April 21, 2017

Thank you for joining us at the Spring 2017 FURI Symposium.

We are excited to share the work of our students in the Fulton Undergraduate Research Initiative — one of our signature experiential programs at the Fulton Schools.

FURI presents students the opportunity to discover a love of research as they work in the lab alongside our renowned faculty. Many of our guests will be surprised and impressed by the ability of so many of our undergraduates to conduct research at levels typical of graduate students.

Programs like FURI attract some of the brightest students from across the country — and around the world — and presents them an opportunity to grow as researchers in settings that enhance their problem-solving skills, independent work ethic, innovative thinking and sense of discovery.

Beyond the lab, students can travel to academic conferences to present their work, a great opportunity early in their academic careers. Participation in FURI also opens doors to scholarships, internships and research opportunities in graduate school.

The projects you will see today put into practice outside-the-box thinking to further solutions to real-world challenges in health, energy, education, security and sustainability.

Congratulations to all the students presenting today — we are proud of your accomplishments this semester. We also are grateful to everyone who helps make this program such a success.

Sincerely,

Kyle D. Squires, Ph.D.
Dean, Ira A. Fulton Schools of Engineering
Professor, Mechanical and Aerospace Engineering

Kae Sawyer
Associate Director
Student Engagement
Students in the Fulton Schools’ FURI research program develop a proposal under the mentorship of a faculty member, then apply for funding. Once accepted, they perform research, attend workshops and prepare research summaries. Participants receive stipends and research supply budgets.

The travel grant program helps students present their research at national conferences by providing financial assistance with travel expenses.

Grand Challenge Scholars Program students conduct research in a grand challenge theme and are invited to present their research at the FURI Symposium.

ASU Kern Project grant recipients and KEEN-supported FURI students receive funding to support research, projects or travel that exemplifies an entrepreneurial-minded approach. These students are invited to share their work at the FURI Symposium.
FURI Faculty Mentors

James Abbas, associate professor
Shahriar Anwar, senior research specialist
Panagiotis Artemiadis, assistant professor
Daniel Aukes, assistant professor
Srividya Bansal, assistant professor
Heni Ben Amor, assistant professor
Visar Berisha, assistant professor
Spring Berman, assistant professor
Jennifer Blain Christen, assistant professor
Stuart Bowden, associate research professor
David Brafman, assistant professor
Michael Caplan, associate professor
Junseok Chae, associate professor
Candace Chan, assistant professor
Aditi Chattopadhyay, Regents’ Professor
Erin Chiou, assistant professor
Oswald Chong, associate professor
Nancy Cooke, professor
Lenore Dai, school director and professor
Shuguang Deng, professor
Sandwip Dey, professor
Adam Doupé, assistant professor
Heather Emady, assistant professor
Peter Fox, professor
Emma Frow, assistant professor
Tirupalavanam Ganesh, assistant dean and associate research professor
David Grau, assistant professor
Matthew Green, assistant professor
Owen Hildreth, assistant professor
Claire Honeycutt, assistant professor
Kiril Hristovski, associate professor
Shawn Jordan, assistant professor
Jeffrey Kleim, associate professor
Vikram Kodibagkar, assistant professor
Jeffrey La Belle, assistant professor
Michal Lande, assistant professor
Hyunglae Lee, assistant professor
Joohyung Lee, associate professor
Baoxin Li, professor
Mary Laura Lind, associate professor
Yongming Liu, associate professor
Hamid Marvi, assistant professor
Abdel Mayyas, assistant professor
Benjamin Mertz, lecturer
Bin Mu, assistant professor
Brent Nannenga, assistant professor
Narayanan Neithalath, professor
David Nielsen, associate professor
Jay Oswald, assistant professor
Kristen Parrish, assistant professor
Vincent Pizziconi, associate professor
Panagiotis Polygerinos, assistant professor
Agami Reddy, professor
Fengbo Ren, assistant professor
Yi Ren, assistant professor
Bruce Rittmann, Regents’ Professor
Armando Rodriguez, professor
Rosalind Sadleir, assistant professor
Sydney Schaefer, assistant professor
Paulo Shakarian, assistant professor
Barbara Smith, assistant professor
Angela Sodemann, assistant professor
Kiran Solanki, assistant professor
Timothy Takahashi, professor of practice
Meng Tao, professor
Hanghang Tong, assistant professor
Sefaattin Tongay, assistant professor
César Torres, associate professor
Shane Underwood, assistant professor
Brent Vernon, associate professor
Erin Walker, assistant professor
Liping Wang, assistant professor
Qing Hua Wang, assistant professor
Daniel White, lecturer
Yezhou Yang, assistant professor
Masoud Yekani Fard, assistant research professor
Hongyu Yu, associate professor
Kori Sauser Zachrison, assistant professor, Massachusetts General Hospital
Wenlong Zhang, assistant professor
Sam Aguiar, Chemical Engineering
Graduation: May 2017
Hometown: Glendale, Arizona
Microbial Chain Elongation: Insights into Biofuel and Complex Organic Production
Mentor: César Torres, associate professor
Research Theme: Energy, Sustainability
The purpose of this project is to determine the fundamental factors that control Microbial Chain Elongation (MCE). MCE is the metabolic process in which simple organic compounds are combined into larger complex organics and is a largely unexplored topic in biogeochemistry and anaerobic microbial metabolism. Ethanol, acetate and hydrogen are provided to various soils and sediments as electron acceptors to determine which chemical characteristics and microbial communities promote MCE. The microorganisms most efficient at MCE are detected through deep-sequencing community analyses. Future work includes optimization of continuous operation bioreactors to maximize production rates and titers of medium/long chain fatty acids.

Andre Apostol, Mechanical Engineering
Graduation: May 2017
Hometown: Los Gatos, California
A Control System for Micro Robots
Mentor: Hamid Marvi, assistant professor
Research Theme: Health
Can micro robots be used to perform medical applications? The application for using micro robots to perform certain surgeries is an appropriate yet difficult challenge. It has been determined that these robots can indeed be controlled by an octo-mag coil system which is a magnetic field output from eight different directions. Ultimately, a future goal will be to send a robot inside a human body to perform heart tissue ablation.

Wade Adams, Engineering (Robotics)
Graduation: May 2018
Hometown: Sedona, Arizona
Carpal Tunnel Syndrome Soft Relief Device for Typing Applications
Mentor: Panagiotis Polygerinos, assistant professor
Research Theme: Health
The objective of this project is to find out if typing with a neutral plane in the wrist will help alleviate symptoms of Carpal Tunnel Syndrome (CTS). It has been documented that CTS symptoms can be prevented or relieved while typing if the wrist is kept in a neutral plane. Creating a soft-actuated, wearable robotic relief device will help maintain a neutral plane in the wrist, thereby eliminating some of the symptoms of CTS. In the future, this device could be designed to be smaller and more efficient without the need of an external air pump.

John Alden, Software Engineering
Graduation: May 2018
Hometown: Tucson, Arizona
Autonomous Multi-Agent Communication and Coordination Based upon the Distributed Control Model
Mentor: Wenlong Zhang, assistant professor
Research Theme: Security, Sustainability
Autonomous decentralized aerial vehicle systems have a potentially profound effect upon the security and development of the human race. Ideally, these autonomous systems will mimic swarm behavior in insects and exhibit intelligent qualities such as spatial awareness and inter-vehicle communication to ensure complete freedom of movement. Current autonomous systems are based upon a remote server transmitting control commands to systems. An unhindered autonomous swarm would have impact in the fields of security, search-and-rescue and sustainability. For future work, the control algorithms implemented in these vehicles will be refined and modified to allow for greater speed and flexibility.

Undergraduate Research Travel Grant Program

Ira A. Fulton Schools of Engineering | engineering.asu.edu
Lisa Baer, Computer Science  
Graduation: May 2017  
Hometown: Chandler, Arizona  
**Creation of Infrastructure for Self-Study of Computer Security**  
Mentor: Adam Doupé, assistant professor  
Research Theme: Education, Security  
A vulnerable, isolated environment to practice computer security concepts is difficult to configure and maintain, but fundamental to the success of students. The Cybersecurity Education Testbed (CET) is an open-source, self-contained solution that offers students an emulated, lightweight and easily distributed environment. CET utilizes Docker containers, which include learning activities and related, properly configured software. Using CET, students can deepen their knowledge of security concepts, repurpose the containers for Capture the Flag competitions and derive additional tools for the security community. Additional modules can be added to CET to extend beyond the original topics and improve comprehensiveness.

Juan Bahena, Mechanical Engineering  
Graduation: December 2017  
Hometown: Scottsdale, Arizona  
**Design and Programming of an LED Ring for Displaying Behavioral States on an Autonomous Swarm Robotic Platform**  
Mentor: Spring Berman, assistant professor  
Research Theme: Energy, Security  
Swarms of autonomous robots can potentially perform tasks such as surveillance, chemical detection and search-and-rescue missions. The purpose of this research is to implement LED rings on small, mobile robots to display their behavioral states such as “idle” and “searching.” Microcontrollers are utilized to effectively control the color emitted by the LEDs. Image processing algorithms are implemented on the robot’s overhead, centralized camera to interpret and communicate from its neighbors’ LED colors. Future research can focus on detecting robot states from aerial vehicles such as quadcopters and developing new decentralized robot controllers that rely on visual feedback.

Dylan Baker, Mechanical Engineering  
Graduation: May 2017  
Hometown: Tempe, Arizona  
**Interfacial Fracture of Cylindrical Ice-Aluminum Specimen**  
Mentor: Jay Oswald, assistant professor  
Research Theme: Security  
A device for the preparation of Cylindrical Ice-Aluminum Specimens was constructed to produce specimens for testing in a uniaxial load cell with the goal of determining mechanical properties of the Ice-Aluminum interface. Specimens produced using different spray settings produce ice with differing microstructures. Further research into the fracture of these specimens will utilize load data at the point of fracture to determine the critical stress intensity factor of the specimens and how the microstructures of the ice might impact the critical stress intensity factor.

Brandon Bartels, Biomedical Engineering  
Graduation: May 2017  
Hometown: Phoenix, Arizona  
**Startle Evoked Movement in a Non-Expert Typing Population**  
Mentor: Claire Honeycutt, assistant professor  
Research Theme: Health  
The goal of this study is to evaluate startle evoked typing movements in a non-expert population. This data will be compared to an expert population in order to see the role of task familiarity in the startle reflex phenomenon. Preliminary data suggests that individuated finger movements are indeed susceptible to startle evoked movement. The protocol will be executed on additional subjects so that the data can be accurately compared between populations.
Michael Bejarano, Biomedical Engineering
Graduation: May 2018
Hometown: Dallas, Texas

Microrobots for Medical Applications
Mentor: Hamid Marvi, assistant professor
Research Theme: Health

Microrobots possess the potential to be directed through the human body for minimally invasive medical procedures such as targeted drug delivery and microsurgery. The objective of this research is to construct an electromagnetic coil system to actuate microrobots for use in minimally invasive medical procedures. Current progress includes assembly completion of the electromagnetic coil system and achieving system functionality. Through testing of various tissue samples, data will be collected to determine the optimal system for medical applications.

Quinn Beauparlant, Civil Engineering
Graduation: December 2017
Hometown: Gilbert, Arizona

Quantifying the Corrosion Characteristic of Alkali-Activated Concretes Using Electrochemical Impedance Spectroscopy
Mentor: Narayanan Neithalath, professor
Research Theme: Sustainability

Alkali-activated (A-A) concretes can reduce or eliminate the need for carbon dioxide intensive ordinary Portland cement (OPC) as a binder. To investigate the effect of A-A systems’ higher alkalinity on the chloride-induced corrosion of steel reinforcement, electrochemical impedance spectroscopy was performed on carbon steels inside of simulated pore solutions (SPS) as well as A-A SPS at varying chloride ion concentrations. Concrete systems which facilitate the passivation of reinforcement steel, and therefore halting corrosion, are suitable for constructing durable and sustainable structures in chloride-intensive environments, such as saltwater jetties or bridge decks subjected to de-icing salts. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

Omar Benitez, Mechanical Engineering
Graduation: May 2017
Hometown: Phoenix, Arizona

Craft Labor Productivity Analysis in Civil Engineering and Construction Projects — A Field Experience
Mentor: David Grau, assistant professor
Research Theme: Sustainability

The research goal is to understand factors that affect craft labor productivity at construction sites. Activity analysis will be utilized to gain understanding by observing laborers and recording the type of work or delays that happen during different times of day, while also recording weather and temperature to determine if that correlates with labor productivity. About one-third of the cost of a construction project is attributed to labor. With this data it will be possible to implement improvements to save time and money. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

Juliana Bennett, Materials Science and Engineering
Graduation: May 2018
Hometown: Mesa, Arizona

Study of Exfoliation of Tantalum Trisulfide
Mentor: Sefaattin Tongay, assistant professor
Research Theme: Sustainability

The interesting properties and possible applications of low dimensional materials have gained the attention of research and industry alike. The production of thin nanoribbons of the layered material, monoclinic tantalum trisulfide (m-TaS$_3$), was studied. Multiple exfoliation methods were tested and modified to produce these nanoribbons from bulk crystal. Liquid exfoliation via sonication currently shows the most promise due to ease of procedure and quantity of nanoribbons produced. The parameters of liquid exfoliation will be explored in future research and optimized for more control of mean nanoribbon dimensions for future studies of properties and experimental devices incorporating this and similar materials.
Brandon Boepple, Chemical Engineering  
Graduation: May 2018  
Hometown: Scottsdale, Arizona  
**Heat Transfer in a Rotary Drum via Conduction, Convection and Radiation**  
Mentor: Heather Emady, assistant professor  
Research Theme: Energy

Rotary drums are commonly used for the mixing, heating and milling of solid granules. Since granules don’t behave like conventional solids, liquids or gases, they are difficult to model and their processing can be inefficient. This research studies the effects of operating parameters such as temperature, rotation speed and fill level on heat transfer in a rotary drum. This will be done by heating the drum and measuring the radial temperature gradient in the granular bed with thermocouples. The data will show which operating conditions maximize the heat transfer between the granules and drum wall.

Julia Boese, Chemical Engineering  
Graduation: May 2018  
Hometown: Gilbert, Arizona  
**Modulating Heat Shock Response in E. coli to Regulate Membrane Protein Expression**  
Mentor: Brent Nannenga, assistant professor  
Research Theme: Health

The objective of this research is to synthesize plasmids that allow E. coli to self-regulate membrane-protein expression and increase yields. The membrane-protein expression pathway was reprogrammed using gene-blocks that were antisense to vital membrane protein DNA and RNA binding-site sequences. After inserting the aPBAD and aHtdR gene-blocks individually within a PMM102 backbone into E. coli cells and inducing and testing the cells via spectrophotometry, it was determined that the reprogrammed cells provided greater protein yields than the control cells. Further work should determine if this trend is only applicable to certain membrane proteins or if it is universal.

Alex Bravenec, Materials Science and Engineering  
Graduation: May 2018  
Hometown: Sierra Vista, Arizona  
**Determining the Relationship between Characteristics in Shape-Memory Polymers**  
Mentor: Shahriar Anwar, senior research specialist  
Research Theme: Energy, Health

Shape-memory polymers (SMPs) are an emerging class of materials that have many biomedical and optical applications because of their ability to alter their shape. This project’s goal is to manufacture SMPs and perform analysis on their properties in order to determine the specific factors that influence each property. This project involved developing and modifying a manufacturing process for SMPs along with conducting thermal and mechanical property testing. Future work would involve modifying the manufacturing process to allow for more casting designs and property adjustment in addition to discovering new applications for SMPs.

