROJECT MENTOR: David Gilblom
TEAM MEMBERS: Zachary Kerr Finsterwald (ECE), Brenda Lorraine Huppenthal (MEE), Zakir Mukhida (SYE), Linden Stone Watwood Sommer (MEE), George Peter Vlassis (MSE)

ADSORPTION AND DESORPTION TESTS FOR VOLATILE ORGANIC COMPOUNDS IN CABIN BLEED AIR

Honeywell

TEAM 16038

Sorbent systems are used in a wide range of applications, from chemical factories to aircraft cabins. Small-scale testing saves materials and time; this project's goal is to design a small-scale system to test the efficiency and capacity of industrial-grade sorbents.

The team compared the adsorption and desorption capabilities of two sorbents: APG-III and AZ-300. Sorbents were tested for their ability to adsorb and desorb volatile organic compounds introduced into an air stream at low concentration, on a scale of parts per billion.

A ppbRAE 3000 wireless handheld volatile organic compound monitor, which is capable of ambient temperature adsorption and temperature-swing desorption, was used to acquire concentration data.

SPONSOR MENTOR/ADVISOR: Nicole Conklin,
PROJECT MENTOR: Gregory E. Ogden
TEAM MEMBERS: Paul Michael Elias (BME), Jaime Goytia (CHE), Fernando Ivich (BME), Ethan Paul Oglesby (SYE), Nicole Helen Oliver (MSE)

STRUT CONDITION MONITOR FOR LARGE MINING TRUCKS

CATERPILLAR®

TEAM 16039

Strut failure on the CAT 770 mining truck means costly downtime for the sponsor's customers. The objective of this project is to design and implement a monitoring system for the truck's hydraulic struts.

The system needs to monitor strut performance continuously during truck operation and alert the driver to strut behavior that indicates it is damaged.

Data gathered by the system from pressure, temperature and displacement sensors on the hydraulic struts is processed through developed algorithms to determine if the strut's behavior matches the ideal within a set tolerance. The driver is prompted with the error and a mitigation strategy, such as recharging the strut with nitrogen or replacing it before it fails.

SPONSOR MENTOR/ADVISORS: Adam Hales, Justin Mamer
PROJECT MENTOR: Steve Larimore
TEAM MEMBERS: Ryan Dale Barents (MEE), David Farrell (MEE), Daniel Steven Small (ECE), Israel Valle (SYE), Zheng Zhou (MEE)

EMERGENCY RESPONSE MODEL FOR SUBSCRIBED, DISTRIBUTED AND PAID RESOURCES

VIJILIS
EMERGENCY RESOURCE MANAGEMENT

TEAM 16040

Secondary collisions are a life-threatening hazard for emergency response personnel and civilians at accident scenes. This project models a crowd-sourced emergency response system that engages local certified civilian contractors, allowing them to respond quickly to emergencies while reducing communication workload and mitigating risk of further property damage or loss of life.

The team designed and built a web-based emergency response system that illustrates the registration, verification, movement, allocation and confirmation of emergency resources via certified civilians. This software model is intended for government use.

System features include real-time traffic and meteorological data monitoring, cloud-based storage of incident records for later analysis, an automatically generated payment algorithm, and a location-based dispatching algorithm. The system is accessible on a responsive mobile platform.

SPONSOR MENTOR/ADVISORS: James Messerly, Dominique Villela
PROJECT MENTOR: Bob Messenger
TEAM MEMBERS: Dawn Jade Binder (SYE), Theresa Marie Bullard (BME), Nathaniel Christianson (ECE), Travis Allan Roser (ECE), Kendall Carrin Stokes (SYE)

TEST SYSTEM FOR SAND INGESTION BY AIRCRAFT ENGINES

Honeywell

TEAM 16041

The goal of this project is to develop a system that accurately simulates sand ingestion by auxiliary power turbine engines used in commercial aircraft.

The system designed tests cooling passages that keep the turbine from overheating. The small size and complex geometry of the cooling passages allow them to become clogged with sand, causing engine failure.

The team replicated the operating conditions of the engine during sand ingestion and then ran a series of tests under various flow configurations. The sponsor will use the team's data as a starting point for a more extensive study of sand ingestion.

SPONSOR MENTOR/ADVISOR: Nicole Conklin
PROJECT MENTOR: Doug May
TEAM MEMBERS: Graham Wood Aston (MEE), Garrett Conlon (EMG), Ryan Paul Richard (AEE), Morgan Marie Struble (MEE), Kevin Kenneth Vock (MEE)

LASER-GUIDED ROBOTIC TERMINAL FOR PREBONDING PART ALIGNMENT

QUARTUS ENGINEERING

TEAM 16042

The team's objective is to develop and build a closed-loop alignment terminal to align a small glass tube with a brass ferrule. The team designed a robotic alignment terminal that only requires an operator to load the ferrule and cartridge holding the glass tube into mounts.

The mounts hold the cartridge and ferrule in the correct position ready for bonding. The terminal is capable of sensing and adjusting for concentricity to within 0.005 millimeters, axial alignment to within 0.05 millimeters, and parallelism alignment between the cartridge and ferrule.

The robotic terminal uses active image processing and micropositioners to align the cartridge and ferrule to the specified requirements. Once the operator loads the cartridge and ferrule, the process is completely automated and requires no further operator input.

SPONSOR MENTOR/ADVISOR: Russ Mitchell
PROJECT MENTOR: Gary Redford
TEAM MEMBERS: Jacob Nathaniel Boyer (OSE), Adrianna Marie Ortiz-Flores (EMG), Daniel Ito (AEE), Stefanie Wells (OSE), Kate Wollgast (MEE)

AUTOMOTIVE LIDAR COLLISION-AVOIDANCE SYSTEM

TEXAS INSTRUMENTS

TEAM 16043

The goal of this project is to design and implement a real-time, LIDAR-based collision-avoidance system. The system has been tested using a remotely operated car. If the operator attempts to crash the car, the system detects an oncoming collision and forces the car to brake to avoid the collision.

The design consists of optical components for the lidar system, a Texas Instruments Hercules microcontroller, time-to-digital converter to record laser time of flight, and a Hall effect sensor to measure wheel speed.

The system determines the velocity of the car and the distance to the oncoming object and calculates the braking required. A tablet-based application shows system status in real time via head-up display; the system is scalable for real-world application.

SPONSOR MENTOR/ADVISORS: Jacob Freet, Anthony Vaughan
PROJECT MENTOR: Clayton Grantham
TEAM MEMBERS: Megha Agarwal (ECE), Alisha Keshav Bandekar (ECE), Ashley Soyoung Kang (ECE), Tyler Jon Martis (ECE), Hossein Namazyfard (MEE), Alan Yeh (OSE)

COST-EFFICIENT AND CONSUMER-ACCEPTED MILK CASE REPLACEMENT

Shamrock Farms
So Pure. So Fresh. So Shamrock.™

TEAM 16044

The sponsor uses high-density polyethylene milk crates an average of 10 times before they are stolen or damaged. The team was charged with designing a cost-efficient milk case that would be acceptable to the sponsor's customers.

The team's design solution is an open frame crate that meets all the requirements for safe handling, proper loading of six one-gallon milk containers, support of the required weight, and for common shipping standards.

The new crate is lighter, backward compatible, less likely to be stolen, more cost-effective to produce, and should become as accepted as the current crate by retailers and consumers.

SPONSOR MENTOR/ADVISORS: Troy Hancock, Tiffany Hawks, Jim Robinson
PROJECT MENTOR: Chris Donat
TEAM MEMBERS: Derek Thomas Bolles (EMG), Carolina Cadena (BSE), Ryan Craig Dang (INE), Cody James Peterson (MEE), Trevor Alexander Smith (MSE), Luis Daniel Sotelo (BSE)

FEASIBILITY OF A WINDSCREEN HEAD-UP DISPLAY

Honeywell

TEAM 16045

A head-up display greatly improves situational awareness and increases safety by allowing the pilot to see outside while providing all the information necessary to maneuver the aircraft. A head-up display enhances safety by providing the pilot with conformal attitude and flight guidance information overlaid on the actual out-the-window view for precision flying and landing.

The objective of this project is to investigate the feasibility of designing a holographic head-up display that can use the windshield as an optical waveguide. The primary focus of the project is to investigate the effect of windshield curvature on the final image displayed to the pilot.

The system design was demonstrated by using a projector system that traps light into the windshield waveguide through an injection hologram. The light must internally reflect totally until it reaches the proper height. The light is then directed into the pilot's eyes through an extraction hologram.

SPONSOR MENTOR/ADVISOR: Brent Larson
PROJECT MENTOR: Bob Messenger
TEAM MEMBERS: Kade William Bowers (OSE), Abril Lopez Garcia (MEE), Savannah Paige Gaston (MEE), Bradley Jarrett Nees (ECE), Isaiah Brandon Strong (MEE)

AUTOMATED ASSEMBLY PLATFORM FOR SIMULATION SYSTEMS

WITTENSTEIN

TEAM 16047

The team designed pilot and copilot simulator platforms upon which the project sponsor can mount its aircraft simulators during integration and test. The platforms are designed for fixed wing and rotary wing aircraft simulators, and can support up to 450 pounds.

Platform heights are adjustable between 32 and 48 inches from the ground, and can tilt in three directions at a maximum angle of 22 degrees. Lifting and tilting mechanisms are controlled remotely.

The platforms will be used in the sponsor's manufacturing facility, and at trade show to demonstrate aircraft simulation controls.

SPONSOR MENTOR/ADVISOR: Daniel Dittmar
PROJECT MENTOR: Rodger Elkins
TEAM MEMBERS: Andrew Gregory Armstrong (MEE), Claire Bricken (EMG), Tobias Sterling Conkey (MEE), Nathaniel Michael Fackrell (MEE), Sofia Hoang Le (MEE), Nicholas Sheptock (ECE)

PATIENT ISOLATION AND TRANSPORTATION SYSTEM

United Rotorcraft®

TEAM 16048

The team designed a patient isolation and transportation system that transports people infected with highly contagious diseases from the field to strategic biocontainment facilities distributed around the world.

While offering the necessary medical procedures and equipment, the transportation system keeps the patient in a sealed, isolated environment to prevent spread of the infectious disease, such as those caused by Flavivirus, Ebola, and Lassa viruses.

The system can be transported by ground and air to reach, secure, isolate and transport patients. It also complies with military and federal standards for withstanding various field uses and transport conditions, such as humidity, temperature, drop, shock, and vibration.

