
April 22, 2016

We are delighted to welcome you to the Spring 2016 FURI Symposium.

The Fulton Undergraduate Research Initiative gives students the chance to find their calling in research through hands-on lab experience, faculty mentoring and travel to academic conferences early on in their academic careers.

Programs like FURI draw some of the brightest students from across the U.S. and the world to work with our renowned faculty in world-class facilities. The important and exciting research conducted by our students helps address real-world challenges.

Students in FURI bring strong academic preparation, the ability to work independently, and creative approaches to problem solving to the FURI program. They leave with confidence in their problem-solving skills, an enhanced sense of discovery and the proven ability to do research — often at a level indistinguishable from graduate-level work. They also learn what it is like to be part of a research team and see firsthand the importance of their contributions to a team working on big problems.

We are proud of our students who are presenting today and grateful for everyone who helps make this program possible and successful. Congratulations to all and we look forward to your continued success.

Sincerely,

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

Amy Sever
Associate Director
Undergraduate 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.

Jeremy Adams
Framarz Alam
Taciana Albuquerque
Lekha Anantuni
Barrett Anderies
Hany Araf
Angel Armenta
Michael Armstrong
Galen Arnold**
Zeynep Ayla
Christopher Balzer
Raymond Barakat
Esteban Barboza
Vanessa Barker
Eric Barrientos
Brandon Bartels
Ryan Bath
Mark Blei
Lyle Bliss
Ashley Brendel
Alexander Bridge
Kyle Burgard
Joseph Burggraaff**
Kaleigh Campbell

Emma Card
Caleb Carlson**
Edgar Castillo
Kregg Castillo
Cesar Castro
David Cayll
Ricki Ceton
Brian Chang
Michael Christy
Benjamin Clayton
Emily Close
Dominick Cociola
Jerry Crum
Avi Dasgupta
Angelo Delluomo
Nicholas Dhuyvetter
Matthew Dickens
Andrew Dopiika
Brandon Dorr
Logan Drda
Daniel D’Souza
Courtney DuBois
Jonathan Edgington
Jasmine Eghbal
Steven Elliott
Gamil Eltahomy
Kiah Engebretson
Nicole Esquivel
Jose Eusebio
Blaine Faber**
Kathleen Farrell
Erin Federspiel
Joseph Figueroa
Ryan Fisher
Alicia Flores
Linda Fou
Rolando Garcia
Saumya Gupta
Theodore Hall
Hannah Hansen
Carolyn Harvey
Tatem Hedgepeth
Bailey Herbstreit
Kendall Hickie
Peter Hillebrand
Alex Hoffmann
Taylor Hoffmann
Mikayle Holm**
Denton Holzer
Ian Horvath**
Ryan Hunter
Shota Ichikawa
Kody Ioia
Adrian Ion
Jonathan Isaiaiah**
Matthew Jackson
Hope Jehng*
Chennging Jiang
Adam Johnson
Kaleigh Johnson
Joslin Jose
Zachary Josephson**
Sagarika Kadambi
Andrew Karnes
Ajay Karpur
Allan Kawanarzua
Nicholas Kemme
Nathan Kirkpatrick
Troy Koizowski
Ryan Kritz**
Theodore Kyriacou
Luke Lammers
Alec Laws
Robert Leader
Gideon Lee
Madeline Lent
Portia Letham
Rubin Linder
Ben Liu
Jialiang Liu
Ryan Madler
Alicia Magann
Aldin Malkoc**
Alex Maltagliati*
Cameron McAllister
Jason Mende
Becca Mercer
Sam Mokdad
Aaron Molina
Nathan Moore
Matthew Mortensen
Bakir Mousa
Gergey Mousa
Mohammad Mousa
Akhila Murella*
Anoosha Murella**
Suhyun Nam
Joey Nguyen**
Ky Nguyen
Thanh Nguyen**
Alexander Niebroi
Weston Olson
Joshua Oremland
Kai Ozawa
Adam Pak**
Andrew Park
Jacob Peplinski
Erik Person**
Joseph Pezzi
David Phelps
Maria Jose Quezada Valladares
Elizabeth Quigley**
Abhishek Rajadas**
Samarth Rawal
Carlos Renteria
Edward Reyes
David Reynolds
Erin Riley
John Robertson**
Nathan Rodkey
Felicia Romero**
Karime Jocelyn Rosas Gomez
Adric Rukkila
Kari Sanford**
Frederick Sebastian*
Gizelle Setovich
Ankush Sharma**
Louis Ship
Ema Shqalsi
Adam Siegel
Dallas Sigrist
Bryan Smith
Katerina Soltero**
Joshua Stevens
Swetha Swaminathan
Hannah Switzer
Gamuchirai Tavaziva
Melby Thelakkaden**
Emily Thompson
Julia Thompson
Joseph Thweatt
Robert Tichy*
John Tobey
Tanguy Toulouse
Zachary Tronstad*
Alexa Vito
Edward Votroubek
SeanWolfgang Wachtel
Zixuan Wang**
Jacob Ward**
Alexander Tenderlich
Shawn White
Noah Wilson**
Avery Witting
John Woodward
Jiaqi Wu**
Jimmy Xu
Jason Yang**
Shengjie Zhu
Kari Sanford**

* Grand Challenge Scholars Program
** Undergraduate Research Travel Grant Program
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Improving Expression Levels of Therapeutic Antigen-Binding Fragments in E. coli

Mentor: Brent Nannenga, assistant professor
Research Theme: Health

Antigen-binding fragments (Fab), the functional regions of antibodies, have been suggested as potential therapeutics for neurodegenerative diseases. However, they may be difficult to express. This project attempts to optimize the expression levels of Fabs in E. coli by testing three different variables that may affect it: expression vector, signal sequence, and the presence of the molecular chaperone trigger factor (TF) in the cell. This project predicts that a significant increase in functional protein expression compared to common systems may be obtained using the pBLN200 expression vector with the co-translational DsbA signal sequence in E. coli that does not produce TF.

Developing an Affordable and Portable Ultrasound Device for Use in the Urbanizing Developing World

Mentor: Barbara Smith, assistant professor
Research Theme: Health

This project seeks to create an ultrasound device built for monitoring cardiovascular health that is both portable and cost-efficient. It will address the concern that the rapid industrialization of developing countries may lead to the adoption of lifestyles responsible for the rise in cardiovascular disease seen in the developed world. The current aim of this research is to build a circuited interface between which ultrasound signals from a transducer may be sent to a computer for processing and analysis. Future work will include building a functional transducer and a mobile app to improve the accessibility and portability of the device.

Solar Powered Energy for Electrodialysis Desalination (SPEED)

Mentor: Patrick Phelan, professor
Research Theme: Energy

Electrodialysis desalination is a cost-effective and sustainable way to desalinate brine water, especially under 4,000 ppm and using only direct current power supply, however the greatest limitation is the efficiency of the photovoltaic cells themselves. By redesigning the system in order to redirect some of the product water over the PV cells, it will provide optimum performing conditions and possibly provide more water for minimum cost. Future work to be done is to see the long-time effects that this would have on the PV cells and see how the system can be adjusted to different parameters, such as continuous flow or incorporating a pump.

Smartphone-Interfaced Haptic Thoracic Harness for the Detection and Alleviation of Freezing of Gait in Individuals with Parkinson’s Disease

Mentor: Troy McDaniel, assistant research professor
Research Theme: Health

Parkinson’s disease is a neurodegenerative disorder in the central nervous system that affects daily activities. In Stage 3 of Parkinson’s, afflicted individuals begin to develop an abnormal gait pattern known as freezing of gait (FoG). This is characterized by decreased step length, shuffling and eventually complete loss of movement. This device will detect abnormalities in gait patterns and posture using the Inertial Measurement Unit (IMU) in an iPhone and will help the patient overcome an episode using multimodal feedback mechanisms. It will be tested for reliability by simulating Parkinsonian gait and comparing data to a 3D motion analysis system.
Waveform Train Decomposition and Quantitative Analysis of ECoG Data for Rapid Screening and Identification of Electrographic Features in Epileptic Patients

Mentor: Bradley Greger, associate professor
Research Theme: Health

Epilepsy is a debilitating condition that affects children, adolescents and adults. Clinical treatment is informed by the type of epilepsy, which is determined by clinical analysis of electrocorticography (ECoG) data acquired from patients. This project aims to create an automatic epilepsy characterization tool to aid physicians during diagnosis. A novel, data-driven feature extraction algorithm is used to decompose ECoG channels into recurring waveforms for further analysis. Initial results show that the algorithm sorts recurring waveforms effectively, but is sensitive to parameter choice and noisy channels. Further modification of the error minimization method is expected to significantly improve waveform accuracy.

A Novel Implementation of Ion Sensitive Field Effect Transistors (ISFETs) for Protein Detection Via Protein Complex Immunoprecipitation

Mentor: Jennifer Blain Christen, assistant professor
Research Theme: Health

A novel implementation of ion sensitive field effect transistors (ISFETs) for protein detection via protein complex immunoprecipitation was explored. The first objective of the study concerned the development of extended gate quartz ISFETs and the overall optimization of biosensors for maximum output. ISFETs with different surface chemistries were characterized and various geometries and pad patterns were tested as well. The second part of the study concerned the refinement of the biochemical process for the detection of an ion gradient. Combining the electrochemical and biochemical aspects of the biosensor will allow for the creation of a robust point of care device.

Desalination as a Solution to the Grand Challenge of Providing Access to Clean Water

Mentor: Tirupalavanam Ganesh, assistant dean of Engineering Education, associate research professor
Research Theme: Sustainability

The goal of this project is to develop a method for the use of concentrated solar power in desalinating seawater. The concentrated solar power system was designed to be completely renewable, to require low frequency and complexity of maintenance, and to provide a sustainable supply of drinking water. This device uses the process of distillation to remove salt from water and make it drinkable for people in underdeveloped regions. Quantitative data were collected to assess the device’s effectiveness in desalinating water. Alternative design components and improvements necessary to the heating process in the desalination system are offered.

Labor Efficiency of Pre-Fabrication Methods in Construction

Mentor: David Grau, assistant professor
Research Theme: Sustainability

Pre-fabrication methods have been shown to increase labor efficiency in industrial production, particularly in the shipbuilding industry. The purpose of this research is to quantify the effects of prefabrication on the efficiency of construction. For this purpose, observations were taken of an active construction site that utilized pre-fabrication methods. These observations were analyzed using activity analysis methods, an industry standard for efficiency. The collected data is currently in the final stages of analysis. Cursory comparisons to industry norms suggest no divergence.
Non-Contact Micropipette Tip Locator for an Electrohydrodynamic Printer

Mentor: Owen Hildreth, assistant professor
Research Theme: Energy

Nano-inkjet printing is an exacting process that requires precise and accurate position control across all aspects of the system. One key component, the inkjet nozzle, must be maintained within 3 to 5 µm of the substrate during the entire printing process. This requires knowing the position of the nozzle to within 0.5 µm. Current methods of establishing the position of the nozzle relative to the substrate risk damaging the nozzle and are time consuming. This project sought to develop a non-contact tip locating method that is faster than current methods and minimizes the risk.

Undergraduate Research Travel Grant Program

Exploring Amino Acid Cross Feeding Strategies in Support of Stable Co-culture Growth

Mentor: David Nielsen, associate professor
Research Theme: Sustainability

The purpose of this project is to analyze amino acid cross-feeding strategies that promote stable co-culture growth of different bacterial pairings. Several E. coli knockout pairings have been considered for co-culture growth. Two knockout strains (phenylalanine and methionine) have been proven to grow together and will be tested with other strains to compare growth patterns. The next step is measuring the growth ratio of a co-culture with blue and white selection and improving and ensuring varying ratios by adjusting initial growth conditions. Future research goals will focus on the cross feeding of multiple amino acids between multiple knockout strains.

Sonofragmentation of Metal-Organic Frameworks

Mentor: Bin Mu, assistant professor
Research Theme: Health

The objective of this research is to study the kinetics of sonofragmentation of several metal-organic frameworks: HKUST-1, UiO-66 and ZIF-8. Sonofragmentation describes the breakage of particles due to shock waves from collapsing cavitation bubbles. Solvothermal-synthesized metal-organic frameworks were sonicated at different concentrations and particle size was analyzed by scanning electron microscopy (SEM). Results indicate concentration independence and rate dependence on the Young’s modulus of the material. Future work includes implementing metal-organic frameworks with tuned particle sizes into different composite materials relevant to gas separation.

Using Diatoms as Photonic Crystals for Biosensing Applications in Mach-Zehnder Interferometer

Mentor: Michael Goryll, associate professor
Research Theme: Health

The main goal of this project is to determine the wave-guiding properties of a diatom in order to create an MZI-based biosensor in conjunction with the diatom. Mach-Zehnder interferometers (MZIs) enable optical sensing at very high sensitivities. Combining a photonic MZI with a diatom will enable bio-sensing at an unprecedented scale. Diatoms are phytoplankton which are much more economical to produce than typical nanostructures. Affordable sensors like this will be able to sense cancer markers and other dangerous ions at extremely low concentrations. This will aid in cancer treatment because early detection greatly improves the effectiveness of treatment.
Esteban Barboza, Civil Engineering
Graduation: May 2016
Hometown: San Antonio, Texas


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

A primary reason for the widespread use of adobe is because of specific heat capacity and thermal conductivity, which makes it an excellent material to mitigate heat rising inside buildings. This research seeks to answer the following question: What are the thermal properties of adobe, and knowing these, is adobe a viable material for increasing energy efficiency in residential construction for Phoenix, Arizona?