Stephanie Brown, Chemical Engineering  
Graduation: May 2017  
Hometown: Fall Creek, Oregon  
**Membrane Modification for Sensing Urine Ammonium Levels**  
Mentor: Mary Laura Lind, associate professor  
Research Theme: Health

Acute Kidney Injury (AKI) can be detected through ammonium biomarkers in urine. This research is being done to develop a membrane for use in separating ammonia gas from urine so that ammonium levels can be monitored. A hydrophobic membrane was treated with a base to change the pH level of an applied sample, turning aqueous ammonium into gaseous ammonia which was detected by a color-changing indicator paper. This method has been effective with single runs using an ammonium chloride solution. In the future, it must be optimized to work with urine in a semi-continuous flow.
Enhancing the Profile of Chemical Engineers as Relevant to Society amongst Middle and High School Students

Mentor: Tirupalavanam Ganesh, assistant dean and associate research professor
Research Theme: Education

The objective is to determine effective methods to convey engineering concepts to high school students. The effectiveness of a poster campaign projecting engineering ideals held by undergraduates and the effectiveness of a set of presentations and activities containing chemical engineering concepts and socially relevant themes are being tested. Eighty students are enrolled to participate in Young Engineers Shape the World. These efforts are aimed at influencing students’ perceptions about engineers and the types of problems they solve. Results are expected to yield correlations between students’ understanding of engineering problems and the appeal of these problems to “want to” solve them.

Building and Designing Tools to Improve the Control of Quadrotor Swarms

Mentor: Panagiotis Artemiadis, assistant professor
Research Theme: Health, Security

The main objective of this research is to develop an interface which will allow humans to control quadrotor swarms through hand gestures. To fly, quadrotors require information regarding speed and direction. Thus, the speed of the quadrotor was automated by establishing a relationship between voltage and force produced by a quadrotor motor. To test the quadrotors’ ability to respond to directions, a camera mount to track quadrotor movement is under development. Developing an interface that controls swarms of robots can improve performance in search and rescue scenarios by allowing rescuers to search more ground in less time.

Designing and Building a Biomimetic Soft Robot Based on a Nautilus

Mentor: Panagiotis Polygerinos, assistant professor
Research Theme: Energy, Security, Sustainability

The research objective is to develop a biomimetic sub-aquatic robot that emulates the movement method of the deep sea nautilus. This consists of using soft materials to mimic the siphon pump propulsion method employed by the nautilus and other mollusks. Current work is focused on validating research conducted on the actuator design and applying it to a new actuator better suited for a standalone unit, then to build a unit that is capable of self propulsion in water. The next step of the research are to give it the ability to control its buoyancy and lateral movement.

Electrochemical Force Transducer

Mentor: Jeffrey La Belle, assistant professor
Research Theme: Health

Electrical responses to applied force can be measured from the Electrochemical Force Transducer. The transducer utilizes electron mediators suspended in a medium to translate pressure into a change in current. This research endeavor has characterized a current verse applied force response. Ferri/Ferrocyanide is the more established electron mediator; its high reactivity presents issues for long-term use or medical application. EPOP is an alternative electron mediator with a similar ability to translate force or pressure into electricity but with no reactivity issues. The transducer can be used for prosthetic limb feedback, and further characterization will reveal new applications.
The purpose of this research is to develop a compact, wearable sensor for long term monitoring and characterization of respiratory issues in a subject. The sensor array uses acoustic signals, electromyography (EMG) and acceleration data to detect and characterize respiratory patterns. The array of sensors is housed in a small, wearable package designed for discreet data collection. The sensor array stores signals gathered locally to later be analyzed to determine a correlation between sensor readings and origins of respiratory problems.

This project aims to develop and test a new cost-efficient silicon solar cell using copper for the front metal contacts by examining the effect of copper thickness on cell performance using deformation and contact resistance testing. Adhesion of contacts to the silicon is critical for reliability. Wider and thicker fingers have better conductivity but higher stress and poor adhesion. Wider fingers also shade the silicon. By characterizing copper, it is possible to develop a copper-plated production line that yields high efficiencies and reliable cells. Future developments will be to completely remove the use of expensive silver.

The objective of this research project is to identify the ideal fin geometry for reducing flutter in a sounding rocket. The first semester of the project focused on motors, which helps lead to reliable and safe launches of the sounding rocket. Motor development is still underway, however, design and construction of the rocket has begun. No significant findings have emerged yet. This semester is being used to develop equipment and procedures for the actual experimentation occurring near the end of this semester. Future work will include building the sounding rocket and wiring the data acquisition electronics to complete the project.

Permanent blindness affects a very large number of people in the world. The research objective is to design and prototype a device that can help people "see." By taking an array of pins, some not much bigger than two human hairs, and exciting them using sound, an "image" can be displayed that can be felt with human fingertips. Thus far, it has proven possible to manufacture larger (~1 mm) pins and excite them using conventional speakers, however, more work will be required to increase the resolution of the display and its reliability.
Krysta Clark, Chemical Engineering

Graduation: May 2018
Hometown: Phoenix, Arizona

Nanostructured Faujasite Zeolites for Carbon Dioxide Adsorption

Mentor: Shuguang Deng, professor
Research Theme: Sustainability

The objective of this research is to determine the adsorption and desorption breakthrough properties of a nanostructured faujasite zeolite that varies with gas composition, pressure and flow rate. This research determined if the proposed new nanostructured zeolite will have lower operating costs than regular zeolites. These proposed improvements to the current zeolite-based post-combustion capture system will be scalable to industry, providing an economical way to reduce carbon dioxide emissions.

Emily Close, Chemical Engineering

Graduation: May 2017
Hometown: Glendale, Arizona

The Effect of Modulator Concentration on the Defects Present in the Zirconium Metal-Organic Framework UiO-66

Mentor: Bin Mu, assistant professor
Research Theme: Energy

Metal Organic Frameworks (MOFs) are a new set of porous materials becoming popular for gas separations due to their abilities to be tailored toward specific applications. The Zirconium MOF UiO-66 is very stable under standard conditions, but recent studies have shown that varying synthesis conditions lead to defects in the framework structure. This research aims to study the effect of modulator concentration on the surface area and crystallinity of UiO-66. Once this is understood, the chemical stabilities of the samples will be tested in various solvents to gain insight into UiO-66’s properties.

Zhanelle Coleman, Engineering (Robotics)

Graduation: May 2017
Hometown: Los Angeles, California

Contaminant Removal Using Nano-enabled 3D-Printed Polymers

Mentor: Kiril Hristovski, associate professor
Research Theme: Health, Sustainability

Polymerized media containing nanoparticles offer a potential for removing contaminants from water. The goal is to develop nano-enabled ribbons that are <200 microns and to measure their mechanical robustness and arsenic removal ability. Titanium dioxide (TiO$_2$) mixed with photosensitive, polymer-based resin has been 3D printed into ribbons approximately 300 microns wide. The next batch of ribbons printed will be tested for tensile strength to define the mechanical robustness added by various TiO$_2$ concentrations. The contaminant removal ability of these polymerized media will be assessed through adsorption tests using arsenic-contaminated water.
Sydney Connor, Biomedical Engineering  
Graduation: May 2019  
Hometown: Lake Stevens, Washington  
**Transferring Motor Practice between Different Motor Tasks**  
Mentor: Sydney Schaefer, assistant professor  
Research Theme: Health

In motor training, transfer is the gain/loss of performance in one task as a result of practicing another. The research objective is to test whether training in one motor task will transfer. This laboratory reveals that practicing a multi-joint coordination task (which simulates arm/wrist movement when feeding) improves performance on a dexterity task (simulating finger/hand movement when dressing) despite task differences. Testing will determine if the dexterity task improves performance of multi-joint coordination. Following neurological injury, patients practice functional motor tasks to retrain their nervous system. Evidence-based approaches to clinical neurorehabilitation will revolutionize current therapies and technologies. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

**ASU KERN Project KEEN supported FURI student**

Alex Conrad, Aerospace Engineering  
Graduation: May 2017  
Hometown: Maricopa, Arizona  
**Transfer Time and Propellant Use for Low-Thrust Trajectories**  
Mentor: Daniel White, lecturer  
Research Theme: Education

The use of low-thrust electric propulsion systems for spacecraft have generated the need to understand the orbital trajectory of spacecraft using these systems. The current goal of this research is to produce a basic working model to determine how long it takes to transfer to a desired orbit as well as the amount of propellant needed. Much more in-depth programs exist for doing these simulations, but are not readily accessible to students or others who wish to understand low-thrust trajectories. Future work will include better precision in the model and additional functionality.

Brittany Convery, Chemical Engineering  
Graduation: December 2017  
Hometown: Lexington, Illinois  
**Consistent Procedure for Contact Angle Measurement Utilizing Washburn Method**  
Mentor: Heather Emady, assistant professor  
Research Theme: Education, Sustainability

This research's purpose is to investigate the most reproducible, reliable procedure for utilizing the Washburn equation for determining contact angles between liquids and powders of both fine and free-flowing particle sizes. The Washburn method relates capillary liquid rise through a permeable membrane in packed tubes to the contact angle of the system. This method is currently challenging to perform with consistent results due to irregular particle distribution in tubes, especially with fine particles. Differing packed densities and efforts to optimize the filter and apparatus setup are being explored. Further studies could examine contact angle variances in relation to powder mixtures.

Andrew Cook, Mechanical Engineering  
Graduation: May 2017  
Hometown: Phoenix, Arizona  
**Development of a Lower Extremity Robotic Device for Ankle Studies**  
Mentor: Hyunglae Lee, assistant professor  
Research Theme: Health

The objective of this research is to design and build a wearable robotic device to facilitate gait studies related to the ankle. The device will rapidly actuate a user’s foot during the swing phase of walking while measuring the ankle’s response. To minimize its interference with a user’s natural gait, the lightweight robot will feature mechanisms that permit inversion-eversion and axial ankle rotation. By giving insight into the mechanics of the ankle, this device could aid in the development of rehabilitation methods for ambulatory disabilities, such as those brought on by strokes.
The Internet of Things (IoT) for Pet Care seeks to promote owner involvement in the health of their pets through the internet to combat the high rate of obesity in pets in the United States. To achieve this, a pet feeder was developed to track the weight of the pet as well as how much food the pet eats while allowing the owner to see videos of their pet eating, all through the owner’s smartphone. The next step for this project will optimize the pet feeder design to prevent common errors in pet food distribution.

The objective of this research is to explore different variables that can be accounted for in power management strategies designed for hybrid electric vehicles. The research will be carried out by simulating a hybrid electric drive train and running different logical controllers to obtain the best results possible. This research could potentially lead to its adaptation in consumer or industrial hybrid electric vehicles, and ultimately in more fuel-efficient vehicles that produce less harmful emissions than their current counterparts.

Hydrocephalus is a condition characterized by the buildup of cerebrospinal fluid in the brain. Open-skull surgery to implant shunt systems, which exhibit greater than 50 percent failure rates within two years of implantation, is the conventional treatment. However, the fully passive hydrogel check valve explored in this project has the potential to curtail the need for multiple invasive surgeries and decrease valve failure from calcification and organic compound obstruction.

The manufacturing industry has made tremendous improvements in efficiency using the lean principles. The construction industry has adopted lean concepts in order to improve lagging efficiency. To optimize the use of lean concepts in construction, the purpose of this research is to understand how different types of variables affect craft labor productivity. Current research is focused on utilizing two techniques to gather productivity ratios: crew balance and activity analysis. The goal is to quantify the impact these variables possess and utilize this knowledge to optimize the interaction of craft laborers with these variables.
Christopher Diaz, Software Engineering
Graduation: May 2017
Hometown: Mesa, Arizona

Linked Data for Sustainability
Mentor: Srividya Bansal, assistant professor
Research Theme: Sustainability

The goal is to develop an iOS application utilizing linked data to provide a solution to the challenge of measuring sustainability and a platform to share their findings. Sustainability Data classified has been collected via custom web-scrapers, and the ontology design to realize the connections between the collected data has begun. Research on measuring sustainability helped determine the challenges of measuring sustainability, leading to a pivot of providing a platform to create algorithms and validate them against found data. Future work will include creating an additional platform to support a broader audience and to add data from other sustainability areas.

Courtney DuBois, Biomedical Engineering
Graduation: May 2017
Hometown: Tempe, Arizona

Development of a Rapid Diagnostic Test to Detect Navajo Neurohepatopathy
Mentor: Michael Caplan, associate professor
Research Theme: Health

Navajo neurohepatopathy (NNH) is a fatal genetic disorder caused by the R50Q point mutation. NNH (affecting 1-in-1,600 Navajo babies) is characterized by brain damage and liver disease/failure. Phoenix Children’s Hospital currently uses gene sequencing to identify the R50Q mutation. While this process is conclusive, there are limitations, as it requires both time (3–4 weeks) and money (> $700). Ultimately, the researchers propose the use of Tentacle Probe technology (TP) to develop a sensitive and specific rapid diagnostic tool. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

Jason Enriquez, Materials Science and Engineering
Graduation: May 2017
Hometown: Phoenix, Arizona

Producing Electricity from Human Body Heat Using Graphene-Infused Thermoelectric Fabric II
Mentor: Qing Hua Wang, assistant professor
Research Theme: Energy

There is an increasing need to find renewable and alternative sources of energy as the world is increasing its demand for energy. Heat from the environment and from human bodies are sources that have not fully been exploited. The purpose of this FURI project is to harness heat energy from either the environment or the body, and convert it into usable electricity. This is done through a cotton fabric impregnated with Poly(3,4-ethylenedioxythiophene)-poly(styrenesulfonate) (PEDOT:PSS, a thermoelectric polymer) and graphene. The future application for this technology is in portable energy generation devices incorporated into clothing and buildings.

Jarrett Eshima, Biomedical Engineering
Graduation: May 2019
Hometown: Phoenix, Arizona

Detection of Hormone Specific Volatile Organic Compounds Using GC-MS
Mentor: Barbara Smith, assistant professor
Research Theme: Health

The objective of the research is to detect and analyze biological hormones and correlate shifts in metabolite concentrations with a primary focus on cortisol. Utilizing the high sensitivity of gas chromatography-mass spectrometry, the researchers aim to develop a method for detecting cortisol at physiological concentrations using derivatization through silylation or acetylation. The finalized method will be used to identify the limit of detection of cortisol, present in the headspace of biological samples. The end goal is to identify shifting metabolites in response to hormone concentration levels and relate this information to mental health and fertility.

ASU KERN Project KEEN supported FURI student
Sebastian Fonseca, Biomedical Engineering
Graduation: May 2018
Hometown: Bogotá, Colombia

Evaluation of Novel Transfection Reagents used to Introduce Exogenous DNA into Various Neural Cell Lines
Mentor: David Brafman, assistant professor
Research Theme: Health

Alzheimer’s disease (AD) is one of the most prevalent illnesses in the world, affecting 47 million people globally, with an estimated 60 percent increase by the year 2030. This research aims to evaluate the efficiency of novel reagents used to transflect (introduce exogenous DNA) embryonic and induced pluripotent stem cells. Current transfection technologies have high cytotoxicity levels and poor effectiveness, making imminent the need for improved DNA delivery methods. Since many AD-related research topics such as CRISPR/Cas9 genome editing and artificial aging involve transfections, it is important to optimize this process to minimize errors and produce better results.