SPONSOR MENTOR/ADVISOR: Mike Slattery
PROJECT MENTOR: Bob Messenger
TEAM MEMBERS: Othman Yahya Alsaid (INE), Emily Caroline Cook (SYE), Colin James Figgins (MEE), Jordan Elias Millen (MEE), Peter Quach (ECE)

VISUALIZATION TOOLS FOR CONNECTED-VEHICLE SYSTEMS

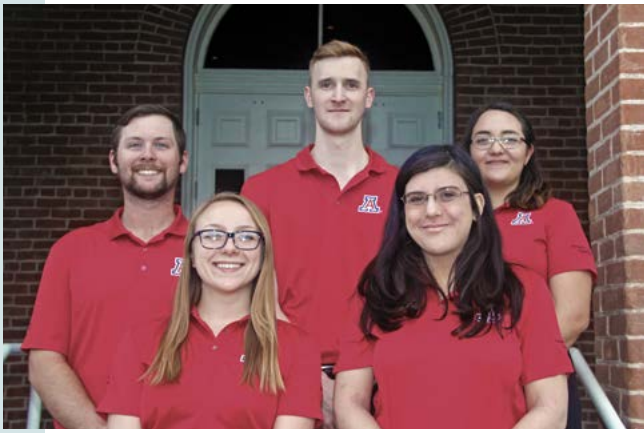
COLLEGE OF ENGINEERING
Systems & Industrial Engineering

TEAM 16049

The team's goal is to develop a visualization tool for the connected-vehicle systems developed by the UA Department of Systems and Industrial Engineering as part of the Multi-Modal Intelligent Traffic Signal Systems project, which is sponsored by a group of state and local transportation agencies and the Federal Highway Administration as a project for the Cooperative Transportation System Pooled Fund Study.

The team designed an intuitive and advanced user interface to display data and metrics produced by the department's system. Through research and discussion, the team created a software structure using the model-view-controller method to implement the visualization. An accurate and real-time representation of the data was designed by integrating C++ socket connections and Java visualization techniques.

The overall goal of this project is to create a software system that is easily modifiable and able to integrate with the Multi-Modal Intelligent Traffic Signal Systems project for future research work.



SPONSOR MENTOR/ADVISOR: Larry Head
PROJECT MENTOR: Clayton Grantham
TEAM MEMBERS: David Benjamin Anderson (ECE), Brett Bushnell (ECE), Andrea Milena Parber (SYE), Beatriz Alejandra Sau (INE), Samantha Wareing (ECE)

SYSTEM FOR TESTING MOTOR MODULE OF HYDRAULIC MINING SHOVEL

CATERPILLAR®

TEAM 16050

The team developed a system to test the motor module of the sponsor's 6020b hydraulic mining shovel, to improve efficiency in its manufacture. The motor module houses the engine, cooling system, pump drive transmission, hydraulic pumps and control values.

The team created conceptual and development designs and focused design effort on creating a test system that interfaces with the sensors on the 6020b motor module. The team built a motor module simulation system that verifies the ability of the test system to determine whether the motor module meets sponsor specifications. The simulator also tests whether the test system shuts down the simulated motor module when an error is detected.

SPONSOR MENTOR/ADVISORS: Matt Railsback, Shawn Roberts
PROJECT MENTOR: Doug May
TEAM MEMBERS: Toan Chu (ECE), Kyler Fong Gee (ECE), Bryan Little (MEE), Hector Obregon (MEE), Alexander David Pusztai (MEE)

ACTIVE ELBOW ORTHOSIS

College of Medicine Tucson | COLLEGE OF ENGINEERING Biomedical Engineering

TEAM 16051

Elbow stiffness after surgery is common and debilitating. It is caused by fibrous tissue accumulating in the joint and surrounding structures during healing, and exacerbated by the rigid bracing used to stabilize the elbow after surgery.

Daily motion exercises to treat stiffness can be painful and ineffective. The goal of this project is to design and create a motor-hinged elbow orthosis that maintains joint motion and breaks down scar tissue during the six-month healing period.

The designed device aids recovery after surgery and has the advantage over physical therapy of being wearable and controllable by the patient. In flexing and extending the arm, the orthotic helps the patient move the arm to a predetermined angle per doctor's orders.

SPONSOR MENTOR/ADVISORS: Daniel Latt, John Szivek
PROJECT MENTOR: Steve Larimore
TEAM MEMBERS: Adriana Barreda (BME), Carissa Liana Grijalva (BME), Justin Showen Hsieh (BSE), Blakeley Louise Koziol (BME), Timothy Charles Shimon (BME), Michael Cameron Sveiven (BME)

SOFTWARE-CONTROLLED, SELF-MONITORING MULTIRAIL POWER SUPPLY

Texas Instruments

TEAM 16052

The purpose of this project is to combine multiple devices from the electrical and computer engineering lab bench into a portable, affordable, and expandable product. The goal is to give electrical and computer engineers a cleaner, less cluttered, and more efficient laboratory workspace.

The system consists of a motherboard and daughter cards. The motherboard printed circuit board consists of an MSP430 microcontroller and main power supply. The daughter card printed circuit boards consist of the different lab devices. The team created test equipment interfaces for a direct-current power supply and developed a graphical user interface to control the system using LabVIEW.

The sponsor asked the team to build a system that would allow future incorporation of equipment, such as a digital multimeter, function generator, and oscilloscope. The resulting system gives users intuitive and efficient control of lab equipment, and allows engineers and hobbyists to create a portable laboratory at a reasonable price.

SPONSOR MENTOR/ADVISORS: Patrick Edwards, Paul Frost
PROJECT MENTOR: Clayton Grantham
TEAM MEMBERS: Jake Ryan Boucher (ECE), Nadim Hassan (ECE), Nigel Baier Kapoor (ECE), Triston Todd McLean (ECE), Danilo Andrade Mendoza (ECE)

ELECTROMYOGRAPHY-BASED TECHNIQUE TO ANALYZE ADVANCED BIOMETRIC SIGNALS AND DETERMINE MUSCLE PERFORMANCE

TEXAS INSTRUMENTS

TEAM 16053

The team's goal is to design a system of integrated sensors to monitor muscle activity by analyzing biosignals that provide insight into an athlete's performance.

The device is a portable battery-operated system designed for personal gym or home use. The system uses electromyography technology to determine the athlete's muscle health and activity. Electromyographic sensors indicate muscle activity as a voltage, which is digitized by an analog-to-digital converter.

The athlete's activity is analyzed, processed and recorded as a comprehensive data set, and results are transmitted via Bluetooth to a mobile device for display.

SPONSOR MENTOR/ADVISOR: Ravi Kiran Raghavendra
PROJECT MENTOR: Clayton Grantham
TEAM MEMBERS: Jacob Ben Denholtz (BME), Zaynab Hourani (BME), Xiongjian Lin (ECE), Kelly Nicole Maroney (SYE)

NANOPARTICLE TRACKING AND ANALYSIS SYSTEM

COLLEGE OF ENGINEERING
Biomedical Engineering

TEAM 16054

The goal of this project is to provide an inexpensive and accessible way to characterize nanoparticles. Current products are extremely expensive and often beyond the reach of research budgets.

Most biomedical researchers have access to microscopes and cameras to take images of samples, so the team designed a system, based on the theory of Brownian motion, to work with existing imaging equipment. The design includes a small, reusable circular chamber to hold the nanoparticles. The small size and 3-D printability reduce waste and cost.

The tracking and analysis software is written in Matlab, and a graphical user interface allows users to upload a video of their nanoparticles. The software shows the tracking of the particles and once tracking is complete, the concentration, total number, and size of the particles are displayed to the user.

SPONSOR MENTOR/ADVISORS: Ted Trouard, Mark Romanowski
PROJECT MENTOR: David Gilblom
TEAM MEMBERS: Nicholas Bradley Bauer (OSE), Alex Kenneth Burton (BME), Rogelio Daniel Delgadillo (ECE), Adley Gin (ECE), Kristi Michelle Wagner (OSE)
WITH SUPPORT FROM: GORE

UNPOWERED EXOSKELETON

TEAM 16055

Cerebral palsy is a movement disorder that affects mobility, motor skills and muscle tone. The purpose of this project is to design and deliver an unpowered exoskeleton that allows cerebral palsy patients to stand and walk.

The exoskeleton helps correct gait, stabilizes core and leg muscles while walking, and engages the pertinent muscles during movement and exercise. The team analyzed frame materials, support strappings and hinge connections.

The exoskeleton was assembled and tested on a patient, and modifications were made according to the patient's feedback. This exoskeleton design gives patients a greater ability to stand and walk than other models and should improve the patient's overall quality of life.

SPONSOR MENTOR/ADVISOR: Hermelinda Bristol
PROJECT MENTOR: Brian O'Cain
TEAM MEMBERS: Martin Galaz (BME), Jason Niran Keatseangsilp (BME), Amanda Tolulope Koiki (BME), Joshua Rufus Owl (MSE), Thomas Fernando Valenzuela (BME), Cole Larson Waldren (MEE)

MODULAR PAYLOAD BAY FOR UNMANNED AIRCRAFT SYSTEMS

TEAM 16056

The unmanned aircraft system, or UAS, is a valuable defense industry asset, but it has its limitations. As UAS platforms age, their payloads become obsolete and need to be replaced with updated technology to stay relevant and effective. Changing payloads often proves difficult because of the way they were integrated into the aircraft.

The goal of this project was to create a functional prototype of a modular mission payload bay for a generic UAS. The design accommodates three payload types that demonstrate the functionality of the payload bay and payloads must function in any given payload slot without physical user intervention. The system recognizes which payload is in which slot and functions appropriately.

Payload types are an LED, an LCD and a sound module. The functional prototype created by the team makes UAS platforms highly versatile in terms of mission capability and payload diversity.

SPONSOR MENTOR/ADVISORS: Dana Cordova, Christian Laboy, Kyle Klouda
PROJECT MENTOR: Bob Messenger
TEAM MEMBERS: Soosan Han (MEE), Johann Meister (MEE), Taylor James Moore (SYE), Stephan Murray (MEE), Andres David Rebeil (ECE), Tristan Robert Roberts (MEE)

WEAR RATE PREDICTION MODEL FOR LARGE MINING TRUCKS

CATERPILLAR®

TEAM 16057

Downtime for repair is costly for a company that operates a large fleet of expensive vehicles. The goal of this project is to create a predictive wear model for the sponsor's large mining trucks.

The model aims to predict the rate at which the wear plates lose volume, determining where the truck will wear and giving truck operators foresight into when repairs will be necessary. Experiments to determine rates of wear over the lifetime of a mining truck were designed after static testing in a lab, to examine the relationship between impinging and wearing materials, and dynamic testing at the sponsor's Tucson Proving Grounds.

The designed system gives operators a customized assessment of repair schedules by allowing them to enter specific truck parameters, such as material mined, type of mining truck, capacity of the body, and shovel specifications.

SPONSOR MENTOR/ADVISORS: Steve Fujan, Adam Hales
PROJECT MENTOR: Gary Redford
TEAM MEMBERS: Jingping Chen (MEE), Jeff Gautreau (MEE), Danielle Ruth Kotke (SYE), Zheng Qu (MSE), Dominic Mark Sorrentino (MEE), Pengyu Sun (EMG)

NONTRADITIONAL DEVICES FOR PEAK ENERGY SHIFTING

TEP Tucson Electric Power 125 YEARS OF SERVICE

TEAM 16059

The goal is to design and test a software application that influences how customers manage electricity use. The mobile application shows how much energy the customer is using and recommends ways to decrease consumption. It can also turn air conditioners on and off.

Better energy management by consumers means that utilities don't have to ramp up production as quickly in peak demand hours. The team built a scaled down model of the real-world setup that would be required. The design measures energy usage using current transformers that connect to a 4Duino microcontroller, which records the data to a server.