To answer this question the research involves gathering building materials and commercial samples of adobe, conducting thermodynamic tests on the samples, and using building energy analysis software to test and analyze effectiveness for Phoenix climatic conditions.

Vanessa Barker, Biomedical Engineering
Graduation: May 2016
Hometown: Phoenix, Arizona

Gait Rehabilitation after Stroke through Unilateral Vibrational Stimulus

Mentor: Panagiotis Artemiadis, assistant professor
Research Theme: Health

Victims of hemiplegic stroke are often left with one side of their body in a paretic state, impacting their ability to walk and move. The purpose of this project was to determine whether unilateral vibrational stimulus of the leg during the gait cycle would produce a muscular and/or kinematic response in the contralateral leg. A device was designed and built that could provide a vibrational stimulus to localized areas of the leg at specific points in the gait cycle. This system will undergo testing on human subjects to determine its potential benefits for stroke patients.

Eric Barrientos, Biomedical Engineering
Graduation: May 2019
Hometown: Berwyn, Illinois

Effect of Cancer Associated Fibroblasts on Migration of Invasive Breast Cancer Cells in a Microfluidic Device

Mentor: Mehdi Nikkhah, assistant professor
Research Theme: Health

The objective of this investigation was to quantify how the presence of cancer associated fibroblasts (CAFs) affected migration levels of invasive breast cancer cells in a microfluidic device designed to recapitulate the tumor microenvironment. In vivo studies have shown that CAFs located in the stroma of the tumor induce higher levels of cancer cell migration. The findings of this project indicate that this effect is reproducible in a microfluidic device. The next step for this investigation is to quantify levels of migratory protein expression given the same conditions, and compare those results to the findings of in vivo studies.

Brandon Bartels, Biomedical Engineering
Graduation: May 2017
Hometown: Phoenix, Arizona

Analyzing the Time Course of Motor Planning in Tasks of Different Complexities

Mentor: Claire Honeycutt, assistant professor
Research Theme: Health

The goal of this study is to examine the time course of motor planning in tasks of different complexities with a primary focus on multi-phased tasks. A subject’s motor plan and task execution is evaluated through examining the startle reflex phenomena. The results of this study may help advance stroke rehabilitation by testing the limitations to this reflex. Preliminary data suggests that multi-phased tasks are susceptible to this reflex and our protocol will be performed on numerous subjects in order to draw conclusions.
Microvillus Inclusion Tentacle Probe Diagnostic

Mentor: Michael Caplan, associate professor
Research Theme: Health

Microvillus inclusion disease (MVID) is a genetic disorder which disproportionately affects the Navajo nation. For the Navajo, MVID is caused by the MYO5B P660L (1977C>T) mutation. Unfortunately, there are currently only two diagnostic methods: electron microscopy and genetic sequencing. Through the development of a tentacle probe (TP), the aim of this project is offer a novel, yet more effective diagnosis method. Using thermodynamics and computer modeling, potential TPs were designed and analyzed. The TP was then combined with synthetic DNA and analyzed via RT-PCR. The resulting fluorescence was measured and used as a basis for diagnosis.

Synthesis of Pseudo-1D Materials for Energy Applications

Mentor: Sefaattin Tongay, assistant professor
Research Theme: Energy

Recently, interests in researching two-dimensional layered materials have grown at an extraordinary rate. Many new materials have been developed in an attempt to exploit the electrical and optical potentials of this new class of materials. Layered transition metal dichalcogenides (TMDCs) are highly conductive, but exhibit relatively low mechanical stability. Research suggests alloying layered TMDCs together will theoretically improve their optical and electrical characteristics. Tongay's lab is interested in group IVB transition metal trichalcogenides (TMTCs) because of their predicted band gap that rivals bulk silicon. TMTCs are also incredibly stable, which renders them a great candidate for field effect transistors (FETs).

Adhesion of Copper to Nickel Sputtering on a Silicon Substrate

Mentor: Stuart Bowden, associate research professor
Research Theme: Energy

Solar energy is an integral part of solving the world's energy crisis, but many problems still hinder the solar industry, such as the declining availability of silver. This is an essential element in the production of solar cells, but research is ongoing to replace silver with cheaper, more abundant metals such as copper and nickel. The different properties of the metals make this difficult, in particular the adhesion of copper/nickel to a silicon substrate. Measuring the contact resistance of different thicknesses of sputtered nickel will help determine if nickel can practically be implemented in industry.

Slag Shrinkage — Characterization of Strain Localization and Crack Pattern

Mentor: Narayanan Neithalath, associate professor
Research Theme: Sustainability

The objective of this project is to understand the shrinkage strain characterization of alkali-activated slag paste. Shrinkage tests in a vacuum drying test setup and digital image correlation (DIC) analysis quantify the crack pattern and propagation of the samples over time. The results showed that the shrinkage process is controlled by two competing functions of moisture loss and strength development. The average positive and negative strains are quantified over the region of analysis. Further research work will seek to limit the analysis region to areas of tensile strains only to seek more accurate representation of shrinkage crack propagation.
Alexander Bridge, Chemical Engineering
Graduation: May 2017
Hometown: Scottsdale, Arizona
Rheology of Novel Polyelectrolytes: Proof of Concept and Application to Membrane Formation
Mentor: Matthew Green, assistant professor
Research Theme: Health
Polymer engineering is a rapidly expanding field that stands to solve many of society’s grand challenges. Rheology, the study of flow characteristics of materials, is a discipline that is a staple for advancements in polymer research. This project aims to prove fundamental rheological concepts and to further knowledge in the context of standard polymer and polyelectrolyte solutions. In addition, applications of polymer engineering to the optimization of medical devices will be explored through the production of a hollow fiber-spinning apparatus. This device will be utilized in future research to explore material-based optimizations of critical components in medical devices.

Kyle Burgard, Mechanical Engineering
Graduation: May 2018
Hometown: Phoenix, Arizona
Academic Efficacy of Studious Play with an HCD Educational Toy
Mentor: Benjamin Mertz, lecturer
Research Theme: Education
This project is designed to put Tyson E. Lewis’ educational theory of studious play into practice. We are currently prototyping a toy that will effectively facilitate curriculum designed around helping students discover and make personal connections to educational topics, rather than being asked to remember the information without having made meaningful or memorable connections to it. We have constructed a working prototype and are now improving upon this first design by incorporating our observations of its function and utility in the classroom, as well as the feedback of those students and teachers.

Joseph Burggraff, Engineering (Robotics)
Graduation: May 2016
Hometown: Gillette, Wyoming
Hyperloop Pod Competition
Mentor: John Parsey, professor of practice
Research Theme: Security
The Hyperloop Pod competition’s objective was to define new methods to design and build a pod or any of its subsystems. The researcher’s contribution concentrated on communication protocols for the emergency management and safety (EMS) system, using a floating point gate array (FPGA) as a node to create a diverse high-speed communication path. Establishing a standard protocol to handle the transfer of data from node-to-node was an additional objective, ending with a protocol that closely aligned with the 1394b or FireWire standard. Future research will focus on the integration of communication nodes for the EMS system into a Pod design.

Kaleigh Campbell, Civil Engineering
Graduation: May 2016
Hometown: Phoenix, Arizona
Do Green Building Methods Create a Sustainable Built Environment?
Mentor: Oswald Chong, associate professor
Research Theme: Energy, Sustainability
Building, construction, design and maintenance is a sector of engineering where improved efficiency will have immense impacts on resource consumption and environmental health. This research examines the Leadership in Environment and Energy Design (LEED) rating system and the International Green Construction Code (IgCC). An evaluation of these green building methods is done through both a comparison of the clauses within the texts and an analysis of simulated/actual green building data. Although these green design methods are progressing toward low-impact, efficient infrastructure, this research sheds light on the strengths and weaknesses of each, allowing for future improvements.
Characterization of DARP in Antibodies for Use in Brain Disease Diagnostics

Mentor: Michael Sierks, professor
Research Theme: Health

Developing a diagnostic tool for brain diseases like Alzheimer’s and Parkinson’s, as well as traumatic brain injuries, could change the landscape of neural treatment in the future. This research aims to use targeted antibodies to discover disease precursor tissue in transgenic mice tissue samples. A unique class of customizable antibodies called designed ankyrin repeat proteins (DARPin) will be studied specifically. Isolating the functional properties of the antibodies will allow further research in developing large-scale diagnostics for human use. Properties of different antibodies of this class were tested and cataloged during this project.

SpaceX Design Weekend

Mentor: John Robertson, professor
Research Theme: Education, Energy, Sustainability

The goal of the research project was to create a safe and viable high-speed tube and pod design based on the design that Elon Musk proposed in the Hyperloop white paper. The research in the project suggests that the team’s final design would be applicable for the situation, however, the team was not selected to move on. Future work would include refining and expanding the design based on researched environmental conditions and reapplying for future Hyperloop competitions.

Aerodynamics of Propulsion

Mentor: Timothy Takahashi, professor of practice
Research Theme: Education

The main goal of this project is to understand the behavior of the flow around an RC-ducted fan, and how it is affected with different nacelles around the engine. To accomplish this goal, a Pitot Traverse System is needed to measure the flow around the engine. Thus far, the Pitot Traverse System has been built and coding is underway to operate the system accurately from the lab computer. Once the wiring and coding for the system is completed, the researchers will be ready to collect data using their designed system.

Undergraduate Research Travel Grant Program

Wearable Respiratory Health Sensor Array

Mentor: Junseok Chae, associate professor
Research Theme: Health

The purpose of this research is to develop a wearable sensor array for long term monitoring and characterization of respiratory issues in a subject. The sensor array uses acoustic signals, electromyography (EMG) and positional data to detect and characterize respiratory patterns. An array of microphone sensors, EMG sensors and an inertial measurement unit (IMU) are situated in a wearable vest in order to monitor and gather data. The sensor array is able to detect and gather data from a subject. The signals gathered will be analyzed to determine a correlation between sensor readings and origins of respiratory problems.
Cesar Castro, Civil Engineering
Graduation: May 2017
Hometown: Tempe, Arizona

Influence of PCMs on the Thermophysical and Mechanical Properties of Cementitious Composites
Mentor: Narayanan Neithalath, associate professor
Research Theme: Energy, Sustainability
The purpose of incorporating lightweight aggregates (LWA) into cementitious composites as a carrier of phase change materials (PCMs), has been shown to improve energy efficiency for lightweight structural applications that suffer from extreme temperature exposure. To determine the effectiveness of PCMs within LWA as inclusions within concrete systems, four different LWAs are examined. The thermal performance of LWA is observed from a microstructural viewpoint based on the pore structure features. The difference in pore structure features for LWA cause differing absorption amounts of PCM, which directly correlates to the amount of thermal energy storage capacity allowed for a particular LWA.

David Cayll, Mechanical Engineering
Graduation: May 2017
Hometown: Sugar Land, Texas

Strain Analysis of Anisotropic 2D materials
Mentor: Sefaattin Tongay, assistant professor
Research Theme: Energy, Sustainability
Two-dimensional materials have very different characteristics from their bulk counterparts. A special 2D material, ZrS3, is highly anisotropic with many of its properties, such as conductivity. This change of properties according to orientation makes it a good candidate for flexible light sensors or flexible solar cells. It is important to know if there are any changes in its properties as it is strained. Therefore, the optical and electronic properties of the material will be measured in different orientations to determine the viability of this technology as a flexible device.

Ricki Ceton, Biomedical Engineering
Graduation: May 2016
Hometown: Chandler, Arizona

The Effect of Nanoparticle Diameter on TAT-mediated Delivery to the CNS In Vivo
Mentor: Sarah Stabenfeldt, assistant professor
Research Theme: Health
The aim of this research is to analyze the effects of the nanoparticle (NP) diameter on targeting efficiency by surface modification with trans-activating transcriptor (TAT), a cell penetrating peptide, on the central nervous system (CNS). To address this, polystyrene nanoparticles were modified with TAT and administered in vivo. Tissue extraction and confocal microscopy were used to measure tissue localization and distribution in various tissues. Analysis indicates TAT-conjugated NPs do not have a higher targeting efficiency than the unmodified 100 nm NPs. Future experiments will utilize NPs with different diameters to determine the effects of size on CNS targeting efficacy.

Brian Chang, Mechanical Engineering
Graduation: May 2017
Hometown: North Brunswick, New Jersey

Investigating the Formation of Nanostructures in Alloys Produced by High-Energy Ball Milling at Cryogenic Temperature
Mentor: Kiran Solanki, assistant professor
Research Theme: Energy, Security, Sustainability
The objective of this research is to investigate the formation of nanostructures in alloys produced through high-energy ball milling at cryogenic temperature. A standard Spex ball mill has been modified to have cryogenic capabilities. Copper-tantalum (Cu-Ta) is then synthesized though the cryomill and the powder will be examined using a transmission electron microscopy (TEM) before and after thermal stabilization tests. The results will be used to improve on the development of nanocrystalline metal alloys, material model development and the development of a large scale material processing technique for cryomilling metal powders.
Machine Vision to help Visually Impaired

Mentor: Angela Sodemann, assistant professor
Research Theme: Health

Machine Augmented Human Vision is the process of supplementing the visual stimuli of your optical nerves with the stimuli of some other process, whether that process is vibration or electrical or audio stimuli. The research consists of researching the vibration stimuli coupled with some other stimuli to create the fullest picture of vision possible.