Nathaniel Ferre, Aerospace Engineering
Graduation: May 2018
Hometown: Chandler, Arizona

AFM-based Near-Field Thermal Metrology for Nanometer-Scale Surface Temperature Mapping
Mentor: Liping Wang, assistant professor
Research Theme: Energy

The primary goal of this project is to experimentally measure local surface temperatures at nanometer scales with the effect of plasmonic local heating. In previous decades, AFMs (atomic force microscopes) have become a basic tool in studying nanotechnology. Using an AFM, local surface temperatures can be accurately measured at the nanometer scale. The rapid development of information technology in microelectronics, such as CPU chips, requires temperature readings at nanometer scales. With the results from this project, microelectronics will become smaller and thermal systems will be more efficient in converting energy.

Emily Ford, Civil Engineering
Graduation: December 2017
Hometown: Chandler, Arizona

An Analysis of Craft Labor Productivity
Mentor: David Grau, assistant professor
Research Theme: Sustainability

Productivity in the construction industry is an essential measure of production efficiency and economic progress quantified by craft laborers’ time spent directly adding value to a project. Data on the effects of time of day on worker productivity was gathered through an activity analysis at the Palo Verde Main construction site. Analysis suggests that supporting tasks, such as traveling or materials handling, make up the majority of craft laborers’ efforts on the job site. Through this research, construction managers can more effectively generate site plans and schedules to increase labor productivity.

Scott Freitas, Computer Science
Graduation: May 2017
Hometown: Phoenix, Arizona

PathFinder: Rapid Visual Mining of Network Connectivity
Mentor: Hanghang Tong, assistant professor
Research Theme: Education, Health, Security

The goal of this work is to create an online platform for users to explore, analyze and visualize network connectivity using a set of user-specific query nodes. There are two fundamental tasks in order to create such a viable online platform. First (Context), the system needs to quickly identify key network regions/communities in relation to query nodes, i.e., to detect the Context that the query nodes belong to. Second (Pathway), the system shall facilitate the end-user to quickly identify the key path(s) to connect the query nodes, i.e., to detect the pathway that groups the query nodes together.
Brandon Gardell, Computer Science
Graduation: December 2017
Hometown: Mesa, Arizona

**Smart Reasoning Framework for IoT**
Mentor: Joohyung Lee, associate professor
Research Theme: Health

The objective is to demonstrate applications of recent development of knowledge representation techniques, such as Answer Set Programming and Probabilistic Answer Set Programming, which are paradigms geared toward solving combinatorial search problems. This research introduces a framework for meshing these knowledge representation techniques and context aware physical devices to solve problems in the scheduling domain, where the increasingly large search space is added to by both information from physical devices and learned user preference. Further development on this framework can be used for creating an expert system as a personal assistant, aiding users in making correct choices for their health.

Daniel Gentry, Biomedical Engineering
Graduation: May 2018
Hometown: Gilbert, Arizona

**Biodistribution of Novel Polymer Hydrogels of Varying Molecular Weights**
Mentor: Brent Vernon, associate professor
Research Theme: Health

The lab is evaluating a new class of injectable polymer-based hydrogels for sustained drug delivery. It has not yet been studied how these polymers metabolize and clear the body after dosing. The researchers evaluated the hydrogels’ degradation for two molecular weights (~35 kDa and 65 kDa) in a study using rats and found minimal accumulation in the liver and kidney at 10 weeks. The accumulation in the kidney could suggest possible extravasation of gel into vasculature. Future work will evaluate metabolism and clearance in a surgical wound model.

Preston Goulet, Software Engineering
Graduation: May 2019
Hometown: San Tan Valley, Arizona

**IMOD**
Mentor: Srividya Bansal, assistant professor
Research Theme: Education

The purpose of the Instructional Module Development (IMOD) software system is to guide instructors, step-by-step, through an outcome-based education process through which they will define learning objectives, select the content that is to be covered, and define the learning environment and context for their course(s). IMOD is designed to assist new teachers instructing science, technology, engineering and math (STEM) degree programs to create better course curriculum that will improve the educational experience for students. The objective of this FURI project is to assess the effectiveness, efficiency and usability of the IMOD system in creating outcome-based course design.

Deven Govin, Biomedical Engineering
Graduation: May 2017
Hometown: Peoria, Arizona

**The Development of a Soft-Robotic Back Orthosis**
Mentor: Panagiotis Polygerinos, assistant professor
Research Theme: Health

The purpose is to develop a Soft-Robotic Back Orthosis to relieve back pain by helping patients achieve the fully upright position and stabilize the lumbosacral spine. During this period, the physics of the body have been established as well as the functional requirements. A first functional prototype was completed and initial testing results are promising but there is more work to be done to create a design that is the most efficient and robust. If the research is successful, the Soft Robotic Back Orthosis could become the new standard for patient care of those affected by a back condition.

ASU KERN Project KEEN supported FURI student
Sue Han, Chemical Engineering

Graduation: May 2018
Hometown: Phoenix, Arizona

Altering Heat Shock Vectors to Optimize Cell Growth in Escherichia coli

Mentor: Brent Nannenga, assistant professor
Research Theme: Health

The objective of the research is to study the effects of heat shock promoters and antisense mRNA inserts in plasmids on cell growth and membrane protein transcription rates. Through cell transformation and optical density studies, it has been found that the protein expression of cell increases as cell growth rate decreases. The increase in protein expression will aid in further study of membrane proteins which are used as markers for targeted medicine and detection of diseases. It is recommended that further experiments with other combinations of promoters and mRNA inserts are done to optimize the process.

Harrison Hanzlick, Mechanical Engineering

Graduation: May 2018
Hometown: Tucson, Arizona

Gender Difference of Ankle Stability in the Sagittal and Frontal Planes

Mentor: Hyunglae Lee, assistant professor
Research Theme: Health

This project offers quantification of ankle stability in relation to simulated haptic environments of varying stiffness. Ankle stability was quantified for both degrees-of-freedom of the ankle in the sagittal and frontal planes. Subjects’ stability consistently decreased when exposed to environments of negative simulated stiffness. In the frontal plane, male and female subjects exhibited nearly identical stability levels. In the sagittal plane, however, male subjects demonstrated marginally more stability than female subjects in environments with negative stiffness. Results of this study are beneficial to understanding situations in which the ankle is likely to lose stability, potentially resulting in injury.

Breanna Hassett, Mechanical Engineering

Graduation: May 2018
Hometown: Phoenix, Arizona

Biomechanical Analysis of Robotic Assistive Smart Shoes for Rehabilitation

Mentor: Wenlong Zhang, assistant professor
Research Theme: Health

The objective of this research is to create a wearable robotic device to assist with push-off during gait therapy. Existing devices are either too heavy or expensive to be used on a daily basis or only assist with dorsiflexion. Stroke or other patients with inhibited plantarflexion are at risk of falling due to toe-drag and have decreased walking speed. Creation of this device will allow these patients to improve their quality of life through greater mobility and independence. Future work will include refining the design, and if it can be validated, getting user feedback through human subject testing with BNI.

Anisha Gupta, Computer Science

Graduation: May 2018
Hometown: Phoenix, Arizona

Simplifying Self-Tracking through the Utilization of Wearable Technology

Mentor: Erin Walker, assistant professor
Research Theme: Health

The purpose of this project is to understand how wearable technology can improve a person’s practice of self-tracking, or monitoring one’s data. People self-track to analyze their behavior patterns so that they can make changes that lead to a healthier lifestyle. However, some people are not motivated to add onto or use their data to make positive behavioral changes. To better understand this problem, four co-design sessions were conducted. They highlighted the importance of customization and simplicity within applications. Both factors will be incorporated in an Apple Watch prototype that could better motivate users to track and improve their well-being.

Undergraduate Research Travel Grant Program
Gregory Hathorn, Chemical Engineering
Graduation: May 2018
Hometown: Tucson, Arizona

**Structural Studies on Urease Mediated Nanoparticle Formation**
Mentor: Brent Nannenga, assistant professor
Research Theme: Sustainability

The formation of metallic nanoparticles by Jack Bean Urease is to be analyzed structurally, in order to determine the reaction mechanism. Nanoparticles were formed at a low concentration with Jack Bean Urease. In order to create a more concentrated solution, Urease was purified directly from Jack Bean meal. A high enough Urease concentration for nanoparticle formation has not been achieved yet. Further optimization of the purification process will be performed. Analysis of this process will result in pure Urease solution that can be used for nanoparticle capture.

Evelyn Holguin, Industrial Engineering
Graduation: May 2018
Hometown: El Paso, Texas

**Engineering Mechanical Adventures: A Young Engineer’s Journey to Success**
Mentor: Tirupalavanam Ganesh, assistant dean and associate research professor
Research Theme: Education

The goal of this research is to study the impact of activities aimed to diversify and increase the number of engineers. A series of presentations, activities and poster campaigns were offered to high school students to help them understand "What Engineering Is" and explore how to think like engineers. The research measured the growing awareness and appeal of different engineering problems for students. Results will assist in designing future messaging campaigns and learning experiences aimed at influencing high school students’ interest in engineering. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

Paul Horton, Software Engineering
Graduation: May 2018
Hometown: Tucson, Arizona

**Radical Collaboration among Engineering Students during Short-Form Hackathon Events**
Mentor: Shawn Jordan, assistant professor
Research Theme: Education

The study’s purpose is to observe teams in a hackathon setting to determine how the environment enables successful software development in a small timeframe. This semester, the study has collected data on teams at various hackathons. Data from these teams has been analyzed using thematic analysis to better understand what success means for individuals during a hackathon. Observations have led the researchers to believe that a hackathon team’s performance is directly related to close proximity and friendliness of the development environment. This study aims to benefit engineering education by providing insight on how project-based learning can be improved.

Joshua Hsu, Biomedical Engineering
Graduation: May 2019
Hometown: Flagstaff, Arizona

**Learning a Library of Motor Skills for a Humanoid Robot**
Mentor: Heni Ben Amor, assistant professor
Research Theme: Health, Sustainability

Unsupervised robotic motor control movements often require a large training time or datasets for the robot to accurately complete assigned tasks. Designing control libraries, which can be generalized, are key to increasing the efficiency of motor control. The findings include the initial optimization time necessary for simple linear tasks. Furthermore, these tasks can be expanded to include bimodal (two hands) tasks that are a challenge for current robots. Generalized robotic programs will have the capacity to specialize, which will contribute to robotic systems. Future work will involve designing a motor control library used for autonomous motor sequence design.
Hope Jehng, Chemical Engineering
Graduation: May 2018
Hometown: Fort Mohave, Arizona
Theranostic Delivery to Canine Intracranial Gliomas via Convection-Enhanced Delivery
Mentor: Michael Caplan, associate professor
Research Theme: Health

The objective of this research was to analyze convection-enhanced delivery to canine intracranial gliomas. Dogs with naturally occurring glioblastoma were injected with iron oxide nanoparticles along with the chemotherapy drug. The percent coverage of tumor with iron oxide nanoparticles was around 30 percent, but as drug delivery continued for 48 hours afterward, the drug volume may be closer to three times that. Recommended future work includes achieving 100 percent coverage, which may involve more catheters and injections and measuring after drug delivery for a more accurate calculation.

George Kharlakian, Environmental Resource Management
Graduation: May 2017
Hometown: Scottsdale, Arizona
Determining Gibbs Free Energy and Arsenic Adsorption for TiO$_2$
Mentor: Kiril Hristovski, associate professor
Research Theme: Health, Sustainability

The research goal is to experimentally determine the enthalpy and Gibbs free energy of arsenic adsorption for TiO$_2$. Point of zero charge and pseudo-equilibrium adsorption tests have been conducted, and isotherms have been developed to determine the media's arsenic adsorption capacity at various pH levels and temperatures. The data will be used to calculate equilibrium constants and Gibbs free energy and enthalpy. It is anticipated that the energy of sorption will be significantly impacted by the pH of the water matrix.

Melissa Ip, Computer Science
Graduation: May 2017
Hometown: Chandler, Arizona
Developing Algorithms for Identifying Native Arizona Snakes in Images
Mentor: Baoxin Li, professor
Research Theme: Education, Health, Sustainability

This research seeks to develop algorithms using objectness estimation and object recognition to identify snakes native to Arizona in images to both preserve native snakes and encourage an interest in them. Features unique to venomous rattlesnakes determined from this work may serve as a tool for herpetologists to assist in their field research. Future work involves using an appropriate training set that produces optimal feature object windows and testing the accuracy of the algorithms. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

Ryan Jones, Computer Science
Graduation: May 2019
Hometown: Ann Arbor, Michigan
Machine Learning Applications in Speech Therapy
Mentor: Visar Berisha, assistant professor
Research Theme: Health

Integrating Machine Learning Technology on an API or mobile platform could help pathologists more accurately identify speech deficiencies. Current issues with deep learning technology is that it requires backend systems to process the signaling data. From the data collected, speech deficiencies can be identified through the aid of recurrent neural networks that learn from existing data. Through the aid of Java's deep learning libraries, it has presented an opportunity to make RNN technologies more practical in a pathological setting. Future work includes being able to collect the data from an Excel spreadsheet and load it into the RNN.

ASU KERN Project KEEN supported FURI student
Aditya Khuller, Aerospace Engineering
Graduation: May 2019
Hometown: New Delhi, India
Development of Biocompatible in Vivo Piezoelectrics for Medical Implant Power Generation
Mentor: Sandwip Dey, professor
Research Theme: Health
In 2010, more than 719,000 knee replacements and 332,000 hip replacements were performed in the USA, with about 52 percent of patients over 65 years of age. However, with premature failures and increased life expectancy, sensor-integrated implants could mitigate premature implant failure by monitoring wear and infections. Piezoelectrics generate power by converting displacement into electricity. Currently the most used, toxic piezoelectric is lead zirconate titanate (PZT). This project aims to develop a biocompatible piezoelectric with a piezoelectric coefficient comparable to PZT's to improve the efficacy of self-powered biomedical implants. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

Sebastian Klype, Mechanical Engineering
Graduation: May 2017
Hometown: Ahwatukee, Arizona
Investigation of Vibrational Stimulus on Hemiplegic Walkers for Gait Rehabilitation
Mentor: Panagiotis Artemiadis, assistant professor
Research Theme: Health
In the United States, more than 795,000 people suffer from a stroke per year, often with lifelong complications including a condition known as drop foot. Prior research indicates vibrational stimulus to the contralateral leg can produce positive muscular and neural reactions in the hemiplegic leg. These results encourage conducting experiments involving vibrational stimulus to the nerves affecting dorsiflexion on the non-paralytic side to stimulate the paralytic side. Experimentation indicates the peroneal nerve on the healthy leg must be thoroughly vibrationally perturbed to stimulate a dorsiflexion reaction in the hemiplegic leg. Future work should include experimentation on hemiplegic stroke patients.

Jacob Knaup, Engineering (Robotics)
Graduation: May 2019
Hometown: Queen Creek, Arizona
Force Control for Low-Cost Robots
Mentor: Daniel Aukes, assistant professor
Research Theme: Education, Security
Force control offers numerous benefits to robots over other control schemes such as more natural movements and increased sensitivity to the surrounding environment, but it is typically only available to high-end robots. This research aims to develop a modular force control solution for low-cost robots. A simple robotic linkage that takes advantage of laminate principles and includes the necessary spring and sensors along with the accompanying control software is being developed. The solution is designed to be easily incorporated into future laminate robots, allowing the designer to add force control capabilities, while placing minimal constraints on the design.