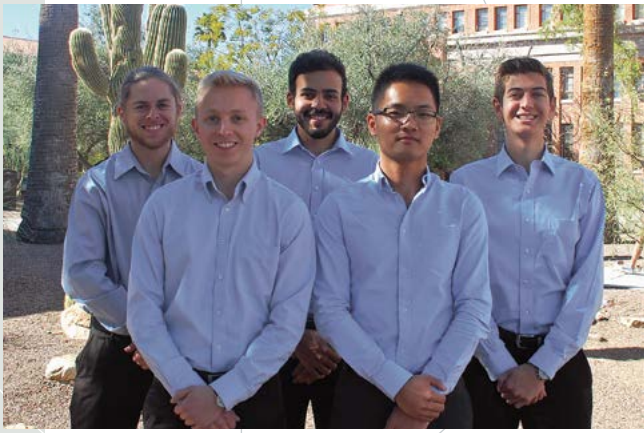
Utility customers can use the mobile application to see their energy usage expressed in kilowatt-hours or dollars.

SPONSOR MENTOR/ADVISORS: Ana Bustamante, Christopher Lynn
PROJECT MENTOR: David Gilblom
TEAM MEMBERS: Faisal Matooq Alhussain (INE), Alejandro Moreno Guzman (MEE), Zachary Tyler Hamilton (MEE), Carlos Andres Molina (INE), Maria Colette Walshe (ECE)

RADAR-BASED VEHICLE LOCATION AND NAVIGATION SYSTEM

ViaSat

TEAM 16060



The demand for improvements in vehicle navigation and automation can exceed the capabilities of GPS, which is not always available. The goal of this project is to evaluate the use of radar for vehicle navigation in GPS-deprived environments.

The navigation system designed by the team integrates two ViaSat radar modules with a student-designed mounting system, interfacing circuit board, and system to collect data for postprocessing. In postprocessing, the system calculates instantaneous velocities from the collected data and uses those velocities to infer the navigation of the vehicle.

The radar-based vehicle navigation system could operate when GPS is unavailable, and if used in conjunction with GPS could lead to more precise and accurate vehicle navigation systems.

SPONSOR MENTOR/ADVISORS: Noel Lopez, Randy Turcotte, Nathan Welborne
PROJECT MENTOR: Rodger Elkins
TEAM MEMBERS: Nwaf Misfer Alghamdi (INE), Sean Thomas Henderson (EMG), Benjamin Abe Schifman (ECE), Justin Siekmann (ECE), Xiaokang Wu (MEE)

REMOTE WATER TANK SENSORS FOR REDUCING RANCH OPERATING COSTS

COLLEGE OF AGRICULTURE & LIFE SCIENCES
COLLEGE OF ENGINEERING
Agricultural & Biosystems Engineering

TEAM 16061

Cattle ranchers in desert environments have to set up expansive water networks for their herds to survive. The integrity of these networks is critical and they need to be checked often.

The goal of this project is to design a system to monitor water tanks on an open range and communicate water levels to the rancher remotely. The system designed by the team measures water level and relays the information to the rancher through a line-of-sight transmission system.

Grid power is not available on the open range, so a power source is installed with the data collection and transmission systems at the tanks. A remote water-measurement system reduces the need for ranchers to visit and inspect their tanks in person.

SPONSOR MENTOR/ADVISOR: Kitt Farrell-Poe
PROJECT MENTOR: Gregory E. Ogden
TEAM MEMBERS: Jim Andrew Encinas (MEE), Nathan Dean Esham (OSE), Leah Paige Feltham (ECE), Joshua Caleb Woodring (BSE)

AUTONOMOUS AERIAL POLLINATION OF MEDJOOL DATE TREES

COLLEGE OF AGRICULTURE & LIFE SCIENCES
COLLEGE OF ENGINEERING
Agricultural & Biosystems Engineering

TEAM 16062

The project's goal is to improve the pollination rates of medjool date palms at a date farm in Yuma, Arizona, by designing and creating a semiautonomous unmanned pollination aircraft.

The current pollination method involves tying a nylon stocking filled with pollen to an unmanned aircraft that is flown over the palm, and letting the wind deliver the pollen to the trees. Farmers determine wind direction by kicking dirt into the air, and coordinate their approximations with the unmanned aircraft pilot to estimate the fall pattern of pollen. The team's improved pollen-delivery system includes an automated pollinator that protects pollen spores from inclement weather and reduces pollen waste by dropping a precise payload.

Unmanned aircraft flight is semiautonomous, with a user interface that integrates camera input with weather station and ground-control data input to avoid collisions, determine flower maturity, and determine ideal aircraft location relative to the palm tree.

SPONSOR MENTOR/ADVISOR: Samuel Peffers
PROJECT MENTOR: Gregory E. Ogden
TEAM MEMBERS: Fatemah Alabdullah (INE), Victor Cortez (SYE), Sara Harders (BSE), Ricardo Andres Jimenez (BSE), Brian Normandeau (BSE), Emma Noel Skidmore (BSE)

AUTONOMOUS MACADAMIA NUT HARVESTER ENHANCEMENT

COLLEGE OF AGRICULTURE & LIFE SCIENCES
COLLEGE OF ENGINEERING
Agricultural & Biosystems Engineering

TEAM 16063

Macadamia nuts are typically harvested at the end of the season, which decreases nut quality and sale price. The team designed an autonomous nut harvester that ensures a regular harvest cycle and requires minimal operator monitoring. A preprogrammed path is uploaded to the GPS-connected autonomous navigation system. The harvester follows this path after a single initialization by the operator.

A sensor prevents the harvester from colliding with obstacles, including humans and animals, by stopping harvester operation until the obstacle has moved. In an emergency the harvester alerts the operator via a smart device. A weight sensor alerts the navigation system when the bed is nearly full, and the harvester pauses on its route. It then heads to the dispensing location, dispenses its load through the base of the harvester, and returns to the route.

This comprehensive harvesting prototype reduces demand for traditional machinery, harvests faster, and minimizes human intervention and overhead costs.

SPONSOR MENTOR/ADVISORS: Kitt Farrell-Poe, Jan Vasiliu
PROJECT MENTOR: Gregory E. Ogden
TEAM MEMBERS: Nicklaus George Arnold (SYE), Alexis Elizabeth Corrion (BSE), Emily Patricia Evans (BME), Hailey Marie Ogren (BSE), Jason Robert Stone (MEE)

DEVELOPMENT AND TRANSLATION OF CLINICALLY RELEVANT MODELS OF SEVERE TRAUMATIC BRAIN INJURY

COLLEGE OF ENGINEERING
Biomedical Engineering

TEAM 16064

The project objective is design of a computational model for severe traumatic brain injury to assist with prognosis in a clinical setting such as in an intensive care unit. Current methods of developing prognoses are subjective, not necessarily reliable, and fail to capture the dynamics of injury progression.

The model incorporates features from multiple modalities, such as physiological processes and clinical data from laboratory tests. A method called "soft computing" is incorporated into the model's algorithm, which is based on human logic and provides a prognosis from the patient's clinical data.

Model prognoses include the state of the patient, based on symptoms and initial lab values, and which laboratory values and events are most likely to occur within a few days of admission.

SPONSOR MENTOR/ADVISOR: Vignesh Subbian
PROJECT MENTOR: Mike Nofziger
TEAM MEMBERS: Kevin John Patrick Croneigh (BME), Jeffry Granados (BME), Lindsey Leigh Hennington (BME), Alana Francesca Sacio (BME), Jaimeson Kendall Veldhuizen (BME)
WITH SUPPORT FROM: GORE

DESIGN, FABRICATION, AND INTEGRATION OF SENSORS FOR SPACE OBJECT CHARACTERIZATION

UA SCIENCE
LUNAR & PLANETARY LABORATORY

TEAM 16065

Detection and characterization of moving objects in Earth orbit to identify their origin, intent and nature is vital for protecting critical space assets. Designing a dedicated sensor system tailored to these special requirements would allow collection of data critical to the success of the UA Space Object Behavior Sciences initiative.

The goal of this project is to refurbish the optical components of a preexisting telescope to create a new optical tube assembly that will be placed on an equatorial fork mount. The primary technical challenge was to create a Serrurier truss that can accommodate the existing optics.

The new optical tube assembly has a universal interface that matches with any type of mount used for this system. The team manufactured two optical tube assemblies that will be mated with the mount. The system will interface with customer-furnished correctional optics.

SPONSOR MENTOR/ADVISOR: Vishnu Reddy
PROJECT MENTOR: Doug May
TEAM MEMBERS: Sameep Akhil Arora (MEE), Ryan Scott Bronson (OSE), Damon Marco Colpo (OSE), Evelyn A. Hunten (ECE), Lindsie Jeffries (BME)

ROBOTIC LABORATORY FOR DISTANCE EDUCATION

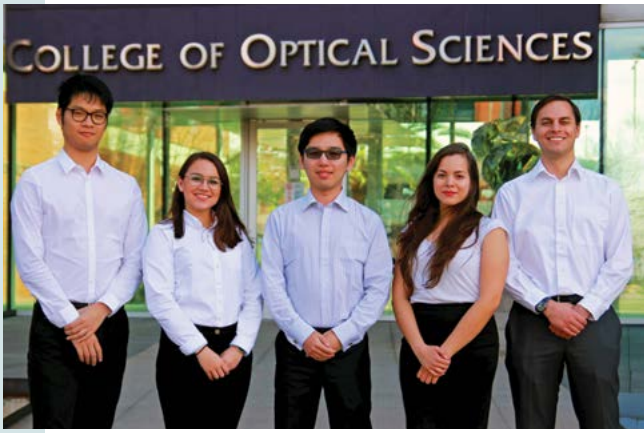
College of Optical Sciences

TEAM 16066

The project aims to design a system to remotely control the sponsor's lab experiments over the Internet. The system consists of several independent and modular linear movement stages that can be assembled in any configuration or anywhere on a standard optical table.

Stages can be built with a variety of movement distances, from 100 to 1000 millimeters of linear travel, ensuring versatility for a wide range of experiments. Stages connect to the electronics box to receive power and communication, or daisy chain to another stage. The electronics box is also the interface between the computer web server system and the stage experiment assembly.

Because all the stages' mechanical interfaces are the same, any optics components that can be installed on a standard optical table can be installed on the stages and be moved by remote control over an internet connection.



SPONSOR MENTOR/ADVISOR: Alan Kost
PROJECT MENTOR: Mike Nofziger
TEAM MEMBERS: Kevin Daniel Curtis (ECE), Tiancheng Dai (MEE), Matilde Garcia (OSE), Yuchao Liao (ECE), Naomi Alejandra Vera (ECE)

SUBSEA ILLUMINATION FOR REMOTELY OPERATED VEHICLES

Areté Associates

TEAM 16067

This project has the objective of improving illumination methods for underwater photography beyond a simple array of bright white LED lights, which can produce backscattering and are not optimized optically for the subsea environment.

Based on the sponsor's requirements, and building upon previous work done by the sponsor, the team designed a trade study to analyze and differentiate between advanced illumination methods such as off-axis illumination, linear and circular polarization of right- and left-handedness, multiple LED wavelengths, and beam shaping.

The team designed software and an experiment to quantitatively measure image contrast in order to determine which illumination method or combination of methods best improved the quality of the image.