Using a Fleet of Low-Cost Ground Robotic Vehicles to Play Complex Games: Development of an Artificial Intelligence (AI) Vehicle Fleet Coordination Engine

Mentor: Armando Rodriguez, professor
Research Theme: Security

The purpose of this project is to become familiar with and implement artificial intelligence algorithms for common games such as Tic-Tac-Toe, Connect Four, checkers and chess. Simple algorithms for each will be implemented and examined. A key issue here is to understand how to implement look-ahead strategies that systematically search the otherwise intractably large space associated with possible moves. Several look-ahead heuristic strategies will be implemented, compared and analyzed to understand their benefits and shortcomings. Efforts will be made to illustrate how two teams of robotic vehicles can implement selected algorithms. This will be initiated using a graphical interface.

Interfacial Synthesis of Zirconium Metal-Organic Frameworks

Mentor: Bin Mu, assistant professor
Research Theme: Energy

Metal-Organic Frameworks (MOFs) are a group of porous materials becoming popular for gas separations due to their abilities to be tailored toward specific gases. The Zirconium MOF UiO-66 is known for its high stability under standard conditions, yet it bonds poorly to substrates. This research aims to grow a stable, free-standing UiO-66 membrane in a binary system of solvents by investigating the effects of different reaction conditions on its growth mechanism. Large MOF crystal membranes are the desired result, and once this is achieved, further studies can be completed on UiO-66 membrane applications.

Surface Modification of ISFETs for Future Use in Protein Detection

Mentor: Jennifer Blain Christen, assistant professor
Research Theme: Health

The goal of this research is to find an adequate surface modification technique using biotin and streptavidin that can be used for more rigorous research in the future. ISFETs were modified with varying concentrations of modifications to test for signal outputs. The resulting outputs were then compared with the concentrations of biotin and streptavidin to determine the most efficient concentration to output ratio. Future work would be to use this method to determine chemical binding agents for protein detection that can be used for faster and more accurate diagnosis.
Jerry Crum, Chemical Engineering  
Graduation: May 2017  
Hometown: Phoenix, AZ  

**Novel Photo-Responsive Sutures for Laser Tissue Welding**  
Mentor: Kaushal Rege, associate professor  
Research Theme: Health

The objective of this project is first, to synthesize and characterize novel collagen sutures embedded with gold nanoparticles (GNRs) and second, to determine if collagen-GNR sutures coupled with laser tissue welding (LTW) can reasonably replace medical sutures in soft tissue surgery. LTW uses a chromophore to convert laser light into heat and seal tissue. The collagen-GNR sutures exhibit photo-thermal response to near infrared (NIR) laser, with direct correlation between laser power and heat generation. The collagen-GNR sutures display similar tensile strength to commercially available medical sutures. Future work will include testing sutures in tissue models for strength recovery.

Avi Dasgupta, Chemical Engineering  
Graduation: May 2016  
Hometown: Phoenix, Arizona  

**Synthesis and Characterization of Mechanophore-Grafted Epoxy for a Self-Sensing Thermoset Network Polymer**  
Mentor: Lenore Dai, school director and professor  
Research Theme: Security

Mechanochemistry is the study of using a physical force to induce a chemical change. Mechanochemistry can be used to revolutionize the public safety industry by detecting when materials are nearing their failing point before failure occurs. If put into practice, this can save countless lives and avoid numerous tragedies. The results have shown that both cinnamamide and di-cinnamamide have properties that can be used to create fluorescence when stress is put on them. At both the 5 percent weight and 10 percent weight, they have produced products that are fluorescent yellow.

Angelo Delluomo, Electrical Engineering  
Graduation: December 2016  
Hometown: Tempe, Arizona  

**Adhesion of Silicon Nanoparticle Thin Films**  
Mentor: Zachary Holman, assistant professor  
Research Theme: Energy

The objective of this research is to study factors involved with silicon nanoparticle deposition and adhesion using a novel deposition method. By using a tool that implements a new form of nanoparticle deposition, varying films were dispersed onto silicon wafers to analyze how different parameters such as thickness and heating play into the adhesion of thin films. Using various methods, some key factors were found to play an important role in adhesion. As the recipe for an adhering film is found, an advanced method for adhesion testing will need to be implemented.

Nicholas Dhuyvetter, Mechanical Engineering  
Graduation: May 2018  
Hometown: Poway, California  

**Investigating Ion Beam-Induced Heating of Samples by a Focused Ion Beam Microscope**  
Mentor: Konrad Rykaczewski, assistant professor  
Research Theme: Energy

The objective is to create a model for the system inside of the focused ion beam microscope (FIB) which will tell a user how to keep their sample from heating damage. Thus far, the heating of samples in the FIB has been modeled mathematically. Experimentation will be undertaken to confirm the validity of the mathematical model for the heating of samples. After confirming this and making necessary adjustments, the model will be able to predict if a sample is in danger of overheating, and how to mitigate any amount of heat which would damage it.
Maker Families, Museums and Informal STEM Learning

Mentor: Micah Lande, assistant professor
Research Theme: Education

This study seeks to better understand how informal learning in Making may improve informal learning in museums through asking the research question: What roles do parents serve in supporting their children in Making? The research has discovered Maker families who support their children’s STEM education. Through thematic analysis of artifact elicitation and critical incident interviews, the results revealed five roles that emerged through analysis. Next, these roles were compared to those found in parents who attend museums. Comparing these roles will help discover gaps in the current informal learning process which can be filled utilizing Maker family insights.

Matthew Dickens, Engineering (Robotics)
Graduation: December 2016
Hometown: Tempe, Arizona

Andrew Dopilka, Chemical Engineering
Graduation: May 2017
Hometown: Glendale, Arizona

Using the Langmuir-Blodgett Process for Water Purification Membranes
Mentor: Mary Laura Lind, assistant professor
Research Theme: Energy, Health, Sustainability

As the world’s population grows and technology spreads to all parts of the world, fresh water must also increase. Currently there is a fresh water shortage and ways are being developed to relieve this dilemma. A prominent process to solve this is reverse osmosis, which relies on a semipermeable membrane to purify water. Most membranes use only polymers but by adding zeolites, a molecular sieve, performance could improve. By using the Langmuir-Blodgett process, which allows a monolayer deposition of these particles, a new semipermeable membrane could be created that has better performance than current polyamide membranes.

Brandon Dorr, Biomedical Engineering
Graduation: May 2018
Hometown: Tucson, Arizona

Cell Subtype Targeted Gene Modification utilizing CRISPR and SCRIBE Methods
Mentor: Xiao Wang, assistant professor
Research Theme: Health

Current genome editing methods with clustered regularly-interspaced short palindromic repeats (CRISPR) systems allow for targeted gene editing within a cell, but do not allow for discrimination between types of cells. A method that is selective between cell subtypes needs to be explored to develop targeted gene therapies. This project reengineers an E. coli retron to target genome modification in yeast using a reverse transcriptase and an RNA template expressed from a regulated promoter, which only activates when inside a specific cell line. After confirmation of gene circuit functions the circuits can be customized for specific therapies and applications.

Logan Drda, Mechanical Engineering
Graduation: May 2017
Hometown: Las Vegas, Nevada

Small-Scale Solar-Powered Reverse Osmosis Desalinization System for Developing Countries
Mentor: Patrick Phelan, professor
Research Theme: Energy, Sustainability

The goal of this research is to design an improved reverse osmosis (RO) desalination system intended for implementation in developing countries. A solar resource analysis of a town in Kenya was conducted to obtain desired performance rates and average available power. Experimental analyses of current RO systems were conducted and modifications were made to customize a system optimized for the town. Further progress in this technology can be made by making improvements to the individual components of an RO desalination system.
Demonstration of Explainable Plans

Mentor: Subbarao Kambhampati, professor
Research Theme: Security

This semester, the research focused on improving robot perception of humans and their environment to test whether planning software can create human explainable plans. The researchers are using a Fetch robot from Fetch Robotics, which provides a platform with a 7 degrees of freedom arm for manipulation and 2 degrees of freedom RGBD camera for perception. The software developed provides real-time information on human actions and the location of objects in the domain. The entire project asks human agents to collaboratively build a sequence of blocks and rate the explainability of the robots actions.

Development of Novel Carbohydrate Glass Template Spheroids to Study Tumor Hypoxia

Mentor: Vikram Kodibagkar, assistant professor
Research Theme: Health

Multicellular spheroids play an important role in cancer research. Despite many similarities, a primary difference between spheroids and tumors is the presence of a vascular network. Thus far, rapidly creating and replicating the tumor’s tortuous vascular network has been a major challenge. The objective of this research is to incorporate a vascular network within a spheroid, thus creating an avenue to better understand the effects of treatments on tumors. The focus of the semester’s work has been optimizing the method of creating a simple one-stranded carbohydrate glass structure and incorporating this structure within a spheroid.

Productivity Analysis in Civil Engineering and Construction Projects — A Sustainability Perspective

Mentor: David Grau, assistant professor
Research Theme: Sustainability

Productivity in the construction industry has not shown improvements over the past few decades when compared to the tremendous productivity improvements in the manufacturing sector. The data analysis results were obtained from the quantification of cyclical job duties or tasks directly affecting construction production rates. Ongoing research includes investigating changes to preparatory work and developing instructions to increase direct work productivity rates. This will be done by using the drawings of work area assessments and five-minute crew monitoring data results.

Mechanical and Hydraulic Properties of Coal Ash

Mentor: Jaewon Jang, assistant professor
Research Theme: Health, Sustainability

In today’s rapidly advancing society, it is vital to examine the effects these advancements have on society. Electricity plays a significant role in our standard of living, with coal generating 44 percent of our electricity in the United States (UCSUSA 2015). The waste created by a typical coal plant includes more than 125,000 tons of ash (UCSUSA 2015). To work toward a more sustainable future, this waste has the possibility of being recycled and used in concrete instead of cement, which releases CO₂ in the atmosphere. In order to properly implement this idea, fly ash properties must be researched.
**Steven Elliott, Aerospace Engineering**  
Graduation: May 2017  
Hometown: Gilbert, Arizona  

**Parametric Modeling of Aircraft Bodies**  
Mentor: Timothy Takahashi, professor of practice  
Research Theme: Education  

The research investigated how to efficiently model aircraft parametrically to allow for the optimization of individual aircraft characteristics. A script to generate an aircraft model has been written from a text file of about 25 numerical inputs, including a few binary inputs. Recommendations include discovering how to efficiently iterate through variations in geometry while gaining accurate data pertaining to aircraft lift and drag.

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**Gamal Eltohamy, Electrical Engineering**  
Graduation: May 2018  
Hometown: Phoenix, Arizona  

**Rechargeable and Flexible Magnesium-Ion Battery**  
Mentor: Hongbin Yu, associate professor  
Research Theme: Energy, Health  

The goal of this project is to develop a small, flexible, energy-dense magnesium-ion battery to address the growing demand of implantable devices. Magnesium ions are intercalated into a matrix-like cathode composed of Vanadium Pentoxide (V₂O₅) and deposited onto a current collector. The anode is composed of a magnesium foil while the electrolyte is a gel-based substance that allows the magnesium ions to travel from cathode to anode freely. Further work may be implemented in testing out different cathode materials other than Vanadium Pentoxide.

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**Kiah Engebretson, Chemical Engineering**  
Graduation: May 2016  
Hometown: Phoenix, Arizona  

**Condensation Cure of PDMS Membrane**  
Mentor: Mary Laura Lind, assistant professor  
Research Theme: Energy  

The goal of this research project is to separate biofuels by creating composite membranes, which have good alcohol separation from water performance. This separation is done through a process known as pervaporation. Polydimethylsiloxane (PDMS) polymer membranes are created by curing the PDMS membrane through condensation. The PDMS membrane’s selectivity, water and 1-butanol permeability were measured and matched the reference data. These results concluded that the PDMS films are good. In the future different loadings of the ZIF-71 particles will be added into the PDMS polymer to improve the alcohol/water separation.

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**Nicole Esquivel, Computer Science**  
Graduation: May 2016  
Hometown: Tempe, Arizona  

**Analyzing Security of Web Protocols**  
Mentor: Gail-Joon Ahn, professor  
Research Theme: Security  

Internet users communicate with websites via a client-server communication protocol, primarily using HTTP, the foundation of the Internet's data communication. Similar to software products, web communication protocols undergo changes, which may transfer previous vulnerabilities to newer models such as HTTP 2.0. The promises of the new protocol are faster and safer than its predecessors. Research was conducted on HTTP 2.0 and the possible benefits in performance and security, and an Android application was updated to use HTTP 2.0 as the primary protocol in order to test this. Future research should test the security of HTTP 2.0 in different environments.
Jose Eusebio, Computer Science
Graduation: May 2016
Hometown: Scottsdale, Arizona

Utilizing Convolutional Neural Networks to Recognize Facial Expression with a Limited Data Set

Mentor: Troy McDaniel, assistant research professor
Research Theme: Security

The objective of this research is to repurpose pre-trained convolutional neural networks (CNNs) to recognize facial expressions. The ability to repurpose pre-trained CNNs while maintaining a similar level of accuracy would eliminate the need for enormous datasets to train new CNNs. This research attempts to extract features from pictures of faces from CNNs trained to recognize objects and age. These features are then inputted into a support vector machine trained to classify the emotion of the faces based on features. The work includes developing a system capable of testing and training CNNs and testing new configurations and methods.