William Kostecki, Computer Systems Engineering
Graduation: December 2018
Hometown: Mesa, Arizona
Localization of Drones Using Exclusively On-Board Sensors
Mentor: Panagiotis Artemiadis, assistant professor
Research Theme: Security
This project seeks to create quadcopters that can use optical flow sensors for closed loop navigation of indoor and outdoor environments. Optical flow sensors use relative motion between two images taken by the quadcopter’s camera to determine the velocity of the quadcopter. The first objective of this project was to ensure that the optical flow sensor would be a viable (accurate) alternative for GPS tracking. Currently, the sensor is being implemented into several drones where only on-board sensors in a closed system will be used.
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Ivan Kruts, Aerospace Engineering
Graduation: May 2017
Hometown: Sacramento, California
RC Aircraft Propulsion Systems
Mentor: Timothy Takahashi, professor of practice
Research Theme: Energy
The goal of this FURI project is to not only analyze ducted fans, but to also compare their performance against propellers in static conditions and during various flight speeds as thrust declines. Previous research shows that propellers are more effective at generating static thrust than ducted fans, but a certain nacelle design might allow a ducted fan to perform as well as a propeller at flight speeds. If ducted fans can produce as much thrust as propellers, it will allow for more compact and faster RC Airplanes. Future work will involve the optimization of ducted fan nacelles to increase thrust.

Quoc Lam, Mechanical Engineering Systems
Graduation: May 2018
Hometown: Phoenix, Arizona
Microgravity Reconditioning Using Soft Actuators
Mentor: Panagiotis Polygerinos, assistant professor
Research Theme: Health
The aim of this project is to develop a new method of microgravity reconditioning utilizing soft actuators. Where current methods involve strenuous hours of exercise, a new passive form of reconditioning would be required when space transportation begins accommodating passengers by the hundreds. Therefore, there is a need to reduce the additional Zero-G exercising equipment to decrease payload. Owing to their lightness, soft actuators can be implemented to aid in this requirement by resisting movement, thus simulating gravity as experienced on Earth. Future works shall include adaptability to suit environments of varying gravity fields.

Jack Landry, Aerospace Engineering
Graduation: December 2018
Hometown: Phoenix, Arizona
Polymagnet Momentum Management Wheel for Spacecraft Attitude Control
Mentor: Daniel White, lecturer
Research Theme: Energy, Security, Sustainability
The purpose of this research is to apply magnets, as an alternative bearing, to extend the service life of a satellite flywheel. Polymagnet technology has enabled precise positioning of magnetic particles that, when configured properly, cause unique reactions compared to typical north and south-faced magnets. Classical physics states that without mechanical contact, one cannot levitate a permanent magnet system without electronics. However, if each magnetic particle is printed in a precise position, would the flywheel spin without expensive electronics? Magnetic simulation software will be employed to further explore this question.

Erik Kruchten, Aerospace Engineering
Graduation: May 2019
Hometown: Lowell, Wisconsin
Aircraft Performance and Public Policy
Mentor: Timothy Takahashi, professor of practice
Research Theme: Energy, Health, Security, Sustainability
With thousands of commercial aircraft flying each day, better public regulation relating to aircraft performance is necessary. Through the observation of commercial pilots in training and experienced pilots flying, a data set was created that reflects the trends of how student pilots are being trained to fly as well as how experienced pilots are flying post-training. Through analysis of these data sets, the message is extremely clear that better regulation of aircraft dispatch procedures is necessary. Not only should policies be updated to reflect the rapidly changing industry, it should also reflect the desire to create safer skies.

Quoc Lam, Mechanical Engineering Systems
Graduation: May 2018
Hometown: Phoenix, Arizona
Microgravity Reconditioning Using Soft Actuators
Mentor: Panagiotis Polygerinos, assistant professor
Research Theme: Health
The aim of this project is to develop a new method of microgravity reconditioning utilizing soft actuators. Where current methods involve strenuous hours of exercise, a new passive form of reconditioning would be required when space transportation begins accommodating passengers by the hundreds. Therefore, there is a need to reduce the additional Zero-G exercising equipment to decrease payload. Owing to their lightness, soft actuators can be implemented to aid in this requirement by resisting movement, thus simulating gravity as experienced on Earth. Future works shall include adaptability to suit environments of varying gravity fields.

Jack Landry, Aerospace Engineering
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How Does Self-Regulated Learning Present Itself in Hackathons?

Cecilia La Place, Software Engineering
Graduation: May 2018
Hometown: Chandler, Arizona

Mentor: Shawn Jordan, assistant professor
Research Theme: Education

Current education teaches generalized methodologies of learning, and leaves some students struggling to learn new concepts. Students should not keep falling behind because they do not know how to learn. This study sought to observe the ways self-regulated learning (SRL) presents itself in hackathon participants and exploring their perspective on how they thought they learned during the hackathon. After qualitative analysis, it was found that students having motivation in their projects were determined to learn what they needed to complete it. Further research would involve more data collection to get a broader understanding of different approaches to SRL.

Alessandro Laspina, Aerospace Engineering
Graduation: May 2018
Hometown: Rome, Italy

Investigation on Aerodynamic Performance of a Canard Forward Swept Wing Configuration in the Supersonic Regime
Mentor: Benjamin Mertz, lecturer
Research Theme: Energy

The goal of this project is to study the subsonic and supersonic behavior of a forward swept canard wing configuration. Results for subsonic flow of the NACA 0012 wing are unable to be replicated to theoretical values. A better model, K-omega SST, is to be employed to reach such results. This model will be used alongside a more defined mesh to accurately achieve the expected results, to then replicate results for the full forward swept canard configuration in subsonic flow, and then supersonic flow. More efficient simulations will be run with Sbatch scripts.

Michael Lay, Chemical Engineering
Graduation: May 2018
Hometown: Chandler, Arizona

Effect of Hopper Design on Granular Flow
Mentor: Heather Emady, assistant professor
Research Theme: Energy, Health

Hoppers are the main industry instrument used to regulate the flow of solid particles. Unlike fluids, the flow rate of solid materials depend on myriad factors including the shape of the hopper and different friction forces. Large, medium and small particles have been run through four cylindrical hoppers of varying angles. All of the particles discharged most quickly through the 55° hopper, and the largest particles had the slowest overall discharge rates. Trials for smooth and rough particles will be run on the initial four hoppers, a square hopper and four-port hopper to investigate stagnant regions in non-cylindrical hoppers.

Hwee Lee, Computer Systems Engineering
Graduation: May 2019
Hometown: Peoria, Arizona

Mobile Application for Data Retrieval in Point of Care Devices
Mentor: Jennifer Blain Christen, assistant professor
Research Theme: Health

Transparency of health information between health practitioners and patients is crucial for the health of the patient. Due to the prevalence of mobile smartphones, building an application that works in conjunction with a point of care device will allow the end user to have easily accessible information regarding their health. Smartphones are portable and with a point of care device, can provide powerful diagnostics in a shorter period of time. Future work will feature mobile health applications at the forefront in making laboratory testing accessible to low-income areas.
**Richard Li, Biomedical Engineering**  
Graduation: May 2019  
Hometown: Gilbert, Arizona

**Siloxane-Based Nanoparticles to Model Hypoxia**  
Mentor: Vikram Kodibagkar, assistant professor  
Research Theme: Health

The objective of this research project is a continuation of last semester’s work in furthering the understanding of hypoxia in tumors through the usage of cancer spheroids and nanoparticles. As of last semester, nanoparticles were shown to have successful distribution throughout the spheroids. This semester will be focused on combining this method with a well-known hypoxia marker, pimonidazole, in further testing of hypoxia. Furthering the understanding of hypoxia and the means of detecting it would be instrumental in the development of hypoxia-activated prodrugs and treatments.

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**Kevin Liao, Computer Science**  
Graduation: May 2017  
Hometown: Chandler, Arizona

**Toward Inductive Reverse Engineering of Web Applications**  
Mentor: Adam Doupé, assistant professor  
Research Theme: Security

Web application cloning without access to source code (black-box) has many applications, such as for security testing or for mock testing of a third-party web service. The research attempts to tackle this problem using a novel technique called inductive reverse engineering (IRE). The goal of IRE is to automatically reverse engineer an abstraction of a web application’s source code that satisfies a set of input and output pairs to the application. Future work will scale IRE to the size and idioms of more complex, stateful web applications.

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**Taylor Little, Biomedical Engineering**  
Graduation: May 2018  
Hometown: Scottsdale, Arizona

**Utilizing VNS during Stroke to Decrease Infarction and Lesion Size in Brain**  
Mentor: Jeffrey Kleim, associate professor  
Research Theme: Health

The objectives of the study are to use VNS (Vagus Nerve Stimulation) during the onset of stroke to evaluate the infarction in a rat brain, as well as to make a motor map of the brain after the stroke/stimulation procedure. The research goals are still in the process of being completed, however readings have indicated one case of previous success using a similar process. This research is highly valuable as the results may show a procedure to greatly limit the damage caused by strokes. Future work should include the altering of signals for stimulation.

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**Rylie Lodes, Mechanical Engineering**  
Graduation: May 2017  
Hometown: Kansas City, Missouri

**Energetic Passivity in the Human Ankle Joint in Two Degrees of Freedom**  
Mentor: Hyunglae Lee, assistant professor  
Research Theme: Health

The energetic passivity, a key parameter in coupled stability systems, for the human ankle was quantified in two DOF in the time domain. Measurements of the quasi-static behavior of the ankle in 20 healthy adults were obtained using a wearable ankle robot fitted with two uniaxial load cells. Time domain torques and angular velocities for four oscillation frequencies and six neutral axis angles were obtained from the robot and sensor data. The passivity was obtained by integrating the torque and velocity data as a function of time. Existing system models may now be updated for future developments in rehabilitation robotics.
Current lithium-ion batteries contain a liquid component that is prone to leakage and combustion, and there are efforts to replace it with a solid material. One candidate is Li$_7$La$_3$Zr$_2$O$_{12}$ (LLZO), and this project focuses on the synthesis of LLZO nanowires and the effects of processing on their structure and properties. Wires have been successfully synthesized using the electrospinning process, and samples were heated at 700°C in a furnace for different lengths of time. The samples have undergone X-ray diffraction and scanning electron microscopy to determine the structure of the wires, and the density of the pressed pellets has been recorded.

This research is focused on determining the relationship between microstructural constituents and mechanical response of carbon fiber reinforced polymer (CFRP) composite panels. Stiffened panels were fabricated and sectioned for microscopic studies to establish various constituents at the microscale. These studies were carried out under dark, fluorescent and confocal conditions. Subsequently, the mechanical response of these panels will be measured by performing tensile pull-out tests. The microstructure-mechanical response relationship will then be analytically determined. Furthermore, this data will be used to validate physics-based computational models. This will allow establishing an exact relationship between the microstructural variables and mechanical response.

Bipedal robots are inherently unstable and there are many solutions to counter their falling tendencies. This research focuses on the use of Control Moment Gyroscopes (CMG’s) as one of these such solutions. CMG technology has been used in satellites for decades and just recently has started to become used in applications on Earth. For this project, the researcher is designing and building a small two-axis CMG system and testing it on a small bipedal robot. Future work includes scaling the experiment to a full-sized robot.

Technological revolution of field painting has remained stagnant for 10 years. The existing technology lacks accuracy, requires effort and involves health hazards to painters. Using swarm robotic technology with a centralized control can reduce effort of manual labor and increase efficiency and accuracy of the entire process. This is a highly economic solution and thereby can sow the seed for a sporting revolution. This kind of technology can not only be used to revolutionize how field painting is executed, but also can be applied in local parks and recreational facilities. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

ASU KERN Project KEEN supported FURI student
Anthony McCourt, Aerospace Engineering

Graduation: May 2018
Hometown: St. Petersburg, Florida

Mechanical Stress Testing on Galvanically Corroded Aluminum and Titanium Joints

Mentor: Kiran Solanki, assistant professor
Research Theme: Energy, Security, Sustainability

This work models the effects of saltwater and fatigue on carrier-based aircraft structures that are continuously in contact with a structurally hostile environment. A testing rig was designed and built to place a specimen of 7075 Aluminum under a constant load while galvanically coupled with Grade 5 Titanium. By monitoring the corrosion rate periodically, a better life-span model can be generated. Since many aircraft are composed of aluminum with titanium bolts, these models can be used to better track when aircraft parts should be replaced and in development of dissimilar lightweight metal joints with superior corrosion resistance properties.

Megan McGuire, Biomedical Engineering

Graduation: May 2018
Hometown: Tempe, Arizona

Mechanical Artificial Bladder for Pediatrics

Mentor: Jeffrey La Belle, assistant professor
Research Theme: Health

The objective of this experiment is to prove if an artificial bladder model can be built using mechanical methods. An artificial heterologous bladder attaches to autologous ureters, and a removable external pump system transfers urine from the bladder to an external reservoir. Creating an internal artificial bladder could be revolutionary by providing a less invasive bladder with fewer complications to pediatric patients with bladder cancer. In the future, clinical testing could prove its longer lifespan than current bladder replacements on the market. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

ASU KERN Project KEEN supported FURI student

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The objective of the research project is to determine the effects of chemical crosslinking on the separation capabilities and stability of composite polymer/metal-organic framework (MOF) membranes. The main challenge thus far was fabricating quality membranes in which the MOF particles are dispersed throughout the polymer film. The problem was overcome by using a higher concentration of acid in the MOF synthesis procedure. Now that a reliable technique for membrane fabrication has been developed, permeation tests can be performed on the samples. The extension of this work will involve different MOF/polymer combinations for the separation of a variety of chemical mixtures.

Efficient transgene delivery is a prerequisite to genetic manipulation of cells, but extant non-viral transfection methods are stressful and inefficient in human stem cells. In this project, the researchers attempt to determine complimentary chemical reagent gene delivery vehicles for stem cell lines used in the lab. They work with lipid conjugated polymers, or lipopolymers, to transiently express plasmid DNA in a wide range of stem cell lines. Conclusions from this project will determine reagents used to transfect cells in the future and facilitate generation of stable cell lines used to model disease.

This project’s goal is to create a prototype flexible composite propellant tank for spacecraft. Throughout this project many flexible composite samples have been created. The most promising material is a combination of Teflon, silicone and composite fabrics. This sample is flexible and maintains the properties of the composite fabrics. A prototype tank is under construction to determine the fabrication methods and feasibility of a flexible tank. Once the tank is created, its material properties and validity as a pressure tank will be tested.

The current standards for piloting procedures during takeoff and landing of commercial aircraft operating under 14 Code of Federal Regulations (CFR) part 121 are lacking in precise methods due to vague regulations. The evidence found during this research shows a clear lack of compliance in the existing regulations as well. The research shows that this is not necessarily due to poor piloting ability, but rather due to vague procedures in the published aircraft flight manuals. This project aims to improve the safety standards in commercial aviation by adding these much-needed procedures to the existing flight handbooks.
There is variation between hospitals on performance of acute ischemic stroke (AIS) care delivery. Some hospitals do well on door-to-needle (DTN) time for tissue plasminogen activator (tPA) delivery and others have substantial room for improvement. Telestroke programs can connect hospitals with fewer resources to the support that they need to ideally care for AIS patients. The correlation between the duration of a hospital’s participation in the Partners Telestroke Network and patients’ DTN time for tPA delivery was explored to better understand the impact of the Telestroke program.