SPONSOR MENTOR/ADVISORS: John Engel, David Hamrick, Jeff Mercer, Chris Reyerson, Matt Wilhelm
PROJECT MENTOR: Gary Redford
TEAM MEMBERS: Benjamin Hunter Crawford (SYE), Jared Hout (OSE), Patrick Daniel Portier (MEE), Zachary Rossi (MEE), Ryan Alexander Sipos (OSE)

NEIGHBORHOOD AUTOMATIC EXTERNAL DEFIBRILLATOR NETWORK

TEAM 16068

This project's objective is to reduce the time taken for someone experiencing sudden cardiac arrest to receive medical attention, because their chance of survival decreases by 10 percent every minute after the onset of the attack. The team achieved this goal by designing and building a neighborhood network of automatic external defibrillators, or AEDs.

When someone on the AED network experiences a cardiac attack, they press a button on the in-home network device. This signals their neighbors' devices, which produce an audio and flashing light alert similar to a fire alarm.

The address of the person experiencing the attack is displayed on the device screen of the responder, who takes the AED to the caller's home and administers it. The device of the person experiencing the attack also calls 911 so someone can talk to a dispatcher about the medical emergency.

SPONSOR MENTOR/ADVISORS: Tom Colberg, Carter Newton, Nick Soloway
PROJECT MENTOR: David Gilblom
TEAM MEMBERS: Abdulmajid Mohammed Alsaeed (INE), Daniel Lawrence Davis (ECE), Jacob Garlant (BME), Nathan Lawson Hancock (BME), Susan Marie Nicholls (MEE), Rohan Mehta (ECE)

AUTOMATED RESCUE LAUNCH CANISTER SYSTEM FOR EMILY

TEAM 16069

The team designed an autonomous launcher that deploys and navigates the sponsor's rescue boat, EMILY, to someone it has detected in the water. The launcher uses a camera to detect the presence of a person in its detection range and collect data about their location.

Upon detecting a person in distress, the launcher's deployment system turns on its visual and audio alert system and launches EMILY into the water. After deployment, the camera continuously updates the person's position while a dual GPS system guides EMILY to the person's location. After the person boards EMILY, an operator is required to complete the rescue.

The operator can pull in EMILY and the rescued person manually by attached rope, or activate the launcher's winch to pull them at a controlled pace.

SPONSOR MENTOR/ADVISOR: Jaime Lara
PROJECT MENTOR: Gregory E. Ogden
TEAM MEMBERS: Connor Joseph Bowe (MEE), Jeremy R. Faber (SYE), Ali Rashid Hassan (ECE), Brandon Michael Lipjanic (ECE), Daniel Louis Victor (EMG)

SMART TAG SYSTEM FOR TRACKING HOSPITAL INPATIENTS

THE UNIVERSITY OF ARIZONA HEALTH SCIENCES
Center for Accelerated BioMedical Innovation

TEAM 16070

The team's goal is to design and build a patient-tracking system to optimize the progress of patients through their hospitalization. The system designed increases hospital productivity by allowing healthcare professionals to easily see patient status without extra consultations, saving patients time and hospitals money.

The team developed an iOS-based mobile application that communicates with Bluetooth beacons that read tags attached to patients as wearable devices. The application uses Wi-Fi to send and receive data to a server via the hospital's local area network.

The application allows healthcare professionals to determine if patients are ready to be discharged and approximately how long they have been waiting. The application also computes and recommends to the user the fastest route to a patient, according to a customizable algorithm that takes into account distance, wait time, floor layout and other relevant variables.

SPONSOR MENTOR/ADVISORS: John Jackson, Fuad Rahman, Marvin J. Slepian
PROJECT MENTOR: Mike Nofziger
TEAM MEMBERS: Nelson Hum (BME), Sajani Naitik Jivan (BME), Patrick Lee Kelley (ECE), Sean Michael Kenney (ECE), Collin Reed (ECE)
WITH SUPPORT FROM: GORE

ROBOSCOPE CART

GEOST

TEAM 16071

The team designed the Roboscope Cart as a transportation and outdoor alignment system for large-diameter telescopes under individual operation.

The autonomous cart can carry a 1000-pound telescope up to 200 meters while remaining stable and upright, thus protecting telescope, mount, and other accessories. Once at a viewing site, the cart deploys, levels and autoaligns north in less than 10 minutes.

The cart allows astronomers to transport larger telescopes with ease and eliminates the need for a permanent dome.

SPONSOR MENTOR/ADVISOR: Tony Gleckler
PROJECT MENTOR: Gary Redford
TEAM MEMBERS: Lisa Kathryn Bennett (MEE), Matthew Ryan Dzurick (ECE), Michael Thomas Futch (MEE), Kevin Norman Sherwood (MEE), Kyle Lee Tatum (ECE)

LOW-COST, REAL-TIME KINEMATIC GPS FOR INDUSTRIAL APPLICATIONS

MISOM TECHNOLOGIES

TEAM 16072

The goal is to create a cost-efficient, high-precision, real-time kinematic GPS for mining. These systems consist of a base station and rover unit, both with the same components, which communicate with each other via radio modems. The base station is placed at a precise, professionally surveyed GPS location.

It sends correction signals to the rover, which then calculates its own highly accurate GPS location. In the design team's system, the high-precision location of the rover is sent to an iPad via a Bluetooth low-energy module. The team designed a power system that provides power to the unit from within the case without outside assistance. The device can withstand the harsh conditions typically found in a mine.

The system interfaces with the sponsor's existing data-storage application found on iPads placed in mining equipment. The system is accurate to within 15 centimeters up to range 4 kilometers between units.

SPONSOR MENTOR/ADVISOR: Sean Dessureault
PROJECT MENTOR: Mike Nofziger
TEAM MEMBERS: Rekaz Abulhamayel (INE), Justin Paul Aisoff (MGE), Meseret Ducote (INE), Bret Cameron Gossler (EMG), Jared Anthony Huss (ECE), Jordan Jeffries (ECE), Riley James Layton (MGE), Darren Jonathan Stroughter (SYE)

FELT RECOIL MEASUREMENT SYSTEM

Raytheon

TEAM 16073

The sponsor asked the team to design and build a test platform to measure the felt recoil of a variety of shoulder-fired weapons. Felt recoil is the energy experienced when discharging a firearm.

The test platform consists of a weapon-containment structure, a remote trigger actuator, and a data-acquisition system that includes an impact sensor and an accelerometer. The weapon-containment structure allows free movement of the weapon in three directions. The remote trigger actuator accommodates triggers with various weights and lengths of pull.

The weapon can be fired from 15 feet away for safety. The impact sensor measures the energy in the axial direction while the accelerometer measures the acceleration of the weapon in the pitch, yaw and axial directions. The acceleration in the axial direction provides correlation of the impact sensor reading.

SPONSOR MENTOR/ADVISOR: Jim Bakarich
PROJECT MENTOR: Mike Nofziger
TEAM MEMBERS: Kevin Andrew Barr (BME), Jacob Henry Niccum (MEE), David Renner (SYE), Robert Steven Rystrom (MEE), Amelia Sylvester (ECE), Mathew Alan Stockman (MEE)

NOVEL HELMINTHIC THERAPY CULTIVATION AND DOSE-DISPENSING SYSTEMS

THE UNIVERSITY OF ARIZONA HEALTH SCIENCES
Center for Accelerated BioMedical Innovation

TEAM 16074

Helminthic therapy uses the natural immunosuppressant properties of hookworms as a remedy for autoimmune diseases and disorders. The U.S. Food and Drug Administration has not approved helminthic therapy, and current methods of administering and dosing are impractical for mass commercial adoption.

The semiautomated system devised by the team requires minimal handling of infectious material, provides highly accurate dosing of *Necator americanus* helminths, and meets all FDA criteria for market approval. The design includes a helminth incubation and cultivation system, including a temperature sensor and hygrometer, which houses the helminth culture and provides a continuous supply of infective *Necator americanus* larvae.

The team also developed a helminth dose dispensing system: a photo-detection apparatus consisting of a glass microfluidic chip, optical fiber photo gate, pumps for worm fluid flow, and a microcontroller subsystem for overall procedure control.

SPONSOR MENTOR/ADVISORS: John Jackson, Marvin J. Slepian
PROJECT MENTOR: Gary Redford
TEAM MEMBERS: Lucrezia Capano (BME), Maxwell Li (BME), Marco Miramontes (BSE), Saffie-Alrahman Ezz-Eldin Mohran (BME), Jessica Carlyle Owens (BME)
WITH SUPPORT FROM: GORE

BISBEE ASSISTED-LIFT DELIVERY SYSTEM

City of BISBEE

TEAM 16075

Bisbee, Arizona, is situated in a steep-sided canyon with thousands of steps providing access to residences. Goods must be transported to residents' homes manually, which is unsafe, inconvenient and a deterrent to people moving to the city, whose residents need a safe and easy way to get items to and from their homes.

The objective of this project is to design a system for transporting items up and down the city's steep hills. The system consists of several posts holding up a set of rails that carry a cart designed to hold whatever needs transporting.

The cart is pulled up the railway by a winch controlled by a Bluetooth keypad and Arduino Uno microcontroller. The city of Bisbee intends to offer this system to residents who request installation in their area.

SPONSOR MENTOR/ADVISOR: Andy Haratyk
PROJECT MENTOR: Brian O'Cain
TEAM MEMBERS: Roberto Cordoba Berigan (ECE), Jakob Edward Davis (MEE), Aaron Hausman (SYE), Wesley Lee (MEE), Scott Payne (SYE), Martin Wong (ECE)

HYBRID PRINTER WITH 3-D PLASTIC AND COMPUTER NUMERICAL CONTROL PRINT CAPABILITIES

Raytheon

TEAM 16076

The goal of this project is to improve the time required to create a high-quality 3-D-printed component. The team designed an automated magnetic tool changer for an existing 3-D printer.

The modification maintains existing printer capabilities and gives 3-D prints a precision finish using end mills, drills and other machining tools. The new tool mount is attached magnetically to the printing head carriage, and tools are mounted on the printer frame for easy access by the carriage. Tools can be picked up and returned swiftly and precisely by the carriage and returned to their original positions when not in use.

SPONSOR MENTOR/ADVISOR: Jim Bakarich
PROJECT MENTOR: Doug May
TEAM MEMBERS: Kyle Glenn (EMG), Eric Gustavo Gutierrez (MEE), Jason Shinn (MEE), Peter William Thomson (MEE), Derek Kristofer Tvedt (MEE)

CONTINUOUSLY VARIABLE DUROMETER 3-D PRINTER

Raytheon

TEAM 16077

Sensitive electronics need to be shielded from shock and vibration but mitigation methods are time-consuming and expensive. The goal of this project was to design a variable durometer 3-D printer that can facilitate the implementation of shock and vibration mitigation in devices subject to vigorous motion.

A 3-D printer was modified for compatibility with a dual extruder and Diamond Hotend mixer. The printer varies the durometer, or hardness, of the material it is printing by feeding hard and soft filaments through the specialized hotend at variable rates dictated by the dual extruder.

The team developed software to postprocess existing dual-extrusion G-code, a machine tool programming language. The software replaces the extrusion values for specified tool changes with the respective ratios of filament that create the necessary durometer. The printer then prints the part with the specified durometer at locations chosen by the user.