Blaine Farber, Engineering (Electrical Systems)
Graduation: May 2017
Hometown: Oceanside, California

Subteam lead in: Mechanical, Levitation, and Propulsion Systems

Mentor: Scott Pollat, senior lecturer
Research Theme: Sustainability

The Hyperloop is a conceptual high-speed transportation system intended to run from Los Angeles to San Francisco at top speeds of 760 mph. This “train” will operate in a low pressure environment, levitate throughout its 350-mile journey and be propelled forward via linear induction motors and air compressors. The Hyperloop Design Weekend Competition was put forward by entrepreneur Elon Musk and was held at Texas A&M University Jan. 29–30.

Kathleen Farrell, Biomedical Engineering
Graduation: May 2016
Hometown: Spokane, Washington

Bio-Inspired Switchable Adhesives for Space Applications

Mentor: Hamid Marvi, assistant professor
Research Theme: Education, Health, Sustainability

The research’s goal is to develop the optimal alternating adhesive patch that can be used on the NASA space station to create more configurations of robotic arms that are currently used for maintenance purposes. Researchers in the Bio-Inspired Robotics, Technology, and Healthcare (BIRTH) lab developed a characterization device to test the friction and adhesion characteristics of different bio-inspired materials in a simulated space environment. This environment includes a pressure vacuum with temperatures ranging from -250 °F to +250 °F.

Erin Federspiel, Civil Engineering
Graduation: May 2017
Hometown: Larchmont, New York

Calibration of a Novel Microstructural Model for Efficient Material Design of Cementitious Systems

Mentor: Narayanan Neithalath, associate professor
Research Theme: Sustainability

An efficient microstructure-guided micromechanical model requires detailed evaluation of microstructural features of the cementitious material. While the properties of hardened cement paste matrix and aggregates are detailed adequately in literature, there is still not enough information available on the interfacial transition zone (ITZ) that exists surrounding each aggregate. The thickness and elastic modulus of the ITZ affects the mechanical behavior of concrete significantly. Therefore, the main goal of this study is to calibrate the microstructural model with respect to characteristics of ITZ (thickness and elastic modulus) in order to enable efficient microstructure-guided design of cementitious systems.
PLC for Stand-Alone PV System

Mentor: Meng Tao, professor
Research Theme: Energy

The project plans to create a controller for a stand-alone photovoltaic (PV) system. In the current findings, a trans-impedance amplifier was determined to be necessary in order to measure the power that will be produced from the solar panels. In addition, the group has concluded that the photovoltaic system will be implemented as a charging station for electric cars. Future work of the project includes programming the programmable logic controller to control the amount of load connected to load connected to the solar panels.

Joseph Figueroa, Electrical Engineering
Graduation: May 2018
Hometown: Tucson, Arizona

Microvillus Inclusion Tentacle Probe
Mentor: Michael Caplan, associate professor
Research Theme: Health

Microvillus Inclusion disease (MVID) is a genetic mutation of a single nucleotide that causes the lining of the small intestine to form incorrectly. As of right now the only way to diagnose MVID is by partial gene sequencing, which can take up to a month to receive the results and costs nearly $3,000. The focus of this project is to formulate a faster diagnostic test that is accurate. A tentacle probe will be designed to be used in conjunction with PCR to detect that mutation.

Ryan Fisher, Biomedical Engineering
Graduation: May 2016
Hometown: Gilbert, Arizona

Optimized Morphology of Parylene Dielectric for Enhanced Thin-Film Capacitor Performance
Mentor: Jay Oswald, assistant professor
Research Theme: Energy

Poly(2-chloro-p-xylylene), commonly known by its trade name, parylene C, has excellent dielectric properties and can be chemically deposited to nanoscale thickness, making it an ideal choice for capacitors. This project investigates the relationship between the processing conditions and morphology of parylene. Using a vapor deposition polymerization process, a capacitor plate was uniformly coated at various plate temperatures, and the resulting coating crystallinity was measured by X-ray diffraction. The resulting relationships between process conditions, crystallinity and dielectric properties is reported. These findings can help guide future capacitor design by allowing engineers to optimize material morphology for maximum device performance.

Linda Fou, Mechanical Engineering
Graduation: May 2017
Hometown: Gilbert, Arizona

Implementation of Variable Damping in Gait Rehabilitation Technology
Mentor: Panagiotis Artemiadis, assistant professor
Research Theme: Health

The objective of this research is to design a variable damping mechanism for implementation in the Variable Stiffness Treadmill (VST), which will widen the range of impedance the device provides. To achieve this, an electromagnet will be used to apply a magnetic field to a conductive element on the treadmill, creating a torque opposite to the VST’s deflection and providing damping which can be varied by manipulating the current passing through the electromagnet. It is then possible to further investigate the effects variable load feedback on gait, which has potential applications in rehabilitation technologies.
Visual Analytics of Scientometric Data

Mentor: Ross Maciejewski, assistant professor
Research Theme: Education

Understanding trends in science is critical for assessing the future. From funding allocation to determining what the best graduate program is, a wide variety of questions can be addressed by analyzing current research trends. As such, scientometrics have emerged as measures of science, technology and innovation. However, the most widely used indicators depend on written publications and the frequency of their citations, which require interested parties to either manually extract metrics or develop expertise in automatic data-scraping. This work presents a web-deployable visual analytics system for automatically extracting scientometric data and enabling end-user data exploration.

Investigation into Organic Templated Bio-Nanoparticle Indicator for Ionizing Radiation

Mentor: Kaushal Rege, associate professor
Research Theme: Health

Gold nanoparticle solutions can accurately determine incident amount of ionizing radiation. Current sensors are toxic due to the implementation of Cetrimonium bromide (C_{16}TAB) as the templating molecule, deterring most human applications. This experiment seeks to determine methods of employing C_{16}TAB in safer approaches. In order to reduce toxic contact, yet maintain functionality of the chemicals involved, the gold nanoparticle solution was integrated into agar gel. When subjected to ionizing radiation, the gel forms suspended nanoparticles, leading to a color change that can be visually detected and analyzed through a spectrometer.

Microvillus Inclusion Tentacle Probe Diagnostic

Mentor: Michael Caplan, associate professor
Research Theme: Health

Microvillus inclusion disease (MVID) is a rare genetic disease. Currently, the two ways to diagnose MVID are electron microscopy of a biopsy or genetic sequencing. This work aims to develop a tentacle probe (TP) to diagnose MVID through real time polymerase chain reaction (PCR), using fluorescence measured to determine if the patient has the MVID mutation. By developing a TP specific to MVID, the diagnostic cost can be reduced from $3,000 to $100 and diagnostic time minimized from four weeks to 24 hours.

Assessment of Microbe-Induced Fracture Healing in Concrete

Mentor: Narayanan Neithalath, associate professor
Research Theme: Sustainability

This research focuses on microbe-induced fissure-healing in concrete through bio-deposition. The ability to generate microbially-induced carbonate precipitation (MICP) was evaluated to minimize crack propagation in concrete. Before treatment with bacterial solutions, controlled cracks were generated through three-point-bending tests and were tested for fissure-healing efficiency. Untreated beams were likely to break with a lower peak load and treated beams were expected to exhibit higher strength. Strain-localization behavior in the beams was evaluated using DIC for a comprehensive comparative understanding of the fracture process. Bacteria-induced carbonate precipitations are likely to rapidly regenerate strength, leading toward the design of a sustainable, self-healing concrete.
Carolyn Harvey, Mechanical Engineering
Graduation: May 2016
Hometown: Cave Creek, Arizona

Developing Robotic Systems for Locomotion on Granular Media
Mentor: Hamid Marvi, assistant professor
Research Theme: Sustainability

Current robotic systems are limited in their abilities to adeptly traverse flowable terrain. Since many animal species are biologically designed for navigation of specific terrains, it is useful to study their mechanical ground interactions and the kinematics of their movement. The understanding of interactions with these surfaces is largely underdeveloped. A fluidized bed is being designed to simulate various terrains under different conditions for testing animals. Robots will be designed to mimic these animals’ locomotion across all types of terrain, which will be invaluable for applications where human intervention is not ideal, such as planet exploration and rescue operations.

Tatem Hedgepeth, Aerospace Engineering
Graduation: May 2016
Hometown: Modesto, California

Indoor Position Determination Using Triangulation of Wi-Fi Signals
Mentor: Daniel White, lecturer
Research Theme: Security

This research’s goal is to create a robust localization algorithm for indoor environments by identifying, analyzing and accounting for confounding factors in the Wi-Fi signal propagation model. Using the received signal strength indicators (RSSIs) to determine distances from a receiver to multiple wireless access points (APs) with known locations, a triangulation algorithm can calculate the receiver’s location. By increasing the number of access points and reducing the amount of structural interference, a more accurate location can be estimated. Possibilities for future related research involve testing the localization system in a more complex environment and using statistical models to improve accuracy.

Bailey Herbstreit, Industrial and Organizational Psychology
Graduation: May 2018
Hometown: Gilbert, Arizona

Investigating the Roles of Tactile/Force Feedback in Motor Control
Mentor: Robert Gray, associate professor
Research Theme: Health

Research has shown that up to 53 percent of stroke patients have impaired tactile sensations with slower recovery time as compared to normal intact tactile sensations. This research investigates the effectiveness of simulated tactile feedback in motor control of arm movements via a haptic video game controller. Participants conduct a video-based gaming task with three different levels of controller stiffness while using a computer mouse with no tactile. The researchers hypothesize that aiming performance will be faster and more accurate at a medium level of tactile-force feedback. Results will be used to inform the development of virtual reality-based post-stroke rehabilitation devices.

Kendall Hickie, Computer Systems Engineering
Graduation: May 2017
Hometown: Chandler, AZ

Handheld, Versatile Electrochemical Impedance Spectroscopy Microprocessor
Mentor: Jeffrey La Belle, assistant professor
Research Theme: Health

Electrochemical impedance spectroscopy and amperometry are historically performed using a multiplexor, which is a large device used to supply a voltage to then measure some aspect of the circuit that is created using a biomarker as one of the components. The use of an Arduino to create a smaller form of this machine would greatly benefit the research on biomarkers as it could be completed much quicker, leading to a better understanding of how they work for a lesser cost. Development will be furthered to continue to reduce the size of the circuit and increase the precision of the device.
Peter Hillebrand, Biomedical Engineering  
Graduation: May 2018  
Hometown: Tempe, Arizona

**Neural Correlates of Enhanced Motor Recovery with a Novel TrkB Agonist**

Mentor: Jeffrey Kleim, associate professor  
Research Theme: Health

The effects of a stroke are devastating in humans due to the lack of rehabilitation time available to stroke patients. The objective of the research was to test the efficacy of a novel drug (LM22A-4) for enhancing motor recovery and cortical plasticity in a rat model of a stroke. To further analyze changes in cortical organization resulting from both the motor training and the drug, intracortical microstimulation will be performed. Results thus far suggest that early on in the training, animals receiving the drug are performing better than control animals. Further testing will confirm these results.

Alex Hoffmann, Biomedical Engineering  
Graduation: May 2016  
Hometown: Scottsdale, Arizona

**Knee Brace for Monitoring Rehabilitation**

Mentor: Panagiotis Polygerinos, assistant professor  
Research Theme: Health

Surgical knee repair of past injuries greatly increases the likelihood of future injury. Inconsistencies in rehabilitation only increase that risk. The purpose of this project is to design and develop a knee brace that will monitor rehabilitation efforts of patients following surgery. This technology seeks to assist patients and doctors to ensure maximum benefits gained from rehabilitation through monitoring of flexion/extension angle, exercise repetitions and time spent completing exercises. User information and data collected will be expressed and saved for future viewing in a database accessible to both patients and doctors.

Taylor Hoffmann, Mechanical Engineering  
Graduation: May 2017  
Hometown: Scottsdale, Arizona

**Increasing Deployment of Photovoltaic Systems with Soft Robotic Technologies**

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

This research utilizes a segment of soft robotics to help optimize the efficiency of today's solar panels. Most solar panels are placed at a predetermined angle and are left in a fixed position so that the angle of the panel, with respect to the sun, is almost never optimal, which severely limits the photovoltaic energy potential. This solar tracker aims to provide an application of soft actuators to create a dual axis base for photovoltaic panels, which will allow them to continuously retain the optimal angle toward the sun and meet their energy potential.

Mikayle Holm, Biomedical Engineering  
Graduation: May 2016  
Hometown: Phoenix, Arizona

**A Study of Thermogenesis on Brown Adipose Tissue**

Mentor: Michael Caplan, associate professor  
Research Theme: Health

This study's goal is to compare and contrast the strength of adaptive thermogenesis through weight gain, energy intake and tracking brown adipose tissue (BAT) temperature after administration of norepinephrine under thermoneutral conditions in young rats. During the control (chow) food consumption stage, the animals showed a minimal increase in BAT temperature (measured by surface temperature, probe temperature, and rectal temperature) after receiving a subcutaneous dose of norepinephrine (NE) and elevation of gain (metabolic) efficiency. These results suggest a reduced thermogenic capacity and metabolic rate with chow-feeding. It is anticipated that thermogenic capacity will increase with high fat diet (HFD) feeding.

**Undergraduate Research Travel Grant Program**
Denton Holzer, Chemical Engineering
Graduation: May 2016
Hometown: Mesa, Arizona

Investigation of Possible Electron Transport Pathways in Thermincola ferriacetica Anodic Biofilms

Mentor: César Torres, assistant professor
Research Theme: Energy, Sustainability

The mechanisms of extracellular respiration in anode-respiring bacteria (ARB) are not well understood. Cyclic voltammetry (CV) techniques in concert with chronoamperometry will be used to gain further insight on the potentials at which these bacteria grow optimally. Thermincola ferriacetica biofilms will be grown in reactors using glassy carbon/graphite rod working electrode, silver/silver chloride (Ag/AgCl) reference electrode, and nickel wire counter electrode. CVs will be performed on the reactors once the biofilms grow. Ferriacetica was successfully grown in test tubes and used to create freezer stocks for proper culture maintenance.