**Analysis of Predicted Current Density Distribution in TDCS in Multiple Head Models**

Mentor: Rosalind Sadleir, assistant professor
Research Theme: Health

Transcranial direct current stimulation (TDCS) is a noninvasive neuromodulation therapy intended to improve brain functions. The goal of this research was to predict how the current density distribution in the human-derived head models varies in selected cortical structures using finite element simulation. The aim of this project is to investigate how physical attributes across TDCS recipients, such as head circumference and brain structure volume, may affect current density distribution, given that the stimulation is done with the same electrode placements. Results from this study can be used to refine TDCS finite element modeling and inform future TDCS brain targeting study.
Suhyun Nam, Electrical Engineering
Graduation: May 2017
Hometown: Chandler, Arizona

Toward Differentiating between Ischemic and Hemorrhagic Strokes Using Microwave Tomography
Mentor: Junseok Chae, associate professor
Research Theme: Health

The utilization of microwave tomography in a clinical setting to identify strokes creates a portable, low-cost alternative to other imaging modalities such as computerized tomography (CT) and magnetic resonance imaging (MRI). Its portability would allow direct diagnosis by first responder teams and, unlike CT scans, is a form of non-ionizing radiation. Since the imaging setup is an inverse problem, an algorithm is being developed to process data from a microwave tomography system and reconstruct the electrical properties of an unknown object. Future work involves utilizing different methods during processing for a clearer image reconstruction.

Jordan Nelson, Biomedical Engineering
Graduation: May 2017
Hometown: Bullhead City, Arizona

Exploration of Electronic Portfolios as Reflection Tools for Engineering Students
Mentor: Emma Frow, assistant professor
Research Theme: Education

Electronic portfolios (ePortfolios) are common tools used for student reflection and career development. For this project, different approaches to ePortfolio use at different universities were evaluated to develop a template specific to students in ASU’s biomedical engineering (BME) program. The key goal is to promote student reflection on progression toward academic and career goals, particularly as applied to Accreditation Board for Engineering and Technology (ABET) student outcome criteria. The template was piloted with BME students and faculty. Next steps include evaluating this tool for use in first-year courses to promote early engagement in the BME experience.

Amanda Nguyen, Biomedical Engineering
Graduation: May 2018
Hometown: Chandler, Arizona

Three Dimensional Reconstruction of Personalized Polyethylene Vocal Ridges for Regenerative Implantation
Mentor: Vincent Pizziconi, associate professor
Research Theme: Health

In order to further develop personalized three-dimensional vocal fold implants, emerging tools of bioengineering are needed in the medical process. Use of reconstructive software allows for doctors and surgeons to accurately identify specific anatomical areas of concern. Isolating a patient’s vocal fold will allow surgeons to develop a biomaterial process in which surgeons will be able to isolate the vocal fold from a scan, print it as a three-dimensional model, and then precision-mold the biomaterial implant to create patient-specific implantable vocal ridges.

Michael Nguyen, Biomedical Engineering
Graduation: May 2017
Hometown: Saratoga, California

Development of Thermosensitive Antibiotic-Releasing Hydrogels with Improved Shelf Life
Mentor: Brent Vernon, associate professor
Research Theme: Health

The formulation of a novel polymer hydrogel for use in delivering a combination of antibiotics to treat biofilm infections that arise from prosthetic hip implantation surgeries was explored. Work has shown that a formulation consisting of N-isopropylacrylamide (NIPAAm), dimethyl-butyrolactone-acrylamide (DBLAm) and Jeffamine M-1000 (JAam) has many of the desired physical and chemical properties required for sustained drug release, such as low acid content over degradation time and sustained drug release in vitro. Further work must be done to refine the formulation by either altering the weight percents of the co-monomers or through the addition of separate co-monomers.
Examining the hierarchical fibril structural design on gecko feet has resulted in new applications of active and passive switchable adhesives. This project explored replacing existing International Space Station robotic arms used for maintenance with more efficient and versatile arms. They will have the ability to adhere to smooth surfaces in a consistent, pick-and-place manner at extreme temperatures. An experimental chamber was fabricated to test various adhesive designs. Through analyzing different switching mechanisms and fiber designs, the effectiveness of the design and its viability can be determined for space applications. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

ASU KERN Project KEEN supported FURI student

Michael Padilla, Aerospace Engineering
Graduation: May 2017
Hometown: Chicago, Illinois
Investigation of Carbon Nanotube Membrane (Buckypaper) as Crack Arrestor and Damage Sensor for Tubular Structures and Hybrid Materials
Mentor: Masoud Yekani Fard, assistant research professor
Research Theme: Security, Sustainability

This research expands on previous studies on the interlaminar fracture behavior to present design guidelines for damage tolerant structures using both seamless and sheet carbon fiber. The intralaminar fracture toughness and shape factor for seamless braided carbon fiber sleeves is being investigated. The seamless carbon fiber is tested for capacity using compact tension testing to find the stress intensity factor (K1) and the energy release rate (G1). These values are compared with values from the three-point bending loading system to determine the shape factor for the tube-type structures. Carbon nanotube membrane-based sensors are used for damage detection and characterization.
Adam Pak, Chemical Engineering
Graduation: May 2016
Hometown: Wroclaw, Poland

Rupture Characteristics of Elastically Stretchable Microcracked Gold Conductors for Stretchable Microelectrode Array Applications
Mentor: James Abbas, associate professor
Research Theme: Health

Stretchable microelectrode arrays (sMEAs) can be fabricated by depositing microcracked gold electrodes between two layers of poly(dimethylsiloxane) (PDMS). To ensure reliable production of high density sMEAs, the researchers investigated the limits for angles on the leads of the microcracked gold electrodes. The microelectrode pattern was produced by thermal evaporation through a shadow mask, and the mechanical and electrical properties of single non-encapsulated microelectrodes were studied as a function of angle and angle structure. This investigation also examined the shadow effect and characterized defects in the microcracked gold conductors for various sample orientations during the thermal evaporator deposition process.

Marissa Palermo, Mechanical Engineering
Graduation: May 2017
Hometown: Gilbert, Arizona

Mechanical and Material Characterization of 3D Printer Filament Comprised of Recycled Plastic Waste
Mentor: Masoud Yekani Fard, assistant research professor
Research Theme: Energy, Sustainability

This investigation examines the mechanical characteristics at micro and coupon levels of recycled filament spooled from plastic waste and carbon nanotubes (CNT) to be used in 3D printers. Sample groups with varying recycled times and CNT weight percentages have been created to prepare for printing for tensile and fatigue testing. The results of this research can determine a more sustainable alternative to 3D printing that utilizes recycled plastic to achieve similar results in strength to non-recycled materials. Improvements to the material will be investigated to improve the mechanical strength of the recycled filament.

Min Su Park, Chemical Engineering
Graduation: May 2018
Hometown: Gilbert, Arizona

Improving Biochemical Production in Escherichia coli by Nutrient Limitation
Mentor: David Nielsen, associate professor
Research Theme: Energy, Health, Sustainability

The goal of this project is to test various methods of controlling microbial uptake of growth-essential nutrients (e.g., phosphate) to dynamically limit cell growth and improve biochemical production. E. coli is used to produce many useful chemicals, and for this project L-phenylalanine, a widely used precursor in pharmaceuticals, is being used as a model bio-product. By targeting phosphate transporter genes using CRISPRi, CRISPR and a synthetic toggle switch, the uptake of essential phosphate can be limited. When the most efficient method(s) of the chemical production is determined, these method(s) can be applied to other pathways, including biofuel-producing strains.

Samuel Perez, Electrical Engineering
Graduation: May 2018
Hometown: Culiacan, Mexico

Comparison of Ground and Air Tracking Technologies and Algorithms for Ground Robotic Vehicles
Mentor: Armando Rodriguez, professor
Research Theme: Security

The objective of the research was to conduct a comparative study of the technologies and algorithms that effectively track vehicles. Research on tracking systems allows the opportunity for the student to learn control theory through hands-on experiences. In addition, the student also learned new programming techniques to utilize in the implementation of an Arduino microcontroller and Raspberry Pi computer. Research opened the door to a new environment which promotes critical thinking, innovation, and analysis of the real world challenges in the field engineering. In the future, it would be ideal to conduct research on air vehicles.
Maria José Quezada Valladares, Biomedical Engineering
Graduation: May 2017
Hometown: Mexico City, Mexico

Presence of Startle Evoked Movements in Individuated Finger Typing Tasks
Mentor: Claire Honeycutt, assistant professor
Research Theme: Health

Strokes are the main cause of long-term disability in the U.S. according to the National Institute of Neurological Disorders and Strokes. Paralysis in stroke victims includes gripping and finger releasing delays. This research aims to evaluate individuated finger movements using the startle reflex, controlled by the brainstem rather than the cortex. Muscle activity from the extensor digitorum was recorded using electromyography. Susceptibility to startle reactions was determined by comparing movement latencies in voluntary and involuntary movements. Results show all fingers, except the middle finger, are susceptible to startle evoked movements. Future research includes testing stroke survivors to development movement therapies.

Alexis Rainery, Chemical Engineering
Graduation: May 2019
Hometown: Phoenix, Arizona

Cleaning Recycled Si from Crystalline-Si Solar Cells
Mentor: Meng Tao, professor
Research Theme: Energy, Sustainability

Within the next ten years, the solar panel industry will begin to create new amounts of waste. It is imperative that a recycling process be integrated into the industry in the near future. A recently developed solar panel recycling process recovers more than 90 percent of the silicon as well as other materials. Similar chemicals are used in the both the recycling and cleaning process for silicon. This opens the possibility of shortening the cleaning process which would create a less-costly and more time-efficient process for the industry to utilize.

Dominic Podzemny, Mechanical Engineering
Graduation: May 2017
Hometown: Tempe, Arizona

Performance Modeling for a Concentrating Photovoltaic Two-Axis Tracker
Mentor: Agami Reddy, professor
Research Theme: Energy, Sustainability

The effects that angle of acceptance and mechanical control system noise have on the power available to a two-axis solar concentrating photovoltaic (CPV) system were studied. The goal was to provide a model of tracking accuracy with errors for application to any similar two-axis systems. The research was performed using two calibrated irradiance sensors mounted on the plane of the tracking system, normal to the sun. One sensor is held at a constant, normal angle (0 degrees) and varying the other by a known interior angle (0–10 degrees) to study the rapidly decreasing irradiance as the angle becomes more extreme.

Malcolm Regan, Electrical Engineering
Graduation: May 2018
Hometown: Denton, Texas

Improving the Robustness of Object Recognition Networks
Mentor: Yi Ren, assistant professor
Research Theme: Energy

The goal of this research is to identify a general method for improving the robustness of object recognition networks. By generating artificial images that render a given neural network unreliable, this research identifies weaknesses intrinsic to the network, and subsequently tests the effectiveness of strategies for eliminating those weaknesses. With growing applications of neural networks in daily life and in critical decision making (e.g., autonomous driving), this research contributes to a learning framework that produces networks that are more secure, reliable and robust when confronted with noisy or adversarial inputs.
Morgan Reimann, Chemical Engineering

Graduation: May 2017
Hometown: Casper, Wyoming

Development of Visible Light Responsive Double Polyacrylamide-poly(acrylic acid) Network Hydrogels for Tactile Display

Mentor: Lenore Dai, school director and professor
Research Theme: Education

The purpose of this project is to investigate the swelling ratio exhibited due to photothermal effects of double network polyacrylamide-poly(acrylic acid) hydrogels synthesized with carbon black. It is predicted that a carbon black amount of less than 1 percent weight of acrylamide, along with an agitation effect that increases particle dispersion, will produce optimal photothermal effects, because this is expected to produce a homogeneous solution. Further work includes developing a hydrogel screen to be used on LED display devices in order to assist the visually impaired with technology through tactile display.

Gina Rivera, Civil Engineering

Graduation: December 2017
Hometown: Tempe, Arizona

Rheological Evaluation of Asphalt Binder Modified with Conductive Additives

Mentor: Shane Underwood, assistant professor
Research Theme: Energy, Sustainability

Traditionally, asphalt has served one main function: provide a stable and erosion resistant surface for transportation. This research investigates new techniques that could change roadways by embedding conductive fillers and permitting energy applications. Evaluating how the addition of graphite, steel wool and carbon nanotubes can affect the rheological properties of viscosity and shear modulus of asphalt cement will be explored. The search continues for the optimal asphalt mix by ensuring the conductive additive does not negatively affect the rheology of asphalt. A long-term goal of this research is being able to harvest energy and deploy smart sensing technologies on roadways.

Felipe Riveros, Mechanical Engineering

Graduation: May 2017
Hometown: Scottsdale, Arizona

Implementation of a Tank Tread Drivetrain on Pheeno, a Swarm Robotic Platform

Mentor: Spring Berman, assistant professor
Research Theme: Education, Security

The objective of this research is to develop a tank tread drivetrain that can be easily attached to Pheeno, a swarm robotic platform, improving its overall mobility. Three different drivetrain prototypes have been created to optimize mobility and reliability, but none considered the problem of track slippage as the robot maneuvers on a terrain. A local position sensor was created using the PS/2 ADNS2610 optical mouse sensor. Unlike wheel encoders, the position sensor can keep track of the overall distance traveled regardless of track slip. Future research will include downsizing the sensor and carrying out extensive testing of the tracks.

Frederick Rivers, Chemical Engineering

Graduation: May 2018
Hometown: Chandler, Arizona

Computational Modeling of Advanced Hybrid Pervaporation Membrane Processes for Inland Brackish Water Desalination

Mentor: Mary Laura Lind, associate professor
Research Theme: Sustainability

Computational methods were used to analyze a reverse osmosis (RO) pervaporation hybrid process for the treatment of inland brackish water desalination concentrate. Hydranautics and Microsoft Excel were used to accurately model the process. Numerous conditions were tested to assess what process parameters, such as temperature feed and membrane surface area, would yield the best energy efficiency and water recovery. The results of this research have the potential to improve water quality at low energy costs across the globe. Lab-scale experimentation, however, is required to confidently conclude whether this process can be effectively applied to real-world processes.
Adric Rukkila, Computer Science  
Graduation: December 2017  
Hometown: Phoenix, Arizona  
Verification of Digital Forensics of ChromeOS Using Google APIs  
Mentor: Adam Doupé, assistant professor  
Research Theme: Security

Being able to verify the integrity of any information gathered during an investigation is critical for forensic analysis. ChromeOS, an encrypted operating system on a web thin client, presents a unique challenge for verification. Previous research determined extensions on ChromeOS created unique 15-dimensional fingerprints, dubbed "centroids." By comparing information gathered from a ChromeOS installation with information gathered from Google API calls, the researchers were able to verify the centroid information was correct. Such verification methodology is a key building block for current research into ChromeOS and other web thin clients, and the knowledge gathered will aid in future forensic investigations.

Taylor Rumsey, Chemical Engineering  
Graduation: May 2017  
Hometown: Chandler, Arizona  
Optimization of H₂O₂ Producing Electrochemical Cell  
Mentor: César Torres, associate professor  
Research Theme: Sustainability

This project aimed to optimize an H₂O₂ producing electrochemical cell by reducing pH induced hotspots at the cathode. Baseline tests showed that for 200 mM NaCl at a four-hour HRT, the cell produced approximately 1 g/L H₂O₂ at a current density of ~10 A/m². With a Phosphoric Buffer catholyte, the cell produced approximately x g/L H₂O₂ at y current density. Finally, it was shown that recycling the Phosphoric Buffer catholyte at a 100 ml/hr flow rate improved the peroxide production to z g/L H₂O₂ at m current density.