SPONSOR MENTOR/ADVISOR: Jim Bakarich
PROJECT MENTOR: Bob Messenger
TEAM MEMBERS: Tim Leach (BME), Rachel Nicole Lindley (MEE), Amanda Kay Olmut (MEE), David A Picazzo (SYE), Ziqiang Wang (INE)

SMART GLASSES INTERFACE FOR MANUFACTURING

Continental
The Future in Motion

TEAM 16078

The sponsor's manufacturing plant uses surface-mount technology to manufacture automotive infotainment systems. Reels of components for surface-mount devices are loaded into surface-mount equipment that needs to be replenished frequently. The sponsor is interested in implementing smart wearable technology to improve this process.

The goal of this project is to develop an application that allows Vuzix M100 smart glasses to interface between manufacturing operators and equipment, simplifying the installation of component reels. The system scans the barcode on the supplied reel, queries the database, and uses an algorithm to determine which machine the reel should go in.

Once the line, machine and slot numbers are determined, the graphical user interface displays the required information to the user and provides interactive guidance to locate where the reel should be installed.

SPONSOR MENTOR/ADVISOR: Carlos Ramos
PROJECT MENTOR: Clayton Grantham
TEAM MEMBERS: Kevin Cortez (ECE), Joshua Mack (ECE), Megan Mary Riedel (SYE), Zainab Al Tarouti (ECE), Salvador De La Torre (SYE)

HIGH-G LAUNCH SHOCK LABORATORY SIMULATOR SYSTEM

Raytheon

TEAM 16079

Onsite high-G shock testing of electronics components for the sponsor's products can be expensive and time-consuming. Coordinating the shock and data-collection aspects of a missile launch in a laboratory simulation would be quicker and less expensive, and could negate the need for a field test.

The objective of this project is to design a robust, high-G shock-delivery system that simulates the set-forward forces created by shoulder-fired missile launchers. The design uses compressed air to induce a shock to a fixture with a mounted test specimen.

Energy in the compressed air is transmitted to the fixture by applying a pressure differential across a pneumatic striker subsystem, rapidly accelerating a steel plunger into the baseplate. Shock data is acquired via accelerometers affixed to the baseplate near the test specimen.

SPONSOR MENTOR/ADVISOR: Dmitry Knyazev
PROJECT MENTOR: Brian O'Cain
TEAM MEMBERS: Kyle Jacob Daniels (MEE), Jonathan Edward Fisher (MEE), Alejandro Castro Gonzalez (ECE), Michael Brandon Kronenfeld (MEE), Michael Richard White (MEE)

MINIATURE SURGE SUPPRESSOR

Raytheon

TEAM 16080

Sensitive electronic devices powered by 28-volt direct current military vehicle electrical systems need surge suppressors to ensure that transient voltage surges, spikes and ripple are within acceptable limits. Commercially available suppressors don't fit the sponsor's products, so the team was asked to design a small surge suppressor that would not require a costly and time-consuming redesign to implement.

The team's design allows modern systems with sensitive electronics to interface with a wide range of military platforms and replaces bulky passive components with two metal-oxide-semiconductor field-effect transistors, or MOSFETs, configured in series to dissipate 100- and 250-volt surges and spikes as required by military standards.

The control circuitry allows for this dissipation to occur in two stages before finally clamping the output voltage at 33 volts. The intermediate clamping voltage between the two MOSFETs was tuned so that both components experience uniform heating.

SPONSOR MENTOR/ADVISOR: Joseph Sanchez
PROJECT MENTOR: Sharon O'Neal
TEAM MEMBERS: Zean R. Alzawawi (INE), Christopher Jason Horinek (SYE), Nicholas Katsinas (MEE), Brian Lawrence Kelly (EMG), Carray Ying (ECE)

DESIGN/BUILD/FLY AIRCRAFT DESIGN COMPETITION

TEAM 16081

The American Institute of Aeronautics and Astronautics, or AIAA, sets requirements for student teams around the world to design, build and fly small, high-performance, remotely controlled aircraft and enter them in its international aircraft design competition.

Teams are scored on their design report and competition performance. Aircraft requirements this year include the ability to carry a payload of hockey pucks and fly around a track specified by AIAA; aircraft also need to fold and fit inside a launch tube for storage and protection.

The team opted for a high, straight-winged monoplane with a U-tail empennage and pod-and-boom fuselage configuration. The aircraft uses composite materials to minimize weight and increase performance. The wings fold and stack on top of each other and the tail booms telescope into the fuselage to allow for packing in the tube. Numerous numerical, ground and flight tests were done to validate and improve the design before the competition date.

PROJECT MENTOR: Jeff Jepson
TEAM MEMBERS: Bryce Nathaniel Burns (AEE), Glynis Davey Facciano (AEE), Elvin Jose Flores (AEE), Loc Dai Ho (AEE), Nicholas Albert Morris (AEE), Devvion Sharrieff Muhammad (AEE), Daniel Allan Nerheim (AEE), Philippa A. Pinnington (AEE), Stephanie Marie Rioux (AEE)

DYNAMICALLY SCALED RESEARCH TESTBED

TEAM 16082

The Dynamically Scaled Research Testbed designed by the team is a one-third dynamically scaled Lockheed Martin X-56A that supports the modular integration of multiple wing configurations. Wing configurations include 22-degree swept wings with stiff, semi-flexible and flexible bending properties, in conjunction with existing straight wings from previous projects.

Varying flexibilities are achieved by altering the geometry of the internal composite spars and skin structure. All of the wings fit into a modular fuselage, which houses mounts for a removable empennage and adjustable landing gear. The empennage serves as training wheels for pilots as they familiarize themselves with the platform. All swept-wing configurations demonstrate static stability with and without the empennage.

The wings will be used to research boundary layer flow separation in the presence of structural motion, a problem that will become increasingly relevant as the use of flexible composites in the aerospace industry grows.

PROJECT MENTOR: Hermann Fasel
TEAM MEMBERS: Jeremy Ryan Harrington (AEE), Jonathan Robert Heinkel (AEE), Jorge Alberto Castro Maldonado (AEE), Michael David Meersman (AEE), Jacob Benjamin Pavek (AEE), Danielle Joan Lim Racelis (AEE), Christopher Andrew Ramos (AEE), Arek James Rembelski (AEE)

MICRO AIR VEHICLE CONTROL USING MICROELECTROMECHANICAL SYSTEM SENSORS

COLLEGE OF ENGINEERING
Aerospace & Mechanical Engineering

TEAM 16083

The goal of this project is to design a control system for micro air vehicles using microelectromechanical system, or MEMS, sensors. The design incorporates an analog-sensing circuit with an Arduino microcontroller embedded in a NACA 4412 airfoil wing section constructed from balsa wood and monokote film.

The circuit senses velocity and angle of attack using MEMS thermal flow sensors embedded in the outer surface of the wing section and uses a closed-loop feedback controller that changes the deflection angle of the wing's elevon to control the pitch of the wing section.

The feedback controller is run using a control system designed in the Simulink interface of MATLAB. The wing section was mounted in a subsonic wind tunnel with flow speeds that do not exceed 20 meters per second to collect aerodynamic data.

SPONSOR MENTOR/ADVISOR: Eniko Enikov
PROJECT MENTOR: Eniko Enikov
TEAM MEMBERS: Daniel Joseph Brauer (AEE), Namrah Habib (AEE), John Donald Mangels (AEE), Kevin David Mueller (AEE), Muhammad Azri Abd Rahim (AEE), Joshua James Raymond (AEE), Syed Ammar Raza (AEE), Daniel Sakson (AEE)

RAPID AERIAL WINGED RECONNAISSANCE

TEAM 16084

The aim of this project is to design a low-cost reconnaissance unmanned aircraft that can be deployed from rough terrain or environments with vertical obstacles. The team designed an unmanned aircraft that can be launched vertically with folded wings, which are deployed to transition the aircraft to conventional horizontal flight.

The unmanned aircraft can fly for 30 minutes and sends live images back to the user. It features fly-by-wire technology so the user can focus on the destination rather than the flight maneuvers to get there.

PROJECT MENTOR: Mark Langhenry
TEAM MEMBERS: Jacob Ryan Boyle (AEE), Matthew Ryan Herstein (AEE), Kameron Nelson Mensing (AEE), Abhishek Dharmesh Rane (AEE), Matthew Marvin Patchett (AEE), Aaron Donald Scheerer (AEE), Jordan Miguel Trujillo (AEE)

GEOPOLYMERIZATION OF MINE TAILINGS AND ADDITIVES

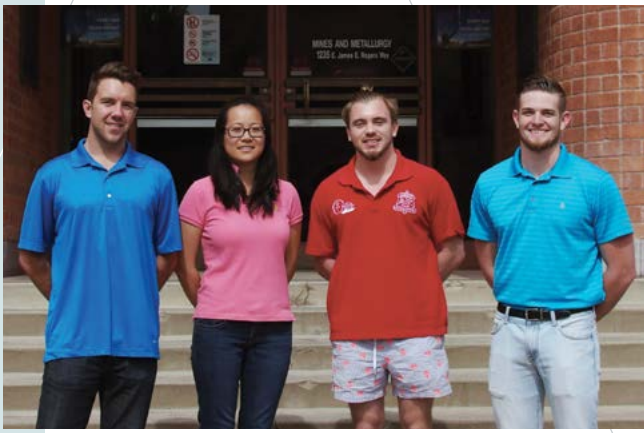
COLLEGE OF ENGINEERING
Mining & Geological Engineering

TEAM 16085

The environmental impact of mine tailings dams ranges from merely taking up space to catastrophic failure leading to loss of life and destruction of property. The team sought a benign use for tailings, so they could be removed from mine sites and the environmental threat eliminated.

The team aimed to create an optimal mixture of mine tailings and industrial additives that would be strong enough to be used in the construction of pavement, bricks, and support material for existing tailings dams. The additives tested included fly ash, fiber, and steel rods.

The resulting product was considered successful if it was stronger and more economical than current construction materials. The team delivered brick-shaped and cylindrical samples made according to the optimal formula.



SPONSOR MENTOR/ADVISOR: Jinhong Zhang
PROJECT MENTOR: Jinhong Zhang
TEAM MEMBERS: Brian Dale Asplund (MGE), Luke Berry (MGE), Jing Liu (MGE), Michael Robert Nichols (MGE)

ORE CHARACTERIZATION AND PROCESSING PLANT REMEDIATION FOR A BRAZILIAN TIN MINE

CSN
Companhia Siderúrgica Nacional

TEAM 16086

Tin is commonly used to produce alloys, solder, and coatings that protect against weathering and corrosion. The goal of this project was to determine the chemical, mineral and metallurgical characteristics of a Brazilian tin mine ore in order to remediate the sponsor's processing plant.

The mine is already running and equipped with the main tools for extraction and concentration of tin ore, but wants to increase throughout via remediation or optimization, depending on what is economically feasible.

The team provided recommendations for method of extraction, processing plant and possible tin recovery from tailings along with a mineral composition analysis.