Undergraduate Research Travel Grant Program

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Ian Horvath, Mechanical Engineering
Graduation: May 2017
Hometown: Pleasant Valley, Arizona

Refinement of Isotopic Analysis for Dating of Zircon Crystals to High Precision

Mentor: Jay Oswald, assistant professor
Research Theme: Education

The invention of radiometric dating rapidly increased our knowledge of the age of the Earth and its important geologic features. Although careful measurement of isotopes of lead in zircon crystals is capable of determining the age of minerals with accuracy greater than 1 percent, most samples fall well outside this threshold. The primary research objective of this project is to improve U-Pb dating techniques through accurate isotopic analysis by employing PIPS detection to measure alpha emission of 238U/235U. These detectors, coupled with high precision knowledge of decay constants, accurate uranium isotopic profiles will be obtained and used to improve dates.

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Rylan Hunter, Aerospace Engineering
Graduation: May 2017
Hometown: Prescott, Arizona

Neural Control of Robotic Swarms

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

Reliable, intuitive control is of paramount importance in the field of robotics, but often proves difficult for multi-agent systems. To address this difficulty, the use of neural interface for the control of multi-agent swarms was explored. Control programs were developed in the Python programming language for the iRobot Create 2 platform and implemented on the Raspberry Pi chipset. User input was derived via electroencephalographic (EEG) signals and analyzed via neural network analysis using the PyBrain programming library. Wireless control was accomplished using off the shelf radio frequency (RF) components and various swarm dynamic models were explored for system guidance.

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Shota Ichikawa, Aerospace Engineering
Graduation: May 2016
Hometown: Susaki, Japan

Evaluation of the Feasibility of a Magnetohydrodynamic (MHD) Momentum Management Device for Low-Jitter Attitude Control

Mentor: Daniel White, lecturer
Research Theme: Security

The objective of this research is to analyze the feasibility of a magneto-hydrodynamic (MHD) momentum management device for attitude control system of satellites. An MHD momentum wheel may provide a solution to reaction wheel vibration issues. This device utilizes crossed electrical and magnetic fields to rotate a conductive liquid, generate torque on the spacecraft body and is expected to not cause vibration issues. For the feasibility analysis, electrical characteristics of this device will be determined by collecting electrical responses from experiments. The responses will be analyzed to characterize the properties of this MHD device.
Kody Ioia, Industrial and Organizational Psychology
Graduation: May 2016
Hometown: Mesa, Arizona

Investigating the Effects of Vicarious Learning and Case-based Learning Approaches Within an Online Training System for LGBT Biases

Mentor: Scotty Craig, assistant professor
Research Theme: Education, Health

One’s biases can influence how one acts toward LGBT individuals. Previous research identified two effective learning strategies: vicarious and case-based, both of which can modify potentially negative behavior. This experiment investigates whether a training program incorporating both learning methodologies is effective in reducing participants’ negative biases or, and actions toward LGBT people. Content for this training program is being developed and validated by subject matter experts. Following content validation, conditions within the online training program will be evaluated to see if they are successful in improving understanding and eliciting positive change in participant attitudes toward LGBT people.

Adrian Ion, Mechanical Engineering
Graduation: December 2016
Hometown: Glendale, Arizona

Gait Rehabilitation: How Does Force Feedback Affect Inter Leg Coordination

Mentor: Panagiotis Artemiadis, assistant professor
Research Theme: Health

This research expands the understanding of inter leg coordination and its application as a rehabilitation tool. The comparison between two unilateral perturbations (stiffness and dropping) could help explain the effects of force feedback on the contralateral leg. Current findings suggest that dropping perturbations provide greater tibialis anterior muscle activation in the latter gait cycle as opposed to stiffness. The contralateral muscle activation has shown to be highly dependent on the manipulation of the hip kinematics on the unilateral leg in accordance with dropping perturbations. Future work will expand the data pool to develop more concrete understandings of these relationships.

Jonathan Isaiah, Engineering (Robotics)
Graduation: May 2016
Hometown: Tempe, Arizona

Hyperloop Embedded Systems Communications Lead

Mentor: Panagiotis Polymerinos, assistant professor
Research Theme: Energy, Sustainability

The researchers investigated the technical feasibility of the planned SpaceX Hyperloop, and proposed a pod design to meet the design specifications, with a focus on safety and emergency management. The researchers designed the pod around a redundant distributed communications network that allows the pod to remain operational even if the communications system is damaged. The pod design was presented to a panel of experts the the SpaceX Hyperloop Pod Design Competition at Texas A&M University in January. The research team hopes to test the design on the SpaceX Test Track after next year’s Pod Design Competition.

Matthew Jackson, Electrical Engineering
Graduation: May 2016
Hometown: Scottsdale, Arizona

Electroencephalogram Feature Extraction

Mentor: Daniel Bliss, associate professor
Research Theme: Education, Health

The objective of this research was to apply signal processing techniques on electroencephalogram (EEG) data in order to extract features for which to quantify an activity performed or a response to stimuli. The responses by the brain were shown in time-frequency plots for each of the 14 sensors in order to show which location on the subject’s head correlated with the neural response. Future applications include medical examinations of patients to determine cognitive impairment based on debilitated cognitive responses.

Undergraduate Research Travel Grant Program
Chenming Jiang, Engineering (Electrical Systems)
Graduation: December 2017
Hometown: Jiangxi, China
Wearable Medical Diagnosis System
Mentor: Junseok Chae, associate professor
Research Theme: Health
The goal of this project is to create a wearable medical diagnosis system, which can receive, analyze and diagnose body signals. This research includes several components: make reliable dry sensors, implement sensors to a wearable device, collect signals from patients, analyze signals and create a smart diagnosis system. Currently, the researchers have made fairly reliable dry sensors and implement them in a wearable device. The next step will focus on testing devices and analyzing patient signals.

Adam Johnson, Industrial and Organizational Psychology
Graduation: May 2016
Hometown: Peoria, Arizona
Writing Errors' Influences on Perceptions
Mentor: Rod Roscoe, assistant professor
Research Theme: Education
This study implements a 4 (error pattern) by 4 (author) within-subjects design. Error pattern will be a within-subjects variable with four levels: no errors, superficial errors only, substantive errors only and both types of errors. All participants will assess a randomized selection of four essays — one essay exhibiting each of the four error patterns. Each of the four essays will also contain unique content pertaining to the same writing topic. Perceptions of the writing (e.g., ideas and content) and of the author (e.g., intelligence) will be gathered from surveys taken after each essay has been read.

Kaleigh Johnson, Chemical Engineering
Graduation: May 2017
Hometown: Gilbert, Arizona
Engineering a Co-Culture of Bacteria and Yeast for the Production of Renewable p-Coumaric Acid
Mentor: David Nielsen, assistant professor
Research Theme: Sustainability
Due to its versatile properties, p-Coumaric acid is used in food, pharmaceutical and cosmetic industries. While prevalent in nature, harvesting the compound from natural sources is an inefficient process that is both difficult and costly. This research aims to produce p-Coumarate using a co-culture of yeast and E. coli directly from glucose. Methods used in this study include designing optimal media for bacterial growth, genetically-modifying strains to produce the compound with maximum yield and analyzing the presence of p-Coumarate using high-performance liquid chromatography. The goal for this project is to create a feasible method for producing p-Coumarate sustainably.

Joslin Jose, Materials Science and Engineering
Graduation: May 2017
Hometown: Phoenix, Arizona
Doped Ceria Nanocubes for Grain Boundary Control in Oxygen Ion Conductors
Mentor: Peter Crozier, associate professor
Research Theme: Energy
This research aims to synthesize and optimize pure ceria and Gd-doped ceria nanocubes to model a polycrystalline oxygen ion conducting electrolyte with controllable grain boundary population. Based on transmission electron microscopy (TEM) images, there was a large distribution of the synthesized nanocubes. Efforts are being made to minimize the size distribution. Compacting the pure ceria cubes and the doped ceria cubes into electrolyte pellets will allow the microstructure of the electrolytes made with cubes to be compared to the microstructure of an electrolyte made with randomly shaped nanoparticles. Future work includes studying the conductivity of the electrolytes made with nanocubes.
Zachary Josephson, Computer Science
Graduation: May 2016
Hometown: Scottsdale, Arizona

**Reimagining the Role of Local Legislative Data in Informing the Public**

Mentor: Ruth Jones, professor
Research Theme: Education

In Arizona, legislatively mandated records are published in obtuse forms that make it difficult for voters to find simple voting histories for their representatives. This is detrimental to the integrity of the democratic system. The main objective of this research is to republish data concerning state legislators, both in terms of governance and campaigns, in changeable, interactive formats on a public web-based presentation system. Because no other resources exist in Arizona for voters to obtain detailed information about their legislature, this research will be able to accurately gauge what the majority of information seeking-voters are concerned about.

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Sagarika Kadambi, Computer Science
Graduation: May 2017
Hometown: Phoenix, Arizona

**Visual Analytics and the Cascading Impact of Climate Change**

Mentor: Ross Maciejewski, assistant professor
Research Theme: Security

As world population increases, global food security is increasingly vulnerable to climate fluctuations. In order to assess risk measures due to climate variability, there is a need for the development of reliable modeling and visualization systems. The goal of this project is to identify climate singularities and note the specific effects on agricultural trade. A geospatial network visualization tool was created to clearly classify links between key climate irregularities and trade patterns. The visualization identifies the impact and severity of those pattern fluctuations. Future directions include further examining links between trade networks and climate irregularities to model future climate-trade interactions.

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Andrew Karnes, Software Engineering
Graduation: May 2018
Hometown: Mesa, Arizona

**Game Developer**

Mentor: Angela Sodemann, assistant professor
Research Theme: Education

This research is to determine what affects facial expressions have on the level of trust that a person has with a robot. This will be used to determine the quality of human likeness that should be placed on a robot’s face. The researchers made a robot that can copy the facial movements of a person. A test subject played a game with and without the help of the robot to determine their trust in the robot. This will be tested with a larger sample of test subjects.

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Ajay Karpur, Electrical Engineering
Graduation: May 2016
Hometown: Phoenix, Arizona

**Exploring Novel Deep Learning Techniques for Speaker Recognition**

Mentor: Shayok Chakraborty, assistant research professor
Research Theme: Security

Automated verification of human identity is a crucial part of many security technologies. One modality for verifying identity is speaker recognition or voice biometrics, which is verifying a person’s identity using the characteristics of their voice. This study investigates a novel technique for speaker recognition using deep recurrent neural networks and evaluates its effectiveness against standard speaker recognition corpora and benchmarks.
A Case Study on building Scalable Web Applications

Mentor: Yinong Chen, senior lecturer
Research Theme: Education

The researcher examined different architectures and open source software that power most popular web applications. An eBusiness website was built and will continue to be refined as a realistic and usable teaching tool. This platform is a model for students to learn how to build scalable and platform independent software while building their own eBusiness sites. The Monte Carlo simulation model will be used for testing the business model to allow business owners to optimize their stock of goods in the eBusiness environment.

Nicholas Kemme, Mechanical Engineering
Graduation: May 2016
Hometown: San Diego, California

Porous Liquid Metal Matrix Embedded in Elastic Substrate

Mentor: Konrad Rykaczewski, assistant professor
Research Theme: Health

Incorporating liquid metal into flexible substrates has resulted in a new avenue for research. Currently, the most promising technique performed was coating a cotton fiber in liquid metal and then using high heat to remove the fiber from the liquid metal without the use of flames or solvents. This is promising in that thin fibers could be coated to create the circuitry, then removed from the liquid metal. The next step for the research is encasing the remaining liquid metal in a flexible polymer.

Nathan Kirkpatrick, Biomedical Engineering
Graduation: May 2016
Hometown: Tempe, Arizona

Student-Graded Homework Using Compare/Contrast and Self-Explanation Exercises

Mentor: Michael Caplan, associate professor
Research Theme: Education

Today's engineering instructors are charged with a difficult task: successfully convey conceptual knowledge and promote critical thinking skills to an ever-expanding student population. One way to optimize instructor/student interactions is to update the homework process. The objective of this research was to design a homework system that is scalable for large class sizes. Exploratory use of this method in an upper-division engineering course has led to the conclusion that self-grading homework with self-explanation and contrasting corrections presents an effective homework process under the constraints of the modern engineering classroom environment.

Troy Kozlowski, Biomedical Engineering
Graduation: May 2016
Hometown: Scottsdale, Arizona

Using a Bi-Exponential Model to Analyze T2 weighted MRI Images of Cancerous Tissue

Mentor: Vikram Kodibagkar, assistant professor
Research Theme: Health

This research analyzed T2 weighted MRI images of tumors treated with hypoxia-activated drugs using a bi-exponential model. The bi-exponential model is used to show the amount of edema present within the tumors. This edema fraction will then be used to weight oxygenation maps created using the proton imaging of siloxanes to map tissue oxygenation levels (PISTOL) method. The edema fraction and weighted oxygenation maps will then be analyzed to determine if they function as accurate predictors of successful treatment with hypoxia-activated drugs.
Ryan Kritz, Engineering (Robotics)

Graduation: May 2017
Hometown: Waddell, Arizona

ASU Hyperloop: Prototyping Viability

Mentor: Panagiotis Polygerinos, assistant professor
Research Theme: Education, Sustainability

The Hyperloop system is a futuristic form of commuter transportation proposed by technical innovator Elon Musk. The specific goal of this research is to understand the viability of building a working prototype pod on the ASU Polytechnic campus that can accommodate one crash test dummy and match transportation tube specifications established by SpaceX. Initial research has shown that based on the cost of raw materials and the fabrication capabilities of the Polytechnic campus that a prototype pod can be built for around $30,000. As this figure undermines or matches cost figures set by other teams, production can be viable.