Luis Saenz, Mechanical Engineering  
Graduation: May 2017  
Hometown: Tempe, Arizona  
Soft Robotic Air Bladders  
Mentor: Panagiotis Polygerinos, assistant professor  
Research Theme: Education, Health

The research objective is to further develop the bladders of the soft robotic back orthotic. The development of the bladders includes examining the attachment to the brace, making it more robust, exploring new material and testing new designs. The current design has the bladders fixed to the brace, which is problematic if a failure occurs. The additional tactics will help with the amount and application of support the brace can give. The guiding research goal is to improve the brace to aid those with back injuries in their day-to-day lives.
Jaime Sanchez de la Vega, Aerospace Engineering
Graduation: May 2019
Hometown: San Luis Rio Colorado, Mexico
Flexible Deployable Solar Array for Cubesat Platforms
Mentor: Daniel White, lecturer
Research Theme: Energy

The practicality of the CubeSat small satellite platform has created a desire to implement higher power applications than those feasible with current space solar power technologies. The objective of this research is to determine the best configuration to maximize power generation density for a deployable flexible solar panel array system. The current proposed design utilizes commercially available flexible solar cells laminated along a rigidizing structure and tightly rolled for storage within the spacecraft structure. Further development of a deployment mechanism for the proposed system is recommended.

Steven Sawtelle, Computer Science
Graduation: May 2019
Hometown: Tempe, Arizona
Development of a Swift Wrapper for the National Instruments Virtual Instrument Software Architecture Standard
Mentor: Owen Hildreth, assistant professor
Research Theme: Sustainability

Existing implementations of the National Instruments (NI) Virtual Instrument Software Architecture (VISA) standard in C and Python suffer from usability issues, lack of support for language features such as multithreading and type safety, and a host of other issues. The explosion in popularity of Apple’s open-source programming language Swift presents an opportunity to develop a new open-source standard that is easy to use and grants access to modern built-in language features. The goal of this project is to create a Swift wrapper for the NI VISA standard that effectively utilizes the strengths of this new language. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

Jake Schichtel, Mechanical Engineering
Graduation: May 2018
Hometown: Grandville, Michigan
Electrolytic Recovery of Silver from Disqualified Silicon Solar Cells
Mentor: Meng Tao, professor
Research Theme: Energy, Sustainability

The objective of this research is to further develop the technology necessary to recycle disqualified solar cells by maximizing the efficiency of the dissolution and electrolysis of silver. The dissolution reaction was experimentally determined in 10 percent aqueous nitric acid at 50 °C, allowing for precise calculations of the amount of silver soluble in nitric acid, as well as a reasonable estimation of concentration from pH. Future research will focus on identifying the conditions needed to effectively produce the desired silver deposition morphology. In addition, a more cost-effective anode material will need to be investigated.

Joseph Schimpp, Mechanical Engineering
Graduation: May 2017
Hometown: Tempe, Arizona
Data and Predictive Analytics for Energy Use and Resource Recapture
Mentor: Oswald Chong, associate professor
Research Theme: Energy, Sustainability

The researcher’s job is to analyze data for power consumption of buildings and corresponding generation of solar energy which can be delivered to those buildings. Analysis was done numerically and qualitatively to predict the degree to which solar energy can compensate for peak loads in building consumption to reduce the need for fossil fuel use. Regression of trigonometric curves for consumption patterns throughout the day proved to be a way to predict energy consumption. Functions to show how much energy from fossil fuels should be generated are useful for providing consistency and an accurate model for energy conservation.

ASU KERN Project KEEN supported FURI student
According to the World Health Organization, each year up to 500,000 people globally experience a traumatic spinal cord injury (SCI) resulting in permanent damage or loss of life. This research aims to develop a deeper understanding of SCI, by analyzing the effects of a startling acoustic stimulus in a population with varying degrees of injury. Data collected will be compared against a control group to verify any conclusions reached. Future plans include conducting more trials with both the SCI population and the control group with the eventual aim to publish a scientific paper.

The objective of this research is to optimize the design of a high-velocity gas gun and calibrate the equipment for investigating impact damage in composite plates. This semester of research will focus on exploring ways to increase the projectile velocity using methods such as optimizing the projectile shape and changing the pressurized gas source. Further tests will be conducted using helium as the compressed gas in the place of nitrogen. Telecons will take place on a bi-weekly basis with a technical contact from the NASA Glenn test facility.

The objective of this research is to identify the gaps in research that concern the health of women on military deployment. The framework suggested by this study was created in an effort to analyze all information previously gathered by experts in order to explain why current solutions have continued to fail. This study opens the door to find new applications of technology and procedures to preserve the reproductive and mental health of military women while on deployment. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

Current transradial prosthetic sockets cause high discomfort to patients due to bad fit or pose a health concern due to the unsanitary environment within the socket stemming from lack of air flow. The objective is to develop a novel design that would counter these problems by allowing more ventilation by utilization of porous polymers or perforations on the outer socket. The increased porosity will reduce the temperature within the socket thus reducing moisture accumulation and bacterial growth. This research is part of a larger lightweight transradial prosthesis project: Fishbone.

ASU KERN Project KEEN supported FURI student
Hacktivists (Hacker-Activists) rely on social media to share security vulnerabilities and gather support. This research analyzes a sample of cyber-security and hacktivism related posts crawled from the Twitter website. By extracting features from the feed of identified accounts, the researchers constructed a graph containing the latent structure of the network. The structural diversity of this graph reveals the influence and outreach of some communities and can be used to predict the level of engagement of their members. Future work will extract more relevant topological features and integrate this analysis into cyber-threat intelligence systems.

Energy capture strategies, such as membranes for gas separation, are important developments to help reduce the effects of climate change on the planet. Developing a phase diagram and predictive model to produce highly porous nano-fibers can be used to predict and separate gases through increased surface area. The absorption capacity for these porous nano-fibers is enhanced when using Molecular Organic Framework (MOFs) as they are extremely selective when separating gases. Polyethylene Oxide (PEO) and Polystyrene (PS) are the polymers to be researched. Different loading ratios of PEO:PS have been analyzed; the next steps are to vary the molecular weight ratios.

Origami, the art of paper folding, has been applied to engineering applications. Currently, conventional antennas are bulky and immobile, and any reconfiguring requires complex microelectromechanical systems (MEMS). A more compact antenna would allow for a greater access to communications in all situations. For future work, an antenna will be produced through micro-fabrication with the ability to change its geometry to its own advantage. However, a problem could arise where its compact form may lead to a loss of performance due to the metal trace connections being under too much stress, thus leading to the fracturing of some of these connections.

The metal pushing V-belt is a crucial component inside a Continuously Variable Transmission (CVT). The objective of this research is to develop a method to predict the fatigue life of the V-belt. A 3D model of the V-belt will be simulated to determine the stress and strain of each node under operation. Then, the fatigue life of each node will be analyzed with multi-axial fatigue damage modeling. It will expose the nodes with minimum fatigue life and help engineers improve their designs. Future work will include perfecting the loading conditions of the simulation for better accuracy.
Danny Simonet, Mechanical Engineering
Graduation: May 2018
Hometown: Parsippany, New Jersey
Minimising Tensile Stress of Copper Busbars on High-Efficiency Solar Cells
Mentor: Stuart Bowden, associate research professor
Research Theme: Energy, Sustainability
This project aims to optimise the current density of solar cells and minimise the tensile stress of copper-plated busbars by modifying the copper plating time and speed in relation to the busbars’ thickness. Ten percent of the world’s silver supply is used for photovoltaic research and application, so one solution to reduce the amount of silver usage is to use copper as the metal contacts. However, copper is plated whereas silver is printed, so copper bends upward, causing tensile stress on the silicon wafer. By creating a procedure to reduce tensile stress, copper can become a more viable substitute.

Ryan Shillingburg, Aerospace Engineering
Graduation: May 2018
Hometown: Scottsdale, Arizona
Physical Design of an Electrically Driven Centrifugal Oxidizer Pump
Mentor: Daniel White, lecturer
Research Theme: Energy
The objective of this research project was to finalize a three-dimensional (3D) computer aided design (CAD) of a centrifugal pump designed for nitrous oxidizer hybrid rocket applications, 3D print it, perform water tests and machine it out of aluminum. The CAD for the centrifugal pump was finalized and 3D printed with plastic and is being prepared for water tests. Further exploration has been performed with commercial brushless DC motors and electronic speed control systems as well as sealant strategies to operate the pump as desired. After finalizing the aluminum prototype, the pump can be integrated into high-power hybrid rocket engines.

Gavin Steeber, Chemical Engineering
Graduation: May 2019
Hometown: Tucson, Arizona
Development of Immunofluorescent-based Methods to Characterize Heterogeneity in Early Neural Cells Derived from hiPSCs
Mentor: David Brafman, assistant professor
Research Theme: Health
The objective of this project is to determine if cell fate is regulated by an unsystematic or deterministic process. It has been identified that endogenous WNT signaling is a primary regulator of heterogeneity, which governs stem cells’ differentiation potential. In an effort to obtain more information on cellular heterogeneity, immunofluorescent-based methods will be developed to better characterize the early neural cells that have been derived. Having a strong understanding of the effects of heterogeneity will help the study of human neuronal development and how cell fate is imposed.

Philip Sitterle, Chemical Engineering
Graduation: December 2018
Hometown: San Antonio, Texas
Synthesis of Light-Responsive Hydrogels for Dynamic Tactile Displays Targeting the Visually Impaired
Mentor: Lenore Dai, school director and professor
Research Theme: Education
This project involves the synthesis of hydrogels that respond to light by absorbing or releasing a solvent, resulting in a volume change. The hydrogels use gold nanoparticle additives that convert light into heat, which then triggers a temperature-dependent shift in the hydrogel. This material can be incorporated into a display which renders projected images in a 3D tactile format, especially for use by the visually impaired, with the goal of improving their involvement within STEM disciplines.
Erin Sussex, Biomedical Engineering
Graduation: May 2019
Hometown: Portland, Oregon

Development of a Minimally Invasive Transducer for Use in Photoacoustic Imaging
Mentor: Barbara Smith, assistant professor
Research Theme: Health

This project aims to develop a photoacoustic transducer for use in catheter imaging of the uterus to detect early signs of endometrial cancer. A preliminary design has been determined and constructed based on available information regarding similar transducers that do not meet design criteria for this project. Future research will include further design testing and optimization of the transducer’s design and fabrication. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

ASU KERN Project KEEN supported FURI student

Zachary Ticktin, Biomedical Engineering
Graduation: May 2018
Hometown: San Francisco, California

The Application of Startle Evoked Movements with Facial Muscles Used for Speech
Mentor: Claire Honeycutt, assistant professor
Research Theme: Health

Startle evoked movement (SEM), the involuntary activation of a planned movement using a stimulus, has been evaluated in upper extremity control and enhanced movement following stroke. The goal of this research is to evaluate if speech is susceptible to SEM and gain a better understanding of the limitations of the startle reflex. The long term goal is to use startle evoked movement alongside traditional therapy to enhance speech in stroke or initiation-specific disorders.

Zachary Tronstad, Chemical Engineering
Graduation: May 2019
Hometown: Tucson, Arizona

Tailoring the Hydrophilicity of Electrospun Membranes for Water Filtration
Mentor: Matthew Green, assistant professor
Research Theme: Sustainability

This project examines the effect differing amounts a hydrophilic polymer would have on the selectivity and wettability of an electrospun membrane. Electrospun mats of varying hydrophilicity will be produced via a rotating collector setup and characterized via SEM Imaging. Each membrane will undergo turbidity and water contact angle measurements to determine its selectivity and hydrophilicity, respectively. The data will then be plotted to determine a model relating hydrophilicity, selectivity and polymer concentration. This work will result in more effective pretreatment membranes for reverse osmosis, decreasing the cost of providing fresh water from vast saline reservoirs.

Cody Van Cleve, Engineering (Robotics)
Graduation: May 2017
Hometown: Tucson, Arizona

Design and Development of Intelligent Safety Gear for a Modernizing Transportation Environment
Mentor: Micah Lande, assistant professor
Research Theme: Health

The goal of this research is to form a base of quantitative motorcyclist safety metrics and evaluate the efficacy of existing motorcycle protective equipment in reducing or preventing injury to the rider. From this information base, criteria and constraints were developed for designing intelligent, active rider safety equipment that aims to reduce risk to the rider more effectively than standard, passive safety equipment. Through this research, the prototypes developed will be introduced to the market and potentially patented.
Derek Velzy, Mechanical Engineering
Graduation: May 2018
Hometown: Pleasanton, California
In-Situ Fatigue Crack Growth Investigation for Bridge Steels
Mentor: Yongming Liu, associate professor
Research Theme: Sustainability
Coastal bridges endure immense amounts of loading from traffic and their environment; therefore, the goal of this research is to examine how bridge steel behaves under fatigue cyclic loading using in-situ scanning electron microscopy (SEM). This method of analysis requires self-done pre-cracking and polishing on steel coupons using the ASTM Standard E647-99 procedure. Thus far, the samples have been pre-cracked and polished, so experimental testing will begin soon. The results from the data will be mathematically modeled to relate crack length to the lifespan of the crack. This knowledge has the potential to greatly improve the infrastructure of this country.

Jonathan Wasserman, Computer Science
Graduation: May 2017
Hometown: Scottsdale, Arizona
SCAN: Static and Customizable Analysis for Node.js
Mentor: Adam Doupé, assistant professor
Research Theme: Security
Static analysis tools for applications built in Node.js have been limited in that their path-sensitivity, context-sensitivity, and other settings have been hard-coded by the developer of the tool. While specially configuring these settings before scanning a particular application may lead to finding more vulnerabilities, this option has not been made available. The researchers made use of JSAl, an abstract interpreter for JavaScript that gives sensitivity options for each scan, in order to build a static analysis tool for certain vulnerabilities in Node.js application. Giving application developers this new testing resource will contribute to the security of all Node.js applications.

Juliana Vazquez, Civil Engineering
Graduation: May 2018
Hometown: El Mirage, Arizona
The Plastic Problem
Mentor: Kristen Parrish, assistant professor
Research Theme: Sustainability
The idea behind this research is to understand the small unsustainable actions of people and create a change in their habits. The research can be used by ASU to change their recycling options around campus to fit that of a college student. While this project is only in a local college setting, the researcher would like to see it expand to a civil engineering setting, specifically construction sites.

Sean Wolfgang Wachtel, Engineering (Robotics)
Graduation: December 2017
Hometown: Ramstein, Germany
Design and Characterization of Shoe Embedded Pressure Sensors for Gait Analysis and Rehabilitation
Mentor: Wenlong Zhang, assistant professor
Research Theme: Education, Health
In clinical gait therapy, gait analysis is critical in developing training plans and monitoring patient progress. Ground contact forces (GCFs) are used to quantify a patient’s gait and help in designing and controlling rehabilitative and assistive devices. Current methods exhibit hysteresis and lack durability. As an alternative to FSR, air pressure sensors are used in a pair of sensor-embedded shoes (smart shoes) as presented in previous research. This work presents some improvements to the shoes’ manufacturing process, and results of sensor linearity, hysteresis and repeatability.
Degenerative Disc Disease (DDD) is a spinal condition in which intervertebral discs (IVDs) herniate and lose disc height, thereby inducing lower back pain (LBP). To address limitations in current replacement disc technologies, this research focuses on designing a flexible spine fixation device for the lumbar (lower) spine, which will provide natural range of motion and stability for affected spinal regions. In partnering with Dr. Morgan Giers of Barrow Neurological Institute, medical imaging and CAD design are combined to design a prototype of the fixation device that is structurally and mechanically compatible with natural spine movement and architecture. This research integrates an entrepreneurial mindset by applying curiosity and connections to create extraordinary value for stakeholders.