SPONSOR MENTOR/ADVISORS: Eric Ballinger, Henrique Villela Aroeira
PROJECT MENTORS: Brad Ross, Jaeheon Lee
TEAM MEMBERS: Jorge Alberto Barrera (MGE), Benjamin Paul Clarke (MGE), Munkhdemberel Batbayar (MGE), Corbin Goldsmith (MGE), Cesar Mauricio Lemas Pesqueira (MGE)

DECLINE DESIGN FOR THE SAN XAVIER MINING LABORATORY

COLLEGE OF ENGINEERING
Mining & Geological Engineering

TEAM 16087

The team's objective is to design a decline for the University of Arizona's San Xavier Mine, a student-run mining laboratory, according to Mine Safety and Health Administration's safety codes. The purpose of the decline is to create opportunities for partnerships between the University of Arizona and mining companies.

A decline is a sloping underground opening for machine access from surface to level. To hold the largest equipment, the decline must have entrances and throughways of 22 feet high and 27 feet across. For optimal equipment performance, the overall slope grade must be no greater than 10 percent. Support, ventilation and mine design were all completed on mine software.

Underground laboratories were designed adjacent to the decline to offer locations for research. A tailings pile was designed and constructed to hold the moved earth in accordance with all safety standards.

SPONSOR MENTOR/ADVISOR: Brad Ross
PROJECT MENTOR: Brad Ross
TEAM MEMBERS: Ryan Matthew Hancock (MGE), Ian Thomas McCarthy (MGE), Anthony Michael Travers (MGE), Aaron Michael Vesledahl (MGE)

GEOLOGICAL HIGHWALL ANALYSIS AND BLAST PATTERN DESIGN FOR AN OPEN PIT MINE

COLLEGE OF ENGINEERING
Mining & Geological Engineering

TEAM 16088

Highwalls are the unexcavated step-like faces of exposed earth in open-pit mines. The purpose of the project is to perform a geological analysis of various highwalls and design a blast pattern for a copper mine 64 miles southeast of Phoenix.

Using lidar and mining-oriented computer-aided design software, 3-D representations were created to analyze various aspects of the mine, including geological characteristics and how they affect highwall stability. Results were compared to projected mine plans versus actual mining results.

Using the analytical data, the team designed an optimal blast pattern that accounted for blast efficiency and areas of geological instability while conforming to the sponsor's mine plan requirements.

SPONSOR MENTOR/ADVISOR: Brad Ross
PROJECT MENTOR: Brad Ross
TEAM MEMBERS: Chris Raymond Deuel (MGE), David Andrew Kijewski (MGE), Anthony Louis Ponce (MGE), Enrique Silva (MGE), Aiza Sharalyn Weber (MGE)

MAIN LANDING GEAR DESIGN

THE NEW NOSE COMPANY, INC.

TEAM 16089

The sponsor asked the team to develop the mechanical design of the main landing gear for the ClipperSpirit amphibious seaplane, a high-wing, 30-seat turboprop regional airliner in which the main gear retracts into a wing-mounted engine nacelle.

Project goals include designing the configuration of the main gear; sizing the components of the gear; determining the kinematic definition of the extension and retraction of the gear; determining the internal structural loads absorbed by the gear structure, the oleo shock strut and tires; and determining the transmitted loads to the wing mount.

The gear design meets sponsor and FAA certification requirements. Analytical design work was demonstrated and tested by building a one-tenth-scale model of the gear.

SPONSOR MENTOR/ADVISOR: Charles Simpson
PROJECT MENTOR: Sergey Shkarayev
TEAM MEMBERS: Luc Didier Arseguel (AEE), Jules Garot (AEE), Bastien Muller (AEE)

DESIGN OF A FIXED WING AND TILT ROTOR VERTICAL TAKEOFF AND LANDING AIRCRAFT

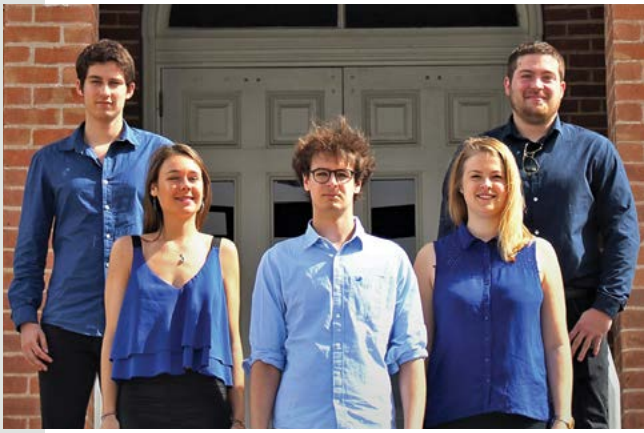
COLLEGE OF ENGINEERING
Aerospace & Mechanical Engineering

TEAM 16090

The aim is to design an unmanned aircraft that can take off vertically and observe small areas. The team's aircraft, configured as a flying wing and lifting body, takes off and lands vertically, hovers, and can fly long distances efficiently.

Wingtip motors and propellers move the plane horizontally, and transition to vertical to supplement the four central fans that provide most of the vertical thrust during hover. The fans are shut down during horizontal flight for better overall aerodynamics. The aircraft weighs one kilogram, has a wingspan of about 1.25 meters, carries a payload of 100 grams, and can fly for 20 minutes.

Equipping the aircraft with a camera linked to a ground station makes it suitable for missions such as area surveillance for reach and rescue and monitoring localized fires.



SPONSOR MENTOR/ADVISOR: Sergey Shkarayev
PROJECT MENTOR: Sergey Shkarayev
TEAM MEMBERS: Adrien Francois Edmond Bouskela (AEE), Romain Charles Michel Jacob (AEE), Kevin Jacquinot (AEE), Theodora Reguine (AEE), Cindie Claude Tresamini (AEE)

DESIGN OF AN EARLY CRUDE OIL PRODUCTION FACILITY

COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

TEAM 16091

Early production facilities take crude oil from wells and process it to meet environmental and standard specifications. The goal of this project is to design such a facility for two wells that extract light and heavy crude from an oil field in Batman, Turkey.

The facility designed uses several tools to remove oil contaminants such as water, basic sediments, and sulfur. The first stage of the process designed by the team separates crude straight from a well into natural gas, water, and oil.

The oil is then heated to reduce its viscosity and mixed with fresh water to dilute the salt concentration. This mixture is passed through an electrostatic coalescer that uses an electric field to polarize and separate the water and salt, which allows the crude to meet basic sediment and water specifications. Oil then goes to a stripping column where nitrogen is bubbled through it to remove hydrogen sulfide. The crude is cooled before storage and transportation.

SPONSOR MENTOR/ADVISOR: Adam Rice
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Kyle Brennen Everly (CHE), Jarrod Ryan Kujawski (CHE), Megan Elizabeth McGuckin (CHE), Derek Ryan Peterson (CHE)

FEASIBILITY OF A CONTINUOUS PROCESS FOR IBUPROFEN PRODUCTION

TEAM 16092

The team analyzed the complexity, efficiency, economics, and environmental impact of a continuous Ibuprofen-manufacturing process to determine its feasibility.

Continuous production of pharmaceuticals has advantages over traditional batch processing, which is slow due to downtime spent cleaning and performing quality checks after production cycles. Continuous manufacturing, however, sends materials through a nonstop process until the final product is completed.

Continuous processing is faster, more efficient, and safer due to reduced human involvement. After initial investment in a continuous pharmaceutical production process, this method could be a less expensive way to produce pharmaceuticals, with the potential for more affordable products.

SPONSOR MENTOR/ADVISOR: Bonnie Curtis
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Jason M. Ackermann (CHE), Danielle Marie Lemieux (CHE), Anton Joseph Polacek (CHE), Morgan Elizabeth Skillman (CHE)

SELECTIVE RECOVERY AND CONCENTRATION OF RARE EARTH METALS

COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

TEAM 16093

The leaching solution used in mines for copper extraction contains rare earth elements. The objective of this project is to design an industrial scale-up of a process to selectively recover and concentrate rare earth elements yttrium and neodymium from a copper pregnant leach solution.

A laboratory-scale version of this process has been developed at the University of Arizona by researchers in the Department of Mining and Geological Engineering. This process incorporates a slip-and-recycle stream into the current copper-extraction process to maximize cost-effectiveness and sustainability.

This design includes a feasibility study of multiple rare earth processing methods, such as solvent extraction and ion exchange. The resulting high-purity neodymium and yttrium metals could help meet growing global demand for rare earth minerals.

SPONSOR MENTOR/ADVISOR: Kim Ogden
PROJECT MENTORS: Kim Ogden, Brent Hiskey
TEAM MEMBERS: Mohammad W. Almasri (CHE), Paola Lazaro Colmenares (CHE), Matthew Alejandro Kim (CHE), Raphael A. Woolley (CHE)

SELF-CONTAINED OFF-GRID WATER AND SOLAR SYSTEM

Resiliency Platform

TEAM 16094

The goal of this project is to create a climate-resilient water-treatment plant and solar energy system housed in a shipping container that supports a hydroponic or aquaponic system.

After assessing customer or community resources, the container setup can be modified to intake, treat and recycle rainwater, grey water and run-off water. Solar energy powers the filtration and ultraviolet disinfection treatment process. Introducing an aquaponic system provides plants with naturally produced nutrients. Water treated to potable standards can be used by plants and for human consumption.

These features make the pod portable, customizable and easy to maintain. Rural communities with limited access to basic utilities can benefit from this project, as can anyone who wants to rely less on the grid or be completely off-grid.

SPONSOR MENTOR/ADVISOR: Daniel Diaz
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Marisa Elena Gonzalez (CHE), Jose Filemon Rodriguez (CHE), Amanda Frances Tenorio (CHE), Yue Ye (CHE)

REMOVAL OF ALGAE AND EXCESS NUTRIENTS FOR OCEAN WATER RECLAMATION

COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

TEAM 16095

The team set out to create a process to remove algae and excess nutrients from an ocean to restore a once-thriving coral reef and the life it supported. Biosphere 2, the Earth systems science research facility in Oracle, Arizona, is equipped with a 700,000-gallon ocean, which the team used as a basis for modeling ocean water reclamation and observing ocean life.

The design concept uses biological and mechanical processes to restore ocean conditions to similar to those found in the Sea of Cortez. These include a hydroponic system with an affinity for nitrogen and phosphorus uptake, ion-exchange columns to remove ammonium and nitrate ions, and drum filters to eliminate the invasion of algae and harmful bacteria.

The design aims to add sand filters, a plate-and-frame heat exchanger, and a 400-nanometer wavelength ultraviolet light. This design will be the basis of a sustainable Biosphere 2 project that ensures the survival of ocean organisms while keeping a low environmental footprint.

SPONSOR MENTOR/ADVISOR: Kim Ogden
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Abdullah B M A M Aleidan (CHE/EEN), Ashley Victoria Lynn (CHE/EEN), Salah Mousa (CHE), Joseph Jacob Musallam (CHE)

ALKYLATION UNIT FOR GASOLINE PRODUCT IMPROVEMENT

COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

TEAM 16096

This project's goal is to design a 5,000 barrel-per-day alkylation unit to be built into an existing refinery in Houston. The alkylate is manufactured using isobutylene and isobutane with a sulfuric acid catalyst.

Concurrent with the alkylate manufacture, impurities in the isobutylene and isobutane feeds, such as n-butane, are separated out and sold. The design includes construction of an acid-regeneration unit so that acid regeneration can be done on site.