Theodore Kyriacou, Biomedical Engineering

Graduation: May 2018
Hometown: Granada Hills, California

Editing of a Synthetic Gene in Live Cells to Advance Epigenetic Research

Mentor: Karmella Haynes, assistant professor
Research Theme: Health

Chromatin modification is an important aspect of epigenetics, which is the stable control of gene expression in dividing cells without altering the DNA sequence. This process plays a critical role in embryonic development and cell differentiation. The objective of this project is to test a sensor that fluoresces inversely to the amount of chromatin repression. The leading technique in determining chromatin states require destruction of the cell. This sensor will potentially allow changes in chromatin states to be observed in living cells. Future work will include measuring the effectiveness and accuracy of the sensor.

Luke Lammers, Biomedical Engineering

Graduation: May 2016
Hometown: Tucson, Arizona

A Novel Computing Platform for Accelerated Magnetic Resonance Spectroscopic Cancer Imaging

Mentor: Vikram Kodibagkar, assistant professor
Research Theme: Health

The goal is to determine if various data acquisition platforms for compressed sensing magnetic resonance spectroscopic imaging (MRSI) can be merged into a single program that is more accessible and if this would retain high fidelity necessary for pediatric cancer diagnoses. A graphical user interface (GUI) successfully combined these platforms along with reconstruction algorithms. The GUI retains a high level of fidelity and makes the data analysis easier for clinicians and researchers by displaying pertinent MRSI information. Future work may focus on the optimization of the reconstruction algorithms as well as increased functionality of the program based on clinical needs.

Alec Laws, Mechanical Engineering

Graduation: May 2016
Hometown: Gilbert, Arizona

Effect of Powder Recycling on Direct-Metal-Laser-Sintered Aerospace Alloy

Mentor: Amaneht Tasoju, associate research professor
Research Theme: Sustainability

This project sought to analyze the effects of recycling Inconel 718 super-alloy powder for direct metal laser sintered additive manufactured processing and create a process for ensuring powder purity. This was done by analyzing powder after multiple cycles of use using an electron microscope and energy-dispersive X-ray spectroscopy to identify contaminants as well as developing various methodology for filtering contaminants. Fractography of low-cycle-fatigue specimen and the analysis of initiation site will provide information on potential contaminants and its effect on fracture properties. Testing recycled AM powder using water elutriation or a settling column to sieve out contaminates is recommended.
Robert Leader, Aerospace Engineering
Graduation: May 2017
Hometown: North Las Vegas, Nevada

Parametric Design of Aircraft Components
Mentor: Timothy Takahashi, professor of practice
Research Theme: Education

The researchers are improving and automating the preliminary stage of the aircraft design process to increase technical accuracy of initial models as well as test various configurations. A Python program in Rhinoceros CAD was created to automatically generate an airplane model given a list of design and geometric parameters, which then calculate performance characteristics as well as regenerating the fuselage cross-sectional area distribution. This project may combine its various elements to a single package which will be controlled externally and will have the capability to run various configurations of a single parameter or multiple parameters.

Gideon Lee, Chemical Engineering
Graduation: May 2016
Hometown: Jerusalem, Israel

HDH Process Improvement
Mentor: James Beckman, associate professor
Research Theme: Health

Providing access to clean drinking water is one of today’s engineering grand challenges. Humidification-dehumidification desalination (HDH) uses air as a carrier gas to evaporate water and then condense the humidity into pure water, while recycling the phase change energy from the condensation to evaporate more water. The goal is to use HDH with improved efficiency concepts to provide low cost and simply constructed units optimized for water purification in developing countries. Future work will be experimentation with different building materials and designs. If a multiple effect of five is achieved, a full-size unit will be built, then enter production.

Madeline Lent, Chemical Engineering
Graduation: May 2017
Hometown: Chandler, Arizona

Electrospinning Stimuli-Responsive Fibers at the Nanoscale as Functional Drug Delivery Mats
Mentor: Matthew Green, assistant professor
Research Theme: Health

This research’s objective is to create electrospun fibers as functional drug delivery mats to enable disease-tailored therapies with targeted delivery to reduce side effects in patients. Using a large electric potential to draw fibers from a solution flowing at a specific rate, the solution reaches a grounded target several inches away. The nanoscale fibers are used as drug delivery mats and the kinetics of the peptide’s release-time are tuned to occur in the range of one hour to a week. Observing impact of solvent on fiber spinning and fiber diameter brings many positive results in improving overall comfort of patients.

Portia Letham, Chemical Engineering
Graduation: May 2016
Hometown: Gilbert, Arizona

Synthesis of Metal-Organic Framework Membranes via a Binary System
Mentor: Bin Mu, assistant professor
Research Theme: Energy

Metal-organic framework (MOF) material is composed of metal ions or clusters and organic linkers with potential applications in gas separation, catalysis, and many other fields. Membranes are typically formed onto a support, but this is difficult due to low affinity of MOF seeds and the support complicates characterization. In this project, synthesis of membranes using a binary system was investigated and successfully applied to synthesis of an MOF membrane without support. Membrane growth and effects of various parameters suggests a possibility for some control over membrane surface morphology. Future work will pursue intermediate product grafting and membrane on support synthesis.
Rubin Linder, Mechanical Engineering  
Graduation: May 2017  
Hometown: Danville, California  
Wetting Properties of the Prickly Pear Cactus  
Mentor: Konrad Rykaczewski, assistant professor  
Research Theme: Sustainability  
The objective of this research is to closely examine the features of the hydrophobic outer shell of the prickly pear cactus. Different varieties of the prickly pear cactus have been evaluated for their unique characteristics and hydrophobic properties. They are then imaged in a scanning electron microscope. Large variations between the surfaces of different varieties of the prickly pear cacti have been found, which affect their wetting properties. More varieties of cacti will be imaged and their properties will be evaluated for water reclamation and decontamination.

Ben Liu, Mechanical Engineering  
Graduation: May 2016  
Hometown: Irvine, California  
Trust in Human-Robot Interactions  
Mentor: Angela Sodemann, assistant professor  
Research Theme: Health  
With the increasing development of robots for the commercial, educational, residential and military sectors, it is important to study the impact that robots have during social interactions between human and robots. Previous studies have found that the appearance and social cues exhibited by the robots have had an effect on participants’ perceptions of the robot as well as their efficiency during team activities. This research will determine how trust is affected in human-robot interactions when the robot displays uncertainty while also taking into account the effects of appearance and social cues of the robot.

Jialiang Liu, Electrical Engineering  
Graduation: May 2016  
Hometown: Yichang, China  
Bacteria Battery: Miniaturized Microbial Fuel Cells for Renewable Energy Converter  
Mentor: Junseok Chae, associate professor  
Research Theme: Energy  
This research is to replace the current cerebrospinal fluid (CSF) draining technique for the treatment of hydrocephalus with a more reliable and effective passive check valve. The passive check valve aims to restore near natural CSF draining operations while mitigating possible failure mechanisms. A simple hydrogel diaphragm structures core passive valve operations and enforces valve sealing properties to substantially lower reverse flow leakage. Peristaltic pumps are being utilized during the burn-in process of the valve to ensure its consistency.

Ryan Madler, Electrical Engineering  
Graduation: May 2016  
Hometown: Prescott Valley, Arizona  
Reducing Leakage Current in RRAM Cross-point Arrays  
Mentor: Shimeng Yu, assistant professor  
Research Theme: Energy  
As digital memory continues to reduce in size, one problem being faced is the loss of charge on the currently used methods of storage. Currently SRAM, DRAM and FLASH are all vulnerable to this loss. To confront this problem, a new form of memory, resistive random access memory (RRAM), has been developed, which relies on variable resistors that can be switched between a low and high impedance state. However, this type of memory has sizable leakage currents that make reading unreliable. This research uses circuit techniques to reduce these leakage currents and find the maximum array size supported.
Alicia Magann, Chemical Engineering
Graduation: May 2016
Hometown: Fountain Hills, Arizona

Dynamical Modeling Of Physical Activity Interventions Using Control Systems Engineering Principles
Mentor: Daniel Rivera, professor
Research Theme: Health

The goal of this research is to optimize behavioral health interventions promoting physical activity via dynamic modeling and control principles. Using recently acquired participant data, system identification studies have been performed to generate 7-input black-box models describing the behavior of each participant. Furthermore, insights from correlation analyses have enabled the determination of which inputs are meaningful on a participant-by-participant basis. From this, reduced-input models have been generated and compared with the full 7-input models, indicating that in many cases, system dynamics can be adequately captured with fewer inputs. Moving forward, input signals will be designed for future system identification experiments.

Aldin Malkoc, Biomedical Engineering
Graduation: May 2016
Hometown: Phoenix, Arizona

Assessment of Student Responses to Various Resources Offered in Biomedical Engineering and Materials Science Courses
Mentor: Casey Ankeny, lecturer
Research Theme: Education

While various resources are available to students, little research has been done to investigate what are the most useful and how frequently they are used. The researchers asked, “which resources do biomedical engineering students feel addresses difficult concept areas, prepares them for examinations, and helps in computer-aided design (CAD) and programming the most and with what frequency?” This analysis highlighted potential resources that are universally beneficial, such as the use of peer work (group studying, engineering tutoring centers and teaching assistants). Differences are also seen by both discipline and topical area.

Cameron McAllister, Biomedical Engineering
Graduation: May 2019
Hometown: Phoenix, Arizona

Single-Stranded DNA Nicking Techniques for Directed Evolution of E. coli
Mentor: Xiao Wang, assistant professor
Research Theme: Energy, Health, Sustainability

CRISPR-cas9 is an effective technology for gene editing. Research focused on whether it is possible to uncover otherwise hidden mutations in E. coli genomes using single-stranded nicking of the genome (cutting one strand of DNA). To investigate, it was first necessary to design and prepare the DNA sequences that correspond to target sites on the LacZ gene. This allows CRISPR-cas9 nicking of one strand of the E. coli genome, which can produce easily-identifiable mutations and a way to analyze how DNA repairs itself. Future work includes applying this technique to other E. coli genes to identify useful mutations in genomes.

Jason Mende, Chemical Engineering
Graduation: May 2016
Hometown: Derby, New York

Investigation of the Relationship in Particle Characterization of Mixtures
Mentor: Heather Emady, assistant professor
Research Theme: Health

Knowing the mixing properties of powders can lead to a streamlined process for making uniform dosages of tablets of pharmaceutical products. This leads to saving time, money, and materials that can be used toward progressing public health. The properties of bulk, tapped and true density and particle size and distribution of mixtures of sand and sugar were tested for their behavior. The relationship of the mixtures was determined and compared to a linear form. This could be used for designing better operating conditions, which will lead to less wasted material and greater uniformity of product.
Drinking Water Quality and Management in Arizona

Mentor: Tirupalavanam Ganesh, assistant dean of Engineering Education, associate research professor
Research Theme: Sustainability

This project examines how clean drinking water is managed in Arizona with attention to the greater Phoenix area. Descriptions of local water sources and management techniques from interviews with the Salt River Project employees were developed. Water sources for the greater Phoenix area are the Salt River, Verde River, Central Arizona Project and ground water. Management practices include artificial ground water recharge in two locations with a total capacity of 168,000 acre-feet per year. An exploratory data analysis of water quality indicators over three years, 2011-14, found that measures were in compliance of federal guidelines.

Thermoelectric Power Generation via the Utilization of Exhaust Heat from Internal Combustion Engines

Mentor: Robert Wang, assistant professor
Research Theme: Education, Energy, Sustainability

The first goal of this project is to use thermoelectric modules to capture waste exhaust heat from an internal combustion engine. Thermoelectric modules with multiple cooling options are being mounted around the exhaust pipe and the resultant voltage will be measured as a function of engine speed. The results will then be implemented as a lab module into MEE 434, demonstrating thermoelectric power generation and allowing students to compare different thermoelectric setups allowing them to understand the importance of cold-side thermoelectric cooling. Furthermore, this project will be used to create a more efficient waste heat recovery device in the future.

Aerodynamics of Propulsion

Mentor: Timothy Takahashi, professor of practice
Research Theme: Energy

Aerodynamic efficiency is an important aspect of any vehicle or surface that is subjected to loads from air. Research in efficiency of aircraft engine nacelles has largely been ignored due to precedence being placed on thermodynamic cycles of engines. This study attempts to test various small-scale aircraft engine nacelles with electrical ducted fans (EDFs) using a pitot probe to measure pressure and velocity profiles in the wake of different designs. The goal is to reach a conclusion as to what combination of nacelle inlet and outlet will provide the best aerodynamic efficiency for low speed flight.