Motivated by water soluble supports in polymers printing, the goal of this research is to develop a technique that electrochemically dissolves 3D printed metal supports. The addition of a sensitizing agent during a post-print annealing step alters the surface composition and microstructure of the metal, resulting in a chemically unstable interface between the component and supports that is readily etched in a diluted acid solution. This research continues studies of electrochemical, kinetic and printing parameters that influence the etch rate and self-terminating characteristics of the technique. This process is batch capable, allows for complex prints and is easy to implement.
The Fulton Schools Grand Challenge Scholars Program (GCSP) combines innovative curriculum and cutting-edge research experiences into an intellectual fusion that spans academic disciplines and includes entrepreneurial, global and service learning opportunities. The program’s goal is to prepare tomorrow’s engineering leaders to solve the grand challenges facing society during the next century. Through completion of the five components of the program, students will have the opportunity to engage in research relating to their selected grand challenge, explore interdisciplinary coursework, gain an international perspective, engage in entrepreneurship and give back to the community through service learning. Fulton Schools students who complete the program will achieve the distinction of Grand Challenge Scholar, endorsed by ASU and the National Academy of Engineering (NAE), and will be uniquely prepared to collaborate and succeed in a transdisciplinary and global environment.

Grand Challenge Scholars Program students who receive the GCSP Research Stipend are invited to share their research with the community by participating in the FURI Symposium.

Omar Arafa, Chemical Engineering
Graduation: May 2018
Hometown: Chandler, Arizona
Characterizing Diffusion of Hydrogen across Gas Transfer Membranes
Mentor: Bruce Rittmann, Regents’ Professor
Research Theme: Sustainability
Gas transfer membranes are used to separate gases. They have many applications in industries like water purification, pharmaceuticals and energy generation. The goal of this research is to study and optimize the diffusion of gases across composite and fiber membranes. This research focuses on the diffusion rate of hydrogen. The impact of varying pressure was studied. It was determined that the diffusion coefficient of the polymer membranes is larger than composite membranes. Future work consists of studying gases such as syngas and carbon dioxide. A mathematical model describing the observed results will be developed.

Lyle Bliss, Chemical Engineering
Graduation: May 2017
Hometown: Albuquerque, New Mexico
Optimization of Front Contact Design on Nickel Plated Si Solar Cells
Mentor: Stuart Bowden, associate research professor
Research Theme: Energy
The development of solar energy is integral to meeting the world’s energy needs in a clean and renewable manner. However, many problems still hinder the solar industry, such as the declining availability and volatile prices for silver. Research is ongoing to replace silver with cheaper, more abundant metals such as copper and nickel. The poor adhesion of copper/nickel to a silicon substrate, coupled with copper diffusion, make this difficult. Using a combination of modeling software and electrical testing, optimal front contact patterns can be determined for nickel plated silicon cells and implemented in an effort to achieve industry-standard cell efficiencies.
Diana Chen, Computer Science
Graduation: May 2019
Hometown: Darien, Illinois
Impact of the Grand Challenge Scholar Program on Student Development
Mentor: Tirupalavanam Ganesh, assistant dean and associate research professor
Research Theme: Education
This research study's purpose is to investigate how the Grand Challenge Scholars Program develops student understanding of being a globally and socially aware engineer. The conceptual framework for the research uses navigation, identity and accountable disciplinary knowledge as dimensions to identify how GCSP students describe their development as engineers. Researchers analyzed graduate and current student portfolios to label and identify trends between aspects of the program and the three dimensions of becoming an engineer. Next steps include identifying patterns that confirm mechanisms offered by GCSP to support student development. The study has potential to impact efforts to improve engineering education.

Jorge Roldan, Computer Science
Graduation: May 2018
Hometown: Los Angeles, California
Grand Challenge Scholar Program Analysis
Mentor: Tirupalavanam Ganesh, assistant dean and associate research professor
Research Theme: Education
The objective for this research project is to understand how experiences from the Grand Challenge Scholars Program affect student development in raising their global and social awareness. Portfolios from graduates and current students in the GCSP have been carefully reviewed. The conceptual framework for the research uses navigation, identity and disciplinary knowledge as the dimensions to describe how GCSP students develop as Grand Challenge Scholar-Engineers. Several initial trends have been identified, and work will continue toward finding patterns that can help pinpoint key experiences for an engineer's development. This knowledge will aid in better preparing engineers to change the world.

ASU KERN Project KEEN supported FURI student

Ira A. Fulton Schools of Engineering | engineering.asu.edu
Where are they now?

Chase Adams (Mechanical Engineering, Computational Mathematical Sciences '16, FURI Fall '14–Fall '15) is a software engineer at Infor Software Solutions.

Teagan Adamson (Biomedical Engineering '12, FURI Fall '10–Spring '12) is a clinical studies engineer at BIOTRONIK, Inc.

Cameron Adler (Bioengineering '11, FURI Spring '09–Fall '09) is a resident physician at Dignity Health. Cameron is a surgical resident at St. Joseph's Hospital and Medical Center and will be completing a residency in Diagnostic Radiology at the Mayo Clinic.

Eric Alonas (Biomedical Engineering '09, FURI Spring '06–Fall '08) is a business associate at Gartner where he is rolling out machine learning projects.

Anthony Anderson (Chemical Engineering '16, FURI Spring '15) is a graduate student at the University of Wisconsin-Madison. He works for Professor Dumesic and Professor Huber for his doctoral studies.

Cody Anderson (Civil Engineering '11, FURI Spring '09–Spring '11) is an adjunct engineering instructor at Scottsdale Community College.

Enjoy the challenge — being part of FURI stretches you in ways that school by itself won’t. It will prepare you for the ‘real world.’

—Regina Arreola

Regina Arreola (Chemical Engineering '11, FURI Fall '09–Spring '10) is a business consultant at ZS Associates. She works as a management consultant for the pharmaceutical industry.

Joseph Babb (Computer Systems Engineering '13, FURI Spring '12–Spring '13) is a development team lead at Tinker Air Force Base. He leads a team of software engineers within the Department of Defense.

Amy Baldwin (Computer Science '15, FURI Spring '14–Spring '15) is a software engineer at Google, Inc. where she works on the Google Assistant.

Elliott Bartell (Civil Engineering '13, FURI Fall '11–Spring '12) is an employment outreach specialist at St. Joseph the Worker. Elliott works full-time for a non-profit that helps connect homeless and otherwise disadvantaged individuals with employment.

Michael Bartholomew (Computer Science '10, FURI Spring '10) is a software engineer II at Amazon.

Lina Bearat (Civil Engineering '12, FURI Fall '10–Spring '11) is an engineer at Kimley-Horn and Associates. Her role at the company is a transportation engineering consultant.

Shona Becwar (Chemical Engineering '16, FURI Spring '14–Fall '15) is a graduate student at the University of California, Santa Barbara. Shona is pursuing her doctorate in chemical engineering.

Milad Behbahania (Biomedical Engineering '10, FURI Fall '09–Spring '10) is a resident physician of general surgery at Banner University Medical Center in Phoenix, Arizona.

Ryan Bellman (Mechanical Engineering '07, FURI Spring '04–Spring '07) is a research and development design engineer at Mobility Research. He works on rehabilitation product design and development.

Michael Benassi (Aerospace Engineering Fall '15, FURI Fall '14–Spring '15) is a systems engineer at Lockheed Martin.

Nick Berk (Computer Systems Engineering '13, FURI Spring '11–Fall '13) is a program manager at Microsoft.

Daniel Bishop (Bioengineering '09, FURI Spring '06–Fall '08) is a CEO at Qualaris Healthcare Solutions, Inc. in Pittsburgh, Pennsylvania.

Shannon Brown (Biomedical Engineering '15, FURI Fall '13–Spring '14) is a graduate student pursuing a master’s in engineering in human machine interaction.

Kevin Bunish (Materials Science and Engineering '15, FURI Fall '12) is a senior design engineer at Honeywell and finishing a master’s in materials science at ASU.

Marco Carrillo (Electrical Engineering '10, FURI Fall '09–Spring '10) is a senior member of the technical staff at Sandia National Laboratories in Livermore, California. He earned a master’s degree at the University of California, San Diego.

Take time to learn from your mentors. They are some of the best minds in their fields!

—Matt Carroll

Matt Carroll (Mechanical Engineering '13, FURI Spring '11–Fall '12) is a mechanical engineer at Southland Industries in Las Vegas, Nevada.

Priya Challa (Aerospace Engineering, Earth and Space Exploration — Astrophysics '10, FURI Spring '09–Spring '10) is a propulsion development engineer at Blue Origin.

Eric Chang (Mechanical Engineering '15, FURI Spring '12–Spring '15) is a graduate student at Stanford University pursuing his doctorate in mechanical engineering.

Kevin Chen (Electrical Engineering '12, FURI Fall '10–Spring '12) is a graduate student at the University of California, Berkeley pursuing his doctorate in electrical engineering and computer sciences.

Michael Christy (Engineering '16, FURI Fall '15–Spring '16) is a consultant engineer at Tata Consultancy Services.

Joshua Conter (Engineering (Automotive Systems) '15, FURI Fall '14–Spring '15) is an architecture engineer at General Motors. He works in advanced and new products propulsion system modeling and simulation.

Javier Corral Clayton (Chemical Engineering '15, FURI Spring '13–Spring '14) is a manufacturing change architect at Bimbo Bakeries USA. He works as a process improvement engineer.

Joshua Daymude (Computer Science and Mathematics '16, FURI Spring '15) is a doctoral student and research assistant at ASU. Joshua is pursuing a doctorate in computer science.

Angelo Delluomo (Electrical Engineering '16, FURI Spring '16) is an applications engineer at Analog Devices. He works in new hire graduate rotation eventually moving into sales engineering.
Abhishek Dharan (Electrical Engineering '14, FURI Fall '13–Spring '14) is a medical student at the Paul L. Foster School of Medicine at the Texas Tech University Health Sciences Center in El Paso, Texas. Abhishek will be starting medical school in July 2017. Previously he worked at Texas Instruments in their Sales and Marketing Leadership Rotation Program before moving to a startup called CEMOSoft LLC.

Brittany Duong (Biomedical Engineering and Biological Sciences (Genetics, Cell and Developmental Biology) '14, FURI Fall '12–Spring '13) is a medical student at Des Moines University.

Laila El-Ashmawy (Civil and Environmental Engineering '11, FURI Spring '10–Spring '11) is an energy data officer at International Energy Agency where she collects and publishes energy statistics for non-OECD member countries.

Erica Engelschall (Biomedical Engineering '13, FURI '10–13) is a senior engineer in research and development at Stryker.

Amye Farag (Biomedical Engineering and Biochemistry Fall '11, FURI Fall '09–Spring '09) is a resident physician at Phoenix Children's Hospital. Amye is currently a pediatrics resident.

Darcy Frear (Biomedical Engineering '13, FURI Fall '11–Spring '13) is a doctoral student at Harvard University. Darcy is pursuing her doctorate in engineering hearing devices.

Ryan Frost (Mechanical Engineering '16, FURI Fall '14, Spring '15, Spring '16) is a graduate student at Boston University. He is pursuing his doctorate in statistics.

Robert Fruchtmann (Computer Science '12, FURI Fall '11–Spring '12) is a senior software engineer at Reddit in San Francisco, California.

FURI taught me how to deal with failure. Research is tough, but once you make a breakthrough, the feeling is indescribable.

—Michael Garcia

Michael Garcia (Aerospace Engineering '09, FURI Fall '08–'09) is a lead mechanical design engineer at SpaceX, working on the first U.S. private manned spacecraft.

Cameron Gardner (Biomedical Engineering and Finance '15, FURI Fall '13–Spring '15) is a graduate student at the National Institutes of Health. Cameron earned a doctorate in biomedical sciences at the National Institutes of Health and the University of Oxford.

Tyler Gavin (Aerospace Engineering '14, FURI Spring '14) is a senior systems engineer at General Atomics working on drone development.

Alison Gibson (Aerospace Engineering '15, FURI Fall '12–Fall '14) is a National Science Foundation Graduate Research Fellow at Massachusetts Institute of Technology/Draper and a graduate student in the Aeronautics/Astronautics Department at MIT.

Zack Gordon (Chemical Engineering '15, FURI Fall '12–Spring '15) is a process engineer at IM Flash, an Intel and Micron joint venture.

Get involved early in research. It broadens your intellectual perspective, makes what you learn in the classroom more practical and helps you formulate what you want to do with your career path.

—Taylor Graber

Taylor Graber (Biomedical Engineering '13, FURI Fall '12–Spring '13) is a fourth-year medical student. Taylor graduated from medical school at the University of Arizona College of Medicine in Phoenix in May 2013, will be matching to residency in anesthesiology, and will become a medical doctor in May 2017.

Omar Habib (Electrical Engineering '10, FURI Fall '09–Spring '10) is a design engineer at Apple Inc. working on high-end latest technology product design. He is also pursuing his doctorate in electrical engineering part time at ASU.

Tina Hendricks (Hakimi) (Biomedical Engineering '12, FURI Spring '09–Spring '12) is a medical student pursuing her MD at the Mayo Clinic College of Medicine and is the entrepreneur-founder of For Good & Glory.

Alexandra Hoffmann (Biomedical Engineering '16, FURI Spring '16) is pursuing her master’s in biomedical engineering at ASU while she works part-time for Scottsdale engineering services consultant company LaunchPoint Energy & Power, LLC (LEAP).

Mikayle Holm (Biomedical Engineering '16, FURI Spring '16) is a graduate student pursuing a doctorate in Biomedical Engineering at the University of Minnesota in a Cardiac Physiological research group.

Seize every opportunity that comes at you. You won’t be surrounded by an environment that has as many opportunities again.

—Carly Hom

Carly Hom (Biomedical Engineering '13, FURI Spring '12–Spring '13) is a senior advanced quality engineer at Stryker Endoscopy in San Jose, California. She is working in new product development for minimally invasive surgical products.
Hyder Hussain (Biomedical Engineering '14, FURI Summer '13–Fall '13) is a graduate student pursuing his master’s in bioengineering at Stanford University.

James Hutchins (Computer Science '17, FURI Fall '16) is an undergraduate student pursuing his bachelor’s in computer science at ASU.

Katherine Irimata (Cai) (Chemical Engineering '13, FURI Spring '10–Fall '12) is a graduate student at ASU pursuing a doctorate in statistics.

Shinya Ishizaki (Industrial and Organizational Psychology '15, FURI Spring '15) is a consultant at Intelligee Business Solutions in Japan.

Ashley Jaeger (Biomedical Engineering '11, FURI Spring '09–Spring '11) is a medical student in the U.S. Air Force Health Professions Scholarship Program (HPSP). Ashley will graduate from Georgetown University School of Medicine in May 2017 before pursuing her residency in obstetrics and gynecology.

James Jensen (Aerospace Engineering '14, FURI Fall '13–Spring '14) is a research engineer at the NASA Ames Research Center in Mountain View, California.

Ben Jimenez (Aerospace Engineering '10, FURI Spring '07–Spring '09) is a CFD engineer analyst at Whirlpool Corporation working in computational fluid dynamics.

Paul Juneau (Biomedical Engineering '14, FURI Spring '13) is a software engineer at G/O Digital developing software to deliver business process solutions.

Amy Kaczmarowski (Aerospace Engineering '12, FURI Fall '11–Spring '12) is a researcher at Sandia National Laboratories.

Morgan Kelley (Chemical Engineering '16, FURI Summer '13–Spring '15) is a graduate student at UT Austin under adviser Michael Baldea. Morgan is pursuing her doctorate in process control/process systems engineering.