The final alkylate product, isooctane, is sent to the refinery to raise the octane content of the gasoline it produces.

SPONSOR MENTOR/ADVISOR: Kim Ogden
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Stefan Luke Kosior (CHE), Fernando Lopez (CHE), Cody Patrick Moffett (CHE), Behnam Safavinia (CHE)

LARGE-SCALE MANUFACTURE OF A ROTAVIRUS VACCINE

COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

TEAM 16097

Rotavirus is the most common cause of stomach flu in young children and accounts for 453,000 deaths every year worldwide. Only 19 percent of the world has been immunized against rotavirus, and there is a substantial need for additional vaccination.

The project team designed a facility capable of manufacturing a rotavirus vaccine on a large scale. The vaccine-manufacturing process has three stages: mammalian cells are grown and infected with a small amount of rotavirus, which then rapidly multiplies; the attenuated virus is filtered from the cells and concentrated; and the final vaccine is formulated, freeze dried and packaged for distribution.

SPONSOR MENTOR/ADVISOR: Kim Ogden
PROJECT MENTORS: Kim Ogden, Laura Chin
TEAM MEMBERS: Brandon Douglas Jernigan (CHE), John Wonhee Lee (CHE), Ashok Parihar (CHE), Alejandro Emmanuel Zamora (CHE)

BIOREMEDIATION OF DAIRY WASTEWATER FOR REUSE

Shamrock Farms
So Pure. So Fresh. So Shamrock.™

TEAM 16098

The dairy-processing industry creates a significant amount of wastewater contaminated with biological oxygen demand, chemical oxygen demand, total suspended solids, and heavy metals.

Energy demands of traditional wastewater-treatment methods are high, and therefore costly. Aerobic bioreactors known as vermifilters are a proven low-energy method of reducing these contaminants in wastewater.

The team researched, developed and tested a small-scale vermifiltration process that will scale up to remediate the 500,000 gallons of dairy wastewater per day produced by the sponsor's plant.

SPONSOR MENTOR/ADVISOR: Manuel Vasquez
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Kara Elizabeth Kanto (CHE), Catherine Marie Patton (CHE), Connor Thomas Stahl (CHE), Calliandra Suzanne Stuffle (CHE)

SUSTAINABLE MICROBREWING CONCEPTS

COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

TEAM 16099

The goal of this project is to design sustainable brewing processes, such as heat-conservation methods, rainwater harvesting, and improved cleaning methods.

The team designed the processes for brewing companies that typically produce 10,000 barrels of beer a year and emphasize environmental safety and sustainability.

Rainwater harvesting for day-to-day washing and rinsing reduces municipal water usage. New cleaning methods and chemicals that are less harsh on the municipal wastewater system further reduce the brewery's impact.

SPONSOR MENTOR/ADVISOR: Kim Ogden
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Elliott James Connor (CHE), James Lawrence Denker (CHE), Ryan McNeill Murphy (CHE), Scott Allen Reyes (CHE)

NATURAL PRODUCT EXTRACTION FROM NATIVE PLANTS

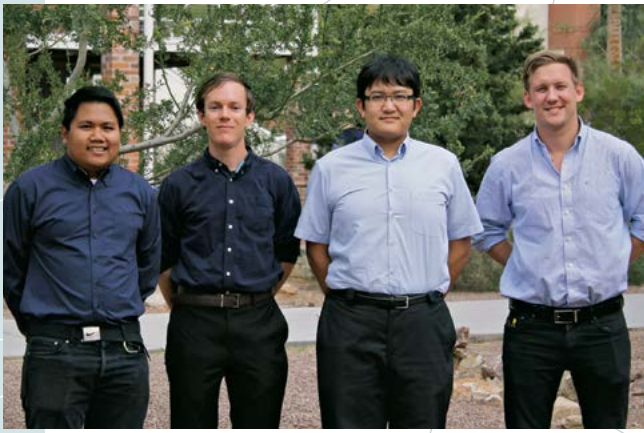
COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

TEAM 16100

Tannic acid is a polyphenol found some plants and trees that causes a dry mouthfeel by decreasing saliva levels. It is also used in the food-processing, cosmetic and anticorrosion industries. Tannic acid is traditionally extracted from high-concentration sources such as pomegranates, but it also exists in many plants native to the Southwest.

The goal of this project is to explore the feasibility of extracting tannic acid from mesquite bark. Using a common solvent, a group of compounds was extracted from the biomass. The extract was separated using column chromatography and analyzed using common lab techniques.

After achieving the desired purity, the team designed a plan for a pilot-scale plant that incorporated calculations of economic feasibility, market demand, energy consumption, process schematics, and future outlook.



SPONSOR MENTOR/ADVISOR: Kim Ogden
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Ian Arthur Carstensen (CHE), Luigi Jaducana Compuesto (CHE), John deKrafft Feather (CHE), James An Nguyen (CHE)

ENVIRONMENTALLY FRIENDLY AND EFFICIENT BREWERY USING CONTINUOUS YEAST REACTORS

COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

TEAM 16101

The project objective is to design a microbrewery using wastewater and other environmentally friendly processes. The design includes treating effluent from a wastewater-treatment plant using reverse osmosis, ozone and ultraviolet light to create a safe, reusable water source for brewing.

A biodigester uses spent grains to produce methane, which can be used as a heat source for the brewing process. Digested grains are fed back into the process and used as the carrier material for immobilized yeast. Two different types of packed reactor are used in order to produce the best flavor possible.

These reactors allow long periods of continuous fermentation with less downtime, and enable control of the amount of beer produced. The brewery is designed to produce 10,000 barrels per year.

SPONSOR MENTOR/ADVISOR: Kim Ogden
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Aaron Casey Ben (CHE), Justin Dean Habit (CHE), Mark Phillip Mellott (CHE), Joshua Steven Taylor (CHE)

FUSION BIOTECH: PRODUCTION OF THE ARTHRITIC DRUG ENBREL

COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

TEAM 16102

The goal of this project is to design a process for the continuous production of Enbrel, an arthritic drug that is an active biologic. The drug is a fusion protein secreted by live Chinese hamster ovary cells and is batch-made in a bioreactor.

Modeling the system with several reactors allowed the team to transform the process from batch to continuous. From the bioreactors, cells are centrifuged before being filtered to remove cellular components.

The protein of interest, etanercept, is further separated by affinity chromatography before viral inactivation and more chromatography steps. The protein goes through viral filtration and diafiltration before it becomes the final product.

SPONSOR MENTOR/ADVISOR: Kim Ogden
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Erica Christy Clevenger (CHE), Solomon George Elias (CHE), Cassandra Nicole Galvez (CHE), Cynthia Sue Humphrey (CHE), Ivana Vasic (CHE)

DESIGN OF HYDRODESULFURIZATION PROCESS FOR ULTRALOW SULFUR DIESEL FUEL

COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

TEAM 16103

Refineries had to design new processes following the Environmental Protection Agency's 2014 decision to limit sulfur content in commercial diesel fuel to 15 ppm.

The goal of this project is to redesign an existing hydrodesulfurization unit in the Delaware Valley to allow for the production of 30,000 barrels per day of ultralow-sulfur diesel fuel with a sulfur content of less than 15 ppm.

The team used Aspen HYSYS simulation software to model and optimize a new hydrodesulfurization catalytic process based on data from industry literature. In the new unit, the feedstock is mixed with hydrogen before being heated to the start-of-cycle temperature. The mixture is then passed through a packed-bed reactor filled with a nickel-molybdenum and silicon dioxide catalyst where sulfur is converted into hydrogen sulfide. The hydrogen sulfide is separated in the final stage using a distillation column to produce the ultralow-sulfur diesel product.

SPONSOR MENTOR/ADVISOR: Kim Ogden
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Riyad Mosaed S. Alohali (CHE), Hussain Jaffar Abdulaal (CHE), Alejandro Rodriguez Castilleja (CHE), Corey Allen Colbert (CHE)

BIOENERGY PRODUCTION VIA HYBRID GAS TURBINE FUEL CELL SYSTEM

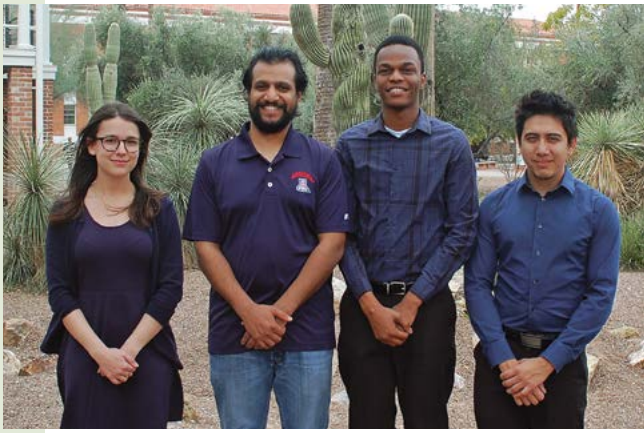
COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

TEAM 16104

Biogas produced by anaerobic digestion of organic material at wastewater-treatment plants is often disposed of by flashing and not reused as fuel. Solid oxide fuel cells can convert the chemical potential energy of biogas fuel, combined with an oxidant, into electrical energy without the need for combustion.

The goal of this project is to design a solid oxide fuel cell and gas turbine hybrid for a wastewater-treatment plant. Excess fuel and heat generated by the solid oxide fuel cell are recovered and fed to a micro gas turbine in a cogeneration system that increases the overall efficiency of the system.

Previously underused biogas is thus used as a biorenewable fuel source, producing electricity that can then be sold back to the electrical grid to reduce the overall utility costs of the wastewater-treatment plant.



SPONSOR MENTOR/ADVISOR: Kim Ogden
PROJECT MENTOR: Rosemary Cox-Galhotra
TEAM MEMBERS: Adrian Acosta (CHE), Mashal Ibrahim Alshammari (CHE), Christina Marie Morrison (CHE), David Obi Okike (CHE)

WASTEWATER TO DRINKING WATER ON AN EARLY PLANETARY BASE

PARAGON SPACE DEVELOPMENT CORPORATION

TEAM 16105

The wastewater-purification system on the International Space Station recovers about 75 percent of the contaminated water on board. Increasing this recovery rate decreases the need for resupply missions.

The design team's goal is to design a water-purification system that can increase the life expectancy of the overall system. The designed trace contaminant control system uses an activated-charcoal bed followed by an alumina bed to remove large contaminants such as siloxanes. After the beds, the stream passes through a photocatalytic oxidizer that uses ultraviolet light and titanium dioxide to create radicals and remove volatile organic compounds.

Finally, the Microlith sorbent bed removes contaminants such as ammonia and carbon dioxide. A heat-exchanger network has been developed using space as the condenser. The designed system is scheduled to be implemented in the late 2020s.

SPONSOR MENTOR/ADVISOR: Patrick Pasadilla
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Chase Joseph Brennan (CHE), Ryan Anderson Faase (CHE), Callie Marie Gill (CHE), Nicholas Alexander Welchert (CHE)

DESIGN OF A WASTEWATER-TO-DRINKING WATER FACILITY

COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

TEAM 16106

Significant research and funding has gone into developing so-called "toilet-to-tap" systems that can treat wastewater to make it 100 percent safe and potable in a single closed loop.