Electrically Conductive Hydrogel-Based Topographies for Development of Three Dimensional (3D) Cardiac Tissue

Mentor: Mehdi Nikkhah, assistant professor
Research Theme: Health

Cardiac tissue engineering is an emerging field that has the potential to regenerate and repair damaged myocardium. Despite significant progress, previously developed tissue constructs have lacked necessary conductivity and cellular organization. To address these drawbacks, photocrosslinkable gelatin methacrylate (GelMA) was nanoengineered with embedded gold nanorods (GNRs) to improve the material...
Matthew Mortensen, Biomedical Engineering  
Graduation: May 2016  
Hometown: Chandler, Arizona  

An In Vitro and In Silico Study of Hemodynamics in Vascular Models  
Mentor: Michael VanAuker, lecturer  
Research Theme: Health  
The two main objectives of this study are to validate standard computational fluid dynamics (CFD) simulations using Particle Image Velocimetry (PIV) experiments, and produce PIV data to validate a novel, massively parallel hemodynamic simulator known as HARVEY. Qualitative analysis of velocity vector contour plots between steady state CFD and PIV for two patient-specific femoral artery bifurcations and an idealized bifurcation show a very strong correlation. Short-term future work includes mesh refinement study analysis, pulsatile simulations, quantitative analysis and conclusions. Long-term future work includes completing these studies on four additional models and validating HARVEY.

Bakir Mousa, Biomedical Engineering  
Graduation: May 2018  
Hometown: Gilbert, Arizona  

Algae Biofilms for Wastewater Treatment and Resource Recovery  
Mentor: César Torres, assistant professor  
Research Theme: Energy, Sustainability  
The use of microalgae biofilm systems can potentially reduce the energy cost in wastewater treatment by providing oxygen via photosynthesis and thus replacing the energy intensive aeration systems, and by providing a cost-effective method for algae production for lipid extraction for biofuels. Photo-bioreactors with a surface area of 162 cm² were used to grow microalgal communities with continuous synthetic wastewater supply. Regular harvesting of the biomass and quantification of lipid content shows the potential application of such systems for algae production for biofuels.

Gergey Mousa, Biomedical Engineering  
Graduation: May 2018  
Hometown: Phoenix, Arizona  

LM22-A to Enhance Motor Recovery With Low Intensity Rehabilitation  
Mentor: Jeffrey Kleim, associate professor  
Research Theme: Health  
Stroke is the leading cause of adult disability and standard amounts of physical therapy are often insufficient to fully restore function. Currently, animal models of motor rehabilitation utilize intensive training regimens that do not mimic clinical standards. Augmenting physical therapy with the novel drug, LM22A-4, may enhance motor recovery and cortical plasticity, thus reducing the necessary rehabilitation intensity to clinically relevant amounts. This study investigates how LM22A-4 impacts stroke lesion size and motor recovery of animals having undergone post-stroke rehabilitation similar to clinical standards. Preliminary results suggest that LM22A-4 may enhance motor recovery with reduced amounts of motor rehabilitation.

Mohammad Mousa, Biomedical Engineering  
Graduation: May 2017  
Hometown: Gilbert, Arizona  

Development of a Smart Prosthetic Palm Using a Cohesion of S.E.B.S. and Graphite  
Mentor: Jeffrey La Belle, assistant professor  
Research Theme: Health  
The focus for this project is to develop an advanced manufactured biomimic prosthetic palm with an embedded flexible pressure sensor with the capability to detect the same levels of sensitivity of a human hand while also maintaining a natural skin-like feel. Utilizing advanced manufacturing techniques allows for the sensor to be embedded within a complete 3D printed prosthetic. The thermoplastic palm has proven to be as capable as the human hand, detecting equivalent levels of sensitivity. Future work includes printing user-specific shapes to embody an entire prosthetic arm.
Anoosha Murella, Materials Science and Engineering
Graduation: May 2016
Hometown: Phoenix, Arizona
Drop-on-Demand Printing of Self-Reducing Copper Inks
Mentor: Owen Hildreth, assistant professor
Research Theme: Energy
Inkjet printing of conductive solutions is a growing area in additive manufacturing research. The goal for this project is to synthesize, print and improve on the resulting electrical and physical properties of self-reducing copper inks. Electrical performance will be quantified via four-point probes while the structure will be characterized through optical and scanning electron microscopy (SEM). Since copper is a cheap, abundant and effective conductor, having a simple method to produce and print it is of great scientific and commercial value.

Undergraduate Research Travel Grant Program

Suhyun Nam, Electrical Engineering
Graduation: May 2017
Hometown: Chandler, Arizona
MEMS Dual Membrane Microphone
Mentor: Junseok Chae, associate professor
Research Theme: Security
A dual membrane microelectromechanical system (MEMS) microphone is to be built and tested for the investigation of its shock mitigation capabilities. The current design of MEMS microphones is susceptible to permanent damage and shearing when an external shock, such as a drop, is induced on its structure. Through using a dual membrane structure, results from this semester indicate that electrostatic force reduces the shock impact significantly on the diaphragm, which is responsible for the microphone’s function. Since MEMS microphones are used in cell phones, the focus is toward a dual membrane microphone with high sensitivity along with shock mitigation.

Hyperloop Design
Mentor: Panagiotis Polygerinos, assistant professor
Research Theme: Education, Energy, Sustainability
What is Hyperloop? Picture traveling in an airplane (without wings) down a low pressure tube. The pod will float on a cushion of air called air bearings at speeds up to 760 mph. The route was from Los Angeles to San Francisco in 40 minutes. The researcher worked on the mechanical system of the pod, mostly dealing with structural models and aerodynamics. They worked with designing the exterior and interior, mechanical safety systems and propulsion/levitation. Designs for test tracks and capsules are currently being developed, with construction of a full-scale prototype 5-mile (8 km) track scheduled to start in 2016.

Undergraduate Research Travel Grant Program

Joey Nguyen, Engineering (Robotics)
Graduation: May 2017
Hometown: Phoenix, Arizona
Hyperloop Design
Mentor: Panagiotis Polygerinos, assistant professor
Research Theme: Education, Energy, Sustainability
What is Hyperloop? Picture traveling in an airplane (without wings) down a low pressure tube. The pod will float on a cushion of air called air bearings at speeds up to 760 mph. The route was from Los Angeles to San Francisco in 40 minutes. The researcher worked on the mechanical system of the pod, mostly dealing with structural models and aerodynamics. They worked with designing the exterior and interior, mechanical safety systems and propulsion/levitation. Designs for test tracks and capsules are currently being developed, with construction of a full-scale prototype 5-mile (8 km) track scheduled to start in 2016.

Undergraduate Research Travel Grant Program

Ky Nguyen, Chemical Engineering
Graduation: May 2016
Hometown: Gia Lai, Vietnam
Relative Acidity Comparisons of Various Metal-Organic Frameworks Using FTIR
Mentor: Bin Mu, assistant professor
Research Theme: Energy
Metal organic frameworks (MOFs) have the potential to be crucial catalysts for industrial processes to reduce energy cost. The number of acid sites and their strength are important in determining the suitability of an MOF in being a catalyst. The goal of this project is to compare the acidity of different MOFs and rank them according to their acidity strength. The focus has been comparing MOFs’ Lewis acid sites using pyridine as the probe molecule. Future work involves working with different probe molecules for a more comprehensive characterization including Bønsted acidity and basicity.
**Resistance Changes and Shear Forces upon Bending in Stretchable Interconnects**

Mentor: James Abbas, associate professor  
Research Theme: Health

This research's objective involves characterization of a flexible resistive sensor, comprising of thin and microcracked gold films patterned and embedded in soft elastomeric polydimethylsiloxane (PDMS). Microcracked morphology will allow for the gold electrodes to remain electrically conductive upon stretching, and demonstrate significant changes in resistance that enables simultaneous detection of normal contact force, shear force and bending. Such sensors — soft, elastic, biocompatible and capable of concurrent detection of various types of stresses — can serve as effective interface with neurons and mechanically active tissues and be adapted for numerous biomedical applications such as enhanced prosthetic tactile perception, plantar pressure sensor.

**Optimization of Grain Structure of In$_2$O$_3$:H Transparent Conducting Oxide Thin Films for Improved Electron Mobility in Photovoltaics**

Mentor: Mariana Bertoni, assistant professor  
Research Theme: Energy

This work investigates how utilizing a novel transparent conducting oxide, indium oxide doped with hydrogen, can improve solar cell efficiency over the industry standard. Hall measurements and temperature-dependent impedance measurements were performed and correlated with structural data of the film obtained through Raman spectroscopy and scanning electron microscopy to determine how electron mobility changes between grain boundaries. It is estimated that an External Quantum Efficiency gain of 1 percent is possible when switching, which is significant for photovoltaic devices with current efficiencies of 25 percent and can improve the performance of any optoelectronic device that relies on a TCO.

**A Supernumerary Wearable Soft Robotic Arm for Task Execution Assistance**

Mentor: Panagiotis Polygerinos, assistant professor  
Research Theme: Health

Soft robotics, a relatively new field of robotics research, differs from traditional “hard” robotics in that they are made using soft materials such as silicone rather than metals and are actuated using fluids. This project utilizes soft actuators to create a supernumerary robotic arm to assist with activities of daily living. Research includes the design, fabrication, testing and characterization of soft actuators which can create various motions when pressurized. The integration of these soft actuators into a robotic arm that is safe to use and offers flexibility and a wide range of motion.

**Generating Representative Volume Elements of Nickel Superalloys by 3D Reconstruction**

Mentor: Aditi Chattopadhyay, Regents’ Professor  
Research Theme: Security

The goal of this research is to generate an accurate and size-optimized 3D representative volume element (RVE) of the nickel superalloy Inconel 718 using computational modeling. The material parameters necessary to generate the 3D RVE will come from electron backscatter diffraction (EBSD) scans as well as microscopy. An accurate RVE can be meshed and analyzed using finite element analysis (FEA), which means that laboratory experiments performed on the material, which involve high temperatures and high stresses, can be matched computationally. Uniaxial and biaxial tension tests will be performed on carefully designed test specimens to verify the simulation results.
Kai Ozawa, Aerospace Engineering
Graduation: May 2018
Hometown: Chandler, Arizona

Analysis of Long-Term Changes in the Environmental Flow System Over Arizona
Mentor: Huei-Ping Huang, associate professor
Research Theme: Energy

Over the past three decades, temperatures have trended upward and surface wind speed has decreased, resulting in a changed environment for Arizona locals. The research hypothesis is that long-term environmental changes are strongly influenced by local land use caused by economic cycles of growth and decay. The researchers examined the data collected by AZMET via local weather stations and re-created a chart representing the surface temperature and wind-speed of urban locations.

Adam Pak, Chemical Engineering
Graduation: May 2017
Hometown: Mesa, Arizona

Mechanical Stimulation of Neural Progenitor Cells
Mentor: Sarah Stabenfeldt, assistant professor
Research Theme: Health

In order to advance traumatic brain injury (TBI) research, the objective of this research was to test in vitro technology that simulates TBI conditions on neural progenitor cells. Cell cultures were prepared on Polydimethylsiloxane (PDMS) and stretched using a voice coil actuator (VCA) with strain and strain rates as independent variables. Implementation of feedback control loop occurred for error rejection and visual videos were used for actual strain and strain rates received by the sample. In the future, stretchable microelectrode array (sMEA) will be implemented to monitor neural field potential of cultures while stretching.

Andrew Park, Mechanical Engineering
Graduation: May 2017
Hometown: Tempe, Arizona

Development of a Portable Automated Ball Indenter
Mentor: Yongming Liu, associate professor
Research Theme: Energy

The main objective of the project is to develop an experimental and numerical method to evaluate the mechanical properties of oil and gas pipelines. Automated ball indentation techniques (ABI), are currently used, and allow researchers to nondestructively gather key mechanical properties. The problem with this technique, however, is that a bulky and expensive ABI system is needed. The research will focus on developing a portable automated ball indentation technique (PABI), and designing an affordable, pocketsize PABI system.

Jacob Peplinski, Electrical Engineering
Graduation: May 2018
Hometown: Gilbert, Arizona

Compressive Testing of a Multimaterial Auxetic Lattice
Mentor: Keng Hsu, assistant professor
Research Theme: Security

This study explores the behaviors of Auxetic lattices with heterogeneous material properties with the purpose of using 3D printing capabilities to strengthen the cell in compression and tension. The researchers did so by replacing the corners of each cell in the lattice with a low-modulus elastic material to relocate critical stress locations. Preliminary results support the use of multi-material printing as a viable option for introducing design flexibility and strength into the lattice. Future research will involve the design and testing of 3D Auxetic structures that take advantage of material heterogeneity.
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The focus of this research project was to create a safe and viable high speed pod and tube design based on the conceptual research done by Elon Musk. A design package and subscale model was created with extensive research done in the field of human safety and emergency management systems. Future research would focus on full scale testing of the proposed package design with data analysis of human survivability under high speed conditions.

Undergraduate Research Travel Grant Program

In Arizona, most consumption of power comes from using air conditioning units to try to beat the heat. This poses a problem for the compressor in air conditioning units as it uses the most power in an air conditioning unit and tends to be overworked, which often leads to failure. To solve this issue, a process known as thermal energy storage will be used to replace the compressor during peak hours. This process will help drive the cost down in air conditioning units during peak hours and prolong the life of compressors.

With recent advances in missile technology, the need to accurately simulate missile-target engagements has never been greater. A kill zone is the set of target initial conditions which results in a kill. This research is examining a fully integrated missile-target engagement environment to understand how the kill zone depends on critical engagement parameters. In order to efficiently compute the kill zone associated with an initial engagement geometry, this research uses a six degree-of-freedom bank-to-turn nonlinear missile model, classic guidance-and-control algorithms and a 360 degree ray-based binary search algorithm which exploits two-dimensional planar symmetry.

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 evaluates finger movements and enhances motor planning by mapping neural connections and brain activity. The startle reflex, which stimulates the brain stem rather than the cortex, triggers specialized finger movements. Electromyography recorded muscle activity from the flexor and extensor digitorum. Movement latencies in voluntary and involuntary movements were compared to determine susceptibility to startle reactions. This research has further implications for movement therapies for stroke survivor patients.
Elizabeth Quigley, Materials Science and Engineering
Graduation: May 2016
Hometown: Plano, Texas

A Novel Methodology for Self-Healing at the Nanoscale in CNT/Epoxy Composites
Mentor: Aditi Chattopadhyay, Regents’ Professor
Research Theme: Energy, Security

Self-healing materials have the potential to repair damage, extend the life of aerospace or civil components, and prevent catastrophic failure. This research uses a novel technique for self-healing capabilities in carbon nanotube (CNT)/epoxy nanocomposite films. To explore functionalized CNTs' effect on healing, specimens with different CNT weight fractions were fabricated. Optical micrographs with different fluorescent filters showed partial or complete healing two to three weeks after damage. Results indicate that using CNTs can retard crack growth in self-healing CNT/epoxy nanocomposites, leading to autonomously repairing, safer materials.

Abhishek Rajadas, Aerospace Engineering
Graduation: May 2017
Hometown: Tempe, Arizona

Characterization, Detection, and Analysis of Damage in X-Cor Composites
Mentor: Aditi Chattopadhyay, Regents’ Professor
Research Theme: Health, Security

A methodology is developed by combining NDE and SHM techniques for detection of in situ damage in advanced X-COR sandwich options. Optimally placed MFC transducers and an advanced time-frequency based signal processing technique (MPD) is used for damage localization. Two new foam-core carbon-fiber samples were manufactured at the Boeing facility. Flash thermography was used to verify the location of the seeded damage within the samples. The data from the MFC transducers will be analyzed using the MPD technique. A novel sensing mechanism utilizing the piezoresistive properties of buckypaper will also be developed to monitor damage evolution under tensile loading.

Samarth Rawal, Computer Science
Graduation: May 2018
Hometown: Chandler, Arizona

BioParser: A Knowledge Parser for Biomedical Text
Mentor: Chitta Baral, professor
Research Theme: Education, Health

The researchers have developed a semantic natural language parser for the biomedical domain and are now applying it toward solvable problems, particularly the DARPA (Defense Advanced Research Projects Agency) Big Mechanism problem. The current research goal is to improve the accuracy of the Bioparser and to apply its abilities to creating and putting together biological-causal mechanisms as outlined by the Big Mechanism proposal. The goal is to finish implementing updates to improve the accuracy of the parser, then develop a reliable and efficient system to use the Bioparser to create causal mechanisms.

Carlos Renteria, Biomedical Engineering
Graduation: May 2016
Hometown: Litchfield Park, Arizona

Mathematical Modeling of Tumor Spheroids for the Quantification of Oxygen Diffusion and Tumor Hypoxia
Mentor: Vikram Kodibagkar, assistant professor
Research Theme: Health

GdDO3NI is a novel hypoxia-targeting magnetic resonance imaging (MRI) contrast agent that could serve to characterize tumor hypoxia in vivo. The goal of this research is to characterize the diffusion characteristics of oxygen in tumor spheroid models. By analyzing the oxygen diffusion characteristics with pimonidazole first, the researchers have a means of correlating the fluorescence of pimonidazole-stained images to the theoretical partial pressures of oxygen in a tumor spheroid through image processing. Future studies with GdDO3NI could then be performed as well, comparing the results obtained from both modalities, serving as another step towards the establishment of the effectiveness of the agent.
Edward Reyes, Chemical Engineering  
Graduation: May 2016  
Hometown: Buckeye, Arizona

**MOF Research**

Mentor: Bin Mu, assistant professor  
Research Theme: Energy

The aim of the study is to monitor the breathing behavior of a flexible metal-organic framework MIL-53(Al), to the adsorption of CO2 via infrared spectroscopy. The appearance and disappearance of the 1715 cm-1 wavenumber appear to coincide with the expected pressures at which the MOF flexes according to literature. Furthermore, the peak intensity does not increase linearly with pressure increase, which suggests that the 1715 cm-1 peak is an adequate wavenumber to monitor for the flexing behavior. Future work should adsorb different gasses into the MOF to give another line of evidence that the isolated peak (1715 cm-1) does show the flexing behavior.

David Reynolds, Chemical Engineering  
Graduation: May 2017  
Hometown: Gilbert, Arizona

**Improved Technique for the Mechanical Exfoliation of Two Dimensional Nanomaterials**

Mentor: Qing Hua Wang, assistant professor  
Research Theme: Energy, Sustainability

An improved technique for the mechanical exfoliation of two dimensional nanomaterials has been shown to increase monolayer area by 50 times by adding a heat treatment to the process. This technique has been validated for graphene, and has also been applied to the exfoliation of MoS2 and WS2. MoS2 showed a 100 percent increase in monolayer sample yield, from 4 m² to about 10 m², while WS2 has shown a substantial increase as well. This technique might be further applied to powder substances such as BN for cheaper production of two dimensional nanomaterials.

Erin Riley, Mechanical Engineering  
Graduation: May 2016  
Hometown: Phoenix, Arizona

**Quantifying Microstructural Effects on the Strain Localization During Fatigue in CP-Ti and Ti-O**

Mentor: Kiran Solanki, assistant professor  
Research Theme: Sustainability

The goal of this research is to compare the mechanical properties of CP Ti and Ti-O and to understand the relationship between a material’s microstructure and its response to fatigue. Titanium has been selected due to its desirable properties and applicability in several engineering fields. Both samples are polished and etched in order to visualize and characterize the microstructure and its features. The samples then undergo strain-controlled fatigue tests for several thousand cycles. Throughout testing, images of the sample are taken at zero and maximum load for DIC analysis. The DIC results can be used to study the local strains of the samples. After data collection and analysis, the difference between the microstructures CP Ti and Ti-O samples and its effect on fatigue loading will be quantified. The outcome of this research can be used to develop long-lasting, high-strength materials.

John Robertson, Computer Science  
Graduation: December 2016  
Hometown: Prescott, Arizona

**Darknet and Deepnet Mining for Proactive Cybersecurity Threat Intelligence**

Mentor: Paulo Shakarian, assistant professor  
Research Theme: Security

Cybersecurity has become an issue of concern for both commercial organizations and governments. The researchers have developed an operational cyber threat intelligence system that gathers data from numerous darknet and deepnet sites, mostly black-hat hacker marketplaces and forums. The system is significantly augmented by the use of various data mining and machine learning techniques that enable researchers to recall almost 90 percent of relevant, hacking-related discussions (resp. products) in forums (resp. marketplaces) with high precision. The research also leverages topic modeling to automatically identify useful forum and marketplaces on which to begin data collection.

Undergraduate Research Travel Grant Program
The influence of H2O on IO:H transparent conducting oxide (TCO) layers has been well documented. However, the influence of adding a greater ratio of Hydrogen gas into the chamber has had no reported observations. Through varying hydrogen gas partial pressures in the sputtering chamber, during deposition, a trend will be mapped out. Results are still underway, but the goal is to determine hydrogen influence on TCO properties such as mobility, carrier concentration and absorption.

**Felicia Romero, Chemical Engineering**
Graduation: May 2016
Hometown: Redmond, Washington

**Engineering Ion-Containing Block Copolymers as Next-Generation Water Purification Membranes**
Mentor: Matthew Green, assistant professor
Research Theme: Sustainability

Desalination through reverse osmosis (RO) is an existing practice used to make potable water from the seemingly unlimited resource of seawater. Existing RO membrane technology faces one of two limitations: salt selectivity or water flux. The objective of this research is to generate membranes and explore and optimize the relationship between amount of poly(ethylene glycol) used to cross-link poly(vinyl alcohol) fibers such that the hydrophobicity of the polymer blend and degree of cross-linking supports desired selectivity and water flux. The factors that affect the membrane properties are presented and discussed.

**Karime Jocelyn Rosas Gomez, Chemical Engineering**
Graduation: May 2016
Hometown: Mexico City, Mexico

**Utilization of Visible Light to Decrease UV Induced DNA Damage in Micropatterned 3D Tumor Models**
Mentor: Mehdi Nikkhah, assistant professor
Research Theme: Health

The use of UV light to develop micropatterned 3D in vitro tumor models has gained popularity in recent years. Nevertheless, there has been an increasing concern that UV light might induce DNA damage in encapsulated cells. The aim of the project is to assess UV-induced DNA damage in cancer cell line MDA-MB-231 over the culture period. A visible light engineered 3D tumor model will aid in comparing parameters such as DNA damage, cell viability, and sample preparation time. Such analysis will help optimize the 3D tumor model which can be advantageous for disease modelling, fundamental studies and drug testing.

**Adric Rukkila, Computer Science**
Graduation: December 2017
Hometown: Phoenix, Arizona

**Lilac: An Open Source Photovoltaic Module Tester**
Mentor: Stuart Bowden, associate research professor
Research Theme: Energy, Sustainability

For photovoltaic modules, there is currently a gap between commercial module testers, many of which cost tens of thousands of dollars, and simple devices that are unable to sweep out the requisite IV curve. By combining the Arduino microcontroller system with open source software, Lilac provides the same functionality as high-end testers at a low-end price point, enabling efficient measurement of modules up to 300 W and opening the door for further development as a research and consumer photovoltaic tool.
In an effort to increase the electrical current of solar cells, the objective of this investigation is to create a monolayer of nanoparticles that will act as a “seed” for nucleating crystalline silicon films. The researcher will observe how the light polarization changes when it reflects off a surface, a silicon monolayer. This data will be used to calculate the thickness and density of the silicon monolayer through spectrophotometry and ellipsometry analysis. Thin, crystalline silicon layers will form a p-n junction with the silicon wafer, creating the absorber of a solar cell that yields a higher current output.

Mentor: Zachary Holman, assistant professor
Research Theme: Energy

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Mentor: Zachary Holman, assistant professor
Research Theme: Energy

Investigation of Dreissena bugensis Reproduction in Arizona Water Sources
Mentor: Peter Fox, professor
Research Theme: Energy, Sustainability

Quagga mussels (Dreissena bugensis) are an invasive species that are currently present in Central Arizona Project (CAP) waters, but have trouble spreading through Salt River Project (SRP) waters. The purpose of this research is to understand spawning behavior for quagga mussels collected from infested local waters. Mussels will be exposed to a serotonin creatinine sulfate monohydrate before being observed in filtered lake water for up to four hours. In-lab mussel spawning will be conducted at least once a month, depending on the ability to conduct collections.

Mentor: Peter Fox, professor
Research Theme: Energy, Sustainability

Shape factors for pseudo-steady state flow of a fractured-well in reservoirs of rectangular shape
Mentor: Kangping Chen, associate professor
Research Theme: Energy

Pseudo-steady state (PSS) flow is a dominant time-dependent flow regime during constant rate production from a closed oil reservoir. Recently, Chen has obtained an exact analytical solution for PSS flow in a fully penetrated fractured vertical well with finite conductivity in a circular drainage area. This research correlates the PSS flow of a fully penetrated fractured vertical well in rectangular drainage areas to Chen’s solution for circular drainage areas using shape factors. This generalization of the PSS flow solution is significant in fracture design optimization, production rate decline analysis and shortens the computational time required for such a solution.

Mentor: Kangping Chen, associate professor
Research Theme: Energy

Visualizing the Run-Time Stack Behavior of x86 Binaries
Mentor: Adam Doupé, assistant professor
Research Theme: Education, Security

During the process of finding exploits in code one must match corresponding registers with locations in memory. The goals are to bring an open source tool to researchers and programmers to find where such vulnerabilities exist. The most probable outcome is that the program is open on GitHub and has a front-end website display for where such vulnerabilities exist. The research has demonstrated that spearheading the program to the end and fixing the details afterward is a key part in the process.
Productivity Analysis in Civil Engineering and Construction — A Sustainability Perspective

Mentor: David Grau, assistant professor
Research Theme: Sustainability

The main objective of this research is to measure and analyze the performance and efficiency in the production of a construction site using two different techniques: crew balance and activity analysis. Crew balance will utilize the five-minute tool rating, which is implemented by collecting data from at least five cycles of a short term, repetitive activity (pouring concrete into slabs, for example). Activity analysis will be used to assess management effectiveness. The researcher will study and identify possible productivity barriers, then implement improvements to reduce barriers.

Ema Shqalsi, Civil Engineering
Graduation: May 2017
Hometown: Tempe, Arizona

Adam Siegel, Materials Science and Engineering
Graduation: May 2018
Hometown: San Diego, California

Heating/biasing TEM holder

Mentor: Peter Crozier, associate professor
Research Theme: Energy

The aim of this research is to develop a transmission electron microscope (TEM) sample holder that will allow for the observation of materials in-situ while under reactive gas conditions with an applied bias at elevated temperatures. The current goal is to optimize the heater design and to create a control circuit. Heater/bias devices have been fabricated and are being tested. Future work will include mounting focused ion beam (FIB) prepared samples onto the sample holder to be tested in the TEM. This holder will enable many new in-situ experiments, which will provide a better understanding of the functioning of materials.

Adam Siegel, Materials Science and