Haroon Khan (Computer Engineering '13, FURI '10–'11) is a software engineer at InEight.

Alexander Kim (Mechanical Engineering '16, FURI Fall '16) is a research technician at the University of Arizona in the Otolaryngology Lab.

Julia King (Chemical Engineering '16, FURI Spring '15–Fall '15) is a graduate research assistant at the University of Washington, Seattle. Julia is pursuing a doctorate in chemical engineering.

Nathan Kirkpatrick (Biomedical Engineering and English Literature '11, FURI Fall '15–Spring '16) is a graduate student at Georgia Institute of Technology and Emory University. Nathan is pursuing his doctorate in biomedical engineering.

John Kondziolka (Civil (Environmental) Engineering '12, FURI Fall '10–Spring '12) is an environmental engineer at Gradient.

Kevin La Rosa (Electrical Engineering '12, FURI Spring '10–Spring '12) is an applications engineer at Texas Instruments.

Andrea Ladner (Keck) (Mechanical Engineering '07, FURI Fall '07–Spring '07) is a process engineer at Intel.

Arad Lajevardi-Khosh (Electrical Engineering '13, FURI Fall '10–Spring '12) is a graduate student at the University of Utah pursuing a doctorate.

FURI was my first experience with real academic research and it inspired me to pursue my Ph.D. I would not be where I am today without the FURI experience!

—David Latshaw II

David Latshaw II (Chemical Engineering '09, FURI Fall '08–Spring '09) is a scientist at Janssen Pharmaceuticals (Johnson & Johnson). David received his doctorate in chemical engineering in 2014 and is now responsible for modeling and process optimization in the Large Molecule Platform and Janssen Pharmaceuticals for Johnson & Johnson.

Jennifer Lehrman (Biomedical Engineering '11, FURI Fall '09–Spring '11) is a research engineer at Dignity Health Barrow Neurological Institute.

Wenyang Li (Computer Systems Engineering '12, FURI '12) is a program manager at Microsoft working on Microsoft Azure.

Tyler Libey (Bioengineering '11, FURI Fall '09–Spring '11) is a CTO/co-founder at MultiModal Health, a health tech startup in Seattle, Washington.

Start doing research early on so that you can discover what areas interest you the most. This will help guide your search for internships and, ultimately, full-time employment!

—Mikaela Links (Stadie)

Mikaela Links (Stadie) (Chemical Engineering '15, FURI Fall '12–Spring '15) is a quality engineer at W.L. Gore & Associates.

FURI gave me an opportunity that I thought would only be for graduate students.

—Ross Maniaci

Ross Maniaci (Geography with Geographic Information Systems Certificate '09, FURI Spring '07) is a senior mobile software developer of iOS at Tel Companies, Inc.

Chelsea Mann (Civil Engineering '13, FURI Fall '13) is an estimator at Structure Tone, a construction firm in Boston, Massachusetts.

Joy Marsalla (Civil and Environmental Engineering '11, FURI Fall '08) is a senior environmental engineer at Intel.

John McCrea (Aerospace Engineering (Astronautics) '16, FURI Spring '15–Fall '16) is an Air Force officer and graduate student pursuing a dual master’s degree in engineering management and systems engineering at the Air Force Institute of Technology.

Kevin McMillin (Computer Science '11, FURI Fall '09) is a computer scientist at the NASA Ames Research Center where he designs mission assurance software.

Soroush Mirtalaei (Bioengineering '07, FURI Fall '05–Spring '06) is a principal quality engineer at Baxter International Inc. in Irvine, California.

Walker Mitchell (Electrical Engineering '15, FURI Fall '12–Spring '13) is an applications engineer at ON Semiconductor.

Kirk Morales (Computer Science '08, FURI Spring '08–Fall '08) is founder and CEO at Hyver in Phoenix, Arizona.

Jeff Morgan (Computer Science '14, FURI '13–’14) is a software engineer at General Motors.

Christian Murphy (Software Engineering '15, FURI '14–’15) is a software engineer at Unicon Inc.

Elizabeth Nofen (Walker) (Chemical Engineering '12, Summer '10–Spring '11) is a senior materials engineer at Intel Corporation. She graduated with her doctorate in chemical engineering from ASU in May 2016.

Gabe Oland (Biomedical Engineering '13, FURI Fall '10–Spring '12) is a medical student finishing medical school at the Medical College of Wisconsin.

Andrew Payne (Chemical Engineering '10, FURI '08–09) is a graduate student at Brigham Young University pursuing a doctorate in neuroscience.
Elisabeth Perea (McLaughlin) (Chemical Engineering ’12, FURI Fall ’09–Fall ’11) is a chemical engineer at SRI International.

Shih Ling Phuong (Mechanical Engineering ‘14, FURI Fall ’13–Spring ’14) is a graduate student at the University of Pennsylvania pursuing her doctorate in electrical and systems engineering.

Guy Pickett (Mechanical Engineering ’12, FURI Summer ’10–Fall ’11) is a development engineer at Mission Solar Energy.

Tiffany Pifher (Biomedical Engineering ’15, FURI Spring ’13) is an operations quality engineer at Medtronic Neurovascular.

Elizabeth Quigley (Materials Science and Engineering ’16, FURI Fall ’15–Spring ’16) is a graduate student at the Georgia Institute of Technology. She is pursuing a doctorate in materials science and engineering under Vladimir Tsukruk.

Tim Reblitz (Electrical Engineering ’12, FURI Summer ’11–Spring ’12) is an application engineer at Applied Materials in the Automation Products Group in Santa Clara, California.

Jose Rios (Bioengineering ’10, FURI Fall ’09–Spring ’10) is a formulation scientist at Agios. He received his doctorate from Cornell University and is now a formulation scientist for pharmaceuticals.

J.J. Robertson (Computer Science and Electrical Engineering ’16, FURI Fall ’15–Spring ’16) is a software engineer at Snap, Inc. writing software for Snapchat’s research and hardware division, Snaplab.

Whether the research goes according to plan or there are a few bumps along the way, all of the time spent in FURI is a valuable experience.

—Tiffany Pifher

I had the opportunity to learn from a great mentor who believed in my potential and to immerse myself in the vast opportunities that ASU has to offer, directly influencing my current success as a professional.

—Mariela Robledo

Mariela Robledo (Chemical Engineering ’13, FURI Summer ’11–Spring ’13) is a manufacturing team leader at General Mills for the Bars department at the General Mills Albuquerque plant.

Julie Rorrer (Chemical Engineering ’14, FURI Spring ’12–Spring ’14) is a graduate student at the University of California, Berkeley pursuing her doctorate in chemical engineering.

Karime Jocelyn Rosas Gomez (Chemical Engineering ’16, FURI Spring ’16) is a graduate student at ASU pursuing her master’s in biomedical engineering.

Francesco Ruta (Physics, Civil Engineering ’15, FURI Spring ’12–Spring ’15) is a graduate student at Stanford University studying materials science.

Matthew Sawtelle (Chemical Engineering ’12, FURI Spring ’11–Fall ’12) is a chemist at Reckitt Benckiser.

Jessica Schiltz (Biomedical Engineering ’15, FURI Fall ’12, Fall ’14, Spring ’14) is a graduate student at the University of Notre Dame pursuing a doctorate in orthopedic materials for additive manufacturing.

Sarah Sharer (Bioengineering ’06, FURI Spring ’05–Spring ’06) is an obstetrician and gynecologist at Dignity Health St. Joseph’s Hospital and Medical Center in Phoenix, Arizona.

Tim Silverman (Mechanical Engineering ’05, participated in FURI before it was called FURI) is a staff scientist at National Renewable Energy Laboratory. He completed his doctorate in mechanical engineering in 2010 and is now studying photovoltaics at the National Renewable Energy Laboratory.

Anne Silverman (Ranes) (Mechanical Engineering ’05, FURI Fall ’04–Spring ’05) is an assistant professor at Colorado School of Mines. She is a tenure-track faculty member in mechanical engineering with a research focus in biomechanics.

Joana Sipe (Chemical Engineering ’16, FURI Spring ’15–Fall ’16) is a doctoral student at Duke University pursuing her doctorate in environmental engineering.

Lorenzo Slay (Chemical Engineering ’13, FURI Fall ’10–Spring ’12) is an engineer II at Arizona Public Service. Lorenzo is an digital modifications engineer at Palo Verde Nuclear Generating Station.

If you don’t like your first project, try something else. Never stop trying to find what you like.

—Victoria Smith

Victoria Smith (Biomedical Engineering ’16, FURI Fall ’15–Spring ’16) is an assistant professor at Colorado School of Mines. She is a tenure-track faculty member in mechanical engineering with a research focus in biomechanics.

Gregory Spell (Electrical Engineering ’16, FURI Spring ’14–Spring ’15) is a graduate student at Duke University pursuing a doctorate in machine learning.

Robert Srinivasiah (Computer Science ’07, FURI Fall ’04–Spring ’07) is a senior virtual reality graphics engineer at Unity Technologies.

Ryan Sullivan (Biomedical Engineering ’16, FURI Summer ’15–Fall ’15) is a performance analyst at Banner Health working on clinical performance improvement.

Ben Teplitzky (Biomedical Engineering ’11, FURI ’08–’09) is a data scientist at Preventice. He finished his doctorate this year and is now working for Preventice.

Start early, get involved and pick a topic that you are excited about!

—Carly Thalman

Carly Thalman (Engineering (Robotics) ’16, FURI Summer ’16–Fall ’16) is a graduate student at ASU and Raytheon. Carly is beginning graduate studies in systems engineering while working as a project test engineer intern with Raytheon Missile Systems.
Create something through FURI that you will be proud of after the program is complete.

—Claire Tilton

Claire Tilton (Civil Engineering ’15, FURI Summer ’13–Spring ’15) is a field engineer at Chicago Bridge & Iron. Claire works at Vogtle Electric Generating Plant Units 3 and 4, the first nuclear power plant built in the U.S. in more than 30 years.

Adam Tse (Computer Science ’16, FURI Fall ’14–Spring ’16) is a graduate student at CERT Software Engineering Institute pursuing a master’s in information security at Carnegie Mellon University, Pittsburgh.

Aimen Vanood (Biomedical Engineering ’16, FURI Spring ’15–Fall ’15) is a product designer at Picmonic. Aimen will start medical school at Oakland University William Beaumont School of Medicine in Fall 2017.

Aman Verma (Biomedical Engineering ’10, FURI Spring ’09–Fall ’09) is a resident physician postgraduate year two at the University of Minnesota. Aman is completing an internal medicine residency.

Anthony Volpe (Electrical Engineering ’08, FURI Spring ’07–Fall ’08) is a team lead and quality assurance engineer at Volkswagen Group of America’s Electronics Research Lab. He works in quality assurance engineering for Audi infotainment systems. Starting in Fall 2017 he will be attending law school.

Alex Weir (Chemical Engineering ’09, FURI Fall ’07) is a plant manager at the Olin Chlor Alkali Products manufacturing site in Henderson, Nevada.

Shawn White (Mechanical Engineering ’17, FURI Spring ’15–Fall ’16) is a graduate student studying mechanical engineering at ASU and an intern at Stara Technologies.

Daniel Wilson (Mechanical Engineering ’14, FURI Spring ’14–Fall ’14) is an operations analyst at Goldman Sachs.

Reed Wittman (Materials Science and Engineering ’13, FURI Fall ’12–Spring ’13) is a Bredesen Fellow graduate researcher at Bredesen Center, University of Tennessee, Knoxville and a doctoral student in energy science and engineering.

Chuan Xu (Industrial Engineering ’12, FURI Fall ’11–Spring ’12) is a supply chain manager at Thermo Fisher Scientific.

Shengjie Zhu (Engineering (Robotics) ’16, FURI Fall ’15–Spring ’16) is a business development manager at Titanium Falcon helping the company to develop business and design electrical circuits.
What does it mean to bring an entrepreneurially minded approach to research?

In a dynamic and interconnected world, it is critical for the Fulton Schools to teach a technical skillset along with an entrepreneurial mindset that fosters curiosity, connections and the creation of value (3Cs).

ASU has long been a leader in entrepreneurially minded learning, with a range of programs, resources and classes to empower students. Programs such as FURI teach students how to apply entrepreneurial thinking to a given career or field, leading to innovative solutions that create extraordinary value.

When research is approached with an entrepreneurial mindset, students use their curiosity as the impetus for determining their area of investigation. They synthesize information from multiple sources as well as the discoveries made in their work to develop a deep understanding of all stakeholders involved. Researchers anticipate societal and economic trends to provide valuable solutions for new or improved business opportunities.

KEEN proudly supports the Fulton Undergraduate Research Initiative and the program’s efforts to instill curiosity, connections, and the creation of value into research projects.

Learn more about KEEN and the 3Cs at engineeringunleashed.com.
Financial support for the FURI program is made possible by Ira A. Fulton.

Special thanks to all of the mentors, family and friends for supporting our students through this program.

We appreciate the efforts of all who helped make this program a success, especially:

Jean Andino
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Usha Jagannathan
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Peggy Kilgore
Stephen Krause
Cortney Loui
Jenna Marturano
Abdel Mayyas
JoAnne McDemand
Kelley McManus
Barbara Minich
Cynthia Moayedpardazi
Bin Mu

Beverly Naig
Jay Oswald
Yulia Peet
Shannon Pete
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Shaunna Price
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Cheryl Roberts
Benjamin Ruddell
Arthur Sainz
Shevonda Shields
Barbara Smith
Angela Sodemman
Tomi St John
Alicia Stiers
Sefaattin Tongay
César Torres
Shane Underwood
Brent Vernon
Gary Waissi
Qing Hua Wang
The Fulton Undergraduate Research Initiative (FURI) enhances and enriches a student’s engineering and technical education by providing hands-on lab experience, independent and thesis-based research and travel to national conferences. This signature program at the Fulton Schools, founded by Ira A. Fulton and his investment in our Schools, attracts and enables some of the brightest students from across the country and around the world and challenges them to sharpen their skills.

The skill set and mindset learned in FURI do not just stop in the lab or at ASU. FURI opens doors for scholarships, internships, jobs and research at high-level institutions down the road. We are proud of our students accomplishments both here at ASU and in their work after their FURI experience.

This year we are proud to celebrate the accomplishments of our young alumni by establishing the FURI Young Alumni Award.

Taylor Brownlee Wiehn

We are honored to award Taylor Brownlee Wiehn as the inaugural recipient of the FURI Young Alumni Award. In addition to FURI, Taylor participated in the Accelerated 4+1 program and graduated in 2012 with a bachelor’s degree and an impressive 4.0 GPA. She then completed her master’s degree in chemical engineering in 2013. Taylor is currently a process engineer at W.L. Gore and Associates.
Fueling Innovation
Building Engineers
At Arizona State University, we've been educating engineers for Arizona and the world for nearly 60 years. With more than 20,000 students, we are building the engineers of the future and pursuing the discoveries and solutions to challenges facing society.

In 2003, Ira A. Fulton, founder and CEO of Arizona-based Fulton Homes, established an endowment of $50 million in support of ASU's College of Engineering and Applied Sciences.

His investment served as a catalyst, enabling the development of a dynamic portfolio of strategic initiatives that benefit our students and faculty and the communities where they live and work.

Throughout the years, Ira A. Fulton has remained an active supporter of the school that bears his name. He is a familiar face to students and a regular presence at events such as this semiannual FURI Symposium.

“I strongly believe you cannot have a great city without a great school of engineering.”

Ira A. Fulton