The goal of this project is to design a treatment facility and process to treat 30 million gallons per day of wastewater and turn it into drinking water. Wastewater of the same composition as that found in Tucson, Arizona, was evaluated and a full-scale process and operation were designed to remove solids and harmful chemicals in the water, and further purify it to EPA drinking water standards.

The team incorporated features such as gravity-induced flow and recycling bacteria into a bioreactor, and the entire process was designed with economic feasibility, and thus the consumer's water bill, in mind.

SPONSOR MENTOR/ADVISOR: Kim Ogden
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Abigail Saville Ballam (CHE), Cayleigh Ross MacKenzie (CHE), Ryan Valente Petronella (CHE), Jonathan David Schertzer (CHE)

CASTABLE TOOLING IMPROVEMENTS FOR COMPOSITE MANUFACTURING

ADVANCED CERAMICS MANUFACTURING

TEAM 16107

Manufacturing processes that use carbon fiber composites all face the same challenge: removing the mandrel core from the cured part. One solution is castable, water-soluble aggregates typically composed of plasters and binders.

This method works well for composites with complex geometries that make removing the mandrel core difficult and labor-intensive. The sponsor's AquaPour is a castable, water-soluble product used to make composites in the aerospace, defense and sporting goods industries. The objectives of this project are to increase the product's green strength for faster mandrel extraction from molds, improve compression strength, optimize water transport and delivery, and improve washout time.

The resulting design involves methods such as crosslinking polymers and using desiccants to absorb water and prevent hemihydrate formation, optimization of water content and recipe, and incorporation of sodium silicate with ester-driven reaction for hardening.

SPONSOR MENTOR/ADVISOR: Zachary Wing
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Jonathan Robert Francis Hancock (CHE), Joshua Robert Malzahn (CHE), Adam Christopher Sweeney (CHE), Sanjay Tharmarajah (CHE)

DESIGN OF A PRODUCTION FACILITY FOR THE ANTIBIOTIC IVERMECTIN

Patton Engineering

TEAM 16108

Ivermectin is an antibiotic derived from avermectins, naturally occurring compounds found in soil microbes. It is effective against parasites and has been used against river blindness, lice, scabies and many other diseases. Merck & Company owns the patent for ivermectin and produces 3-milligram pills for human use.

To produce ivermectin, the team proposes a facility with four stages: catalyst production, ivermectin synthesis, purification, and packaging. The catalyst-production stage includes a batch reactor that produces Wilkinson's catalyst, which creates ivermectin by hydrogenating a specific double bond in avermectin's molecular structure. This hydrogenation occurs in a batch reactor at the ivermectin-synthesis stage.

Wilkinson's catalyst contains rhodium, which is reduced to 9 ppm by separators in the purification stage. The packaging stage dries and packages the powder ready for sale and distribution.

SPONSOR MENTOR/ADVISOR: Harry Patton
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Bailey Sedona Arakelian (CHE), Madison Marie Bambauer (CHE), Andrew Scott Falwell (CHE), Alec Bradley Gordon (CHE)

ZERO EMISSIONS SOLAR PLANT

COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

TEAM 16109

Solar power is becoming increasingly economically feasible. The goal of this project is to design a concentrated solar plant to power all the houses in Chandler, Arizona.

The plant consists of a central power tower filled with molten salt heated by solar energy, which allows the plant to produce large amounts of energy through various turbines and generators.

The plant creates zero emissions and, unlike similar solar plants, reuses all its water during steady-state operations. The economical feasibility of this type of plant has been determined.

SPONSOR MENTOR/ADVISOR: Kim Ogden
PROJECT MENTOR: Kim Ogden
TEAM MEMBERS: Nicholas Spencer Ashley (CHE), Sebastian Richard Golawski (CHE), Michael Rasool Rabbani (CHE), Kyle Taylor Tippit (CHE)

CONCRETE CANOE

COLLEGE OF ENGINEERING
Civil Engineering
& Engineering Mechanics

TEAM 16110

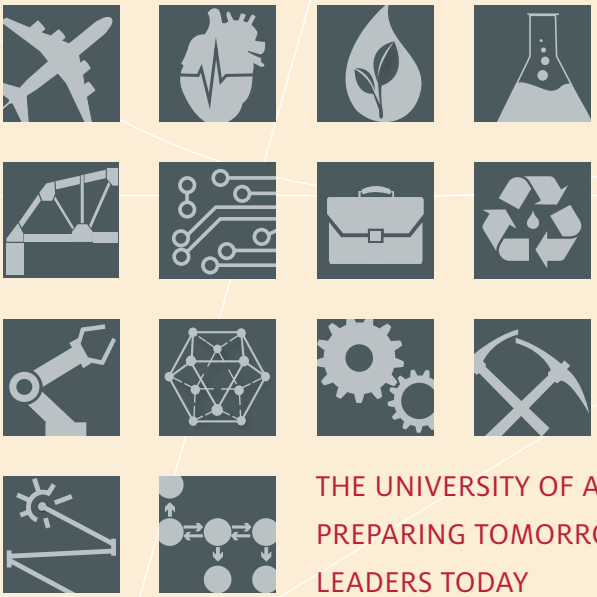
The requirements of the project are to create a lightweight concrete canoe that can withstand the tension and compression forces generated by two or four rowers in a five-race competition against 18 other civil engineering schools.

Specific constraints for the construction of the canoe are that, of the entire concrete mix, a minimum of 25 percent by volume must be aggregate, and of that aggregate a minimum of 25 percent by volume must comply with ASTM-C330. The canoe must also pass a swamp test, which means it must surface on its own after being filled with water and submerged.

To overcome drag forces on the canoe the team designed a streamlined shape with a sharp stern and wide bow that allow it to slice easily through the water. To minimize erratic turning when paddling, the canoe has a narrow shape with a tumblehome hull and a flat keel line.

SPONSOR MENTOR/ADVISOR: Tribikram Kundu
PROJECT MENTOR: Tribikram Kundu
TEAM MEMBERS: Hunter Michael Brown (CVE), Maria Lissette Flores Denogean (CVE), Taylor Lynne Dunkle (CVE), Francisco Nicanor Gomez (CVE), Ana Dariela Rapalo-Padilla (CVE), Matt T Updegraff (CVE)

PARTICIPATING ENGINEERING DEGREE PROGRAMS



THE UNIVERSITY OF ARIZONA: PREPARING TOMORROW'S LEADERS TODAY

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(BME)	BIOMEDICAL ENGINEERING
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(MGE)	MINING ENGINEERING
(OSE)	OPTICAL SCIENCES & ENGINEERING
(SYE)	SYSTEMS ENGINEERING

ENGINEERING DESIGN PROGRAM
YEAR AT A GLANCE

ENGINEERING DESIGN OPEN HOUSE

SYSTEM REQUIREMENTS 4 WEEKS

After students are assigned to projects, teams work with their sponsors to generate structured lists of system requirements and metrics to evaluate final designs/prototypes.

SYSTEM REQUIREMENTS MEMO

This structured document defines a sponsor's requirements for completed projects. All designs, tests and prototypes are gauged against this document.

PRELIMINARY DESIGN 4 WEEKS

Following approval of the Systems Requirements Memo, teams conduct research and brainstorm to produce a "best" preliminary or conceptual design.

PRELIMINARY DESIGN REVIEW

This formal review is an opportunity for sponsors and mentors to critique conceptual designs, challenge assumptions, and help teams refine or modify their designs. All teams must obtain sponsor approval for their conceptual designs.

DETAILED DESIGN 6 WEEKS

Based on feedback from sponsors and mentors at the Preliminary Design Review, teams modify their preliminary designs and generate detailed manufacturable designs to create prototypes for Engineering Design Day.

CRITICAL DESIGN REVIEW

This important milestone in the design process is where sponsors and mentors ensure their teams are meeting all mandatory requirements and have a feasible plan to manufacture/test a prototype within budget. This is the final checkpoint for sponsors to approve sound designs and test plans before teams begin manufacturing their prototypes.

WINTER BREAK

DESIGN CHANGES/ BEGIN BUILD 7 WEEKS

Following Critical Design Review and approval of the Critical Design Report by sponsors and mentors, teams begin production of their prototypes. In the initial phase of construction, teams start purchasing parts and manufacturing custom components in University of Arizona facilities.

FINAL DESIGN PRESENTATION

This is the final formal opportunity for teams to receive feedback from sponsors and mentors on the status of their projects and any last-minute changes. Beyond this point, teams finish building and testing their prototypes before presenting results to sponsors at a Final Acceptance Review and to industry judges at Engineering Design Day.

FINALIZE BUILD/ ACCEPTANCE TESTING 9 WEEKS

During the final phase of the Engineering Design Program, teams – in close collaboration with sponsors – assemble and test their prototypes. At the same time, teams prepare their presentations and demonstrations for Engineering Design Day.

ENGINEERING DESIGN DAY

2017 ENGINEERING DESIGN DAY ACKNOWLEDGMENTS

STUDENTS: Projects exhibited here today are the culmination of a year's worth of student's work. Students have applied knowledge gained over the course of their undergraduate education, exercised out-of-the-box thinking, and spent hundreds of hours producing the best solutions for their sponsors. We acknowledge your dedication and professionalism and congratulate you on your achievements.

MENTORS: Twelve project mentors apply hundreds of years of collective engineering experience to guide students in the completion of their projects. Mentors ensure the implementation of industry standards in the design process. Their understanding of devising solutions to challenging problems adds a critical dimension to students' engineering knowledge. Thank you for your hard work, commitment to excellence in engineering design, and your role in the education of our students.

SPONSORS: Sponsors provide students with real-world projects and allocate funds to the program. They designate technical staff and mentors to guide students through the intricacies and requirements of their projects. Sponsors are a big part of what makes make the Engineering Design Program at the University of Arizona what it is today – one of the largest and best-quality programs of its kind in the nation. Thank you immensely for your continued support.

JUDGES: The 120+ external judges who participate in Engineering Design Day supply independent professional opinions on the quality of students' work. They help maintain the accreditation of undergraduate University of Arizona Engineering degree programs by providing insight and suggestions for improving the Engineering Design Program. Thank you for volunteering your time and applying your knowledge to evaluate and critique students' capstone projects.

STAFF: Dedicated professionals in the College of Engineering ensure smooth operation of the program. They spend thousands of hours each year organizing events, communicating with sponsors, operating functional manufacturing areas, generating marketing materials and news about the program, maintaining budgets and purchasing records, and performing a myriad of other tasks. Thank you all for your invaluable contributions and the excellence you bring to the program.

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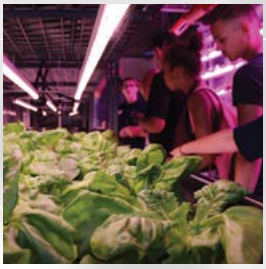
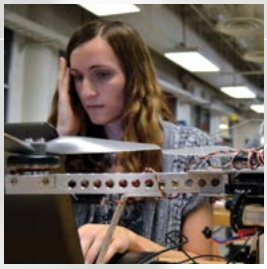

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- Move products to market
- Support engineering education
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ENGR DESIGN 2017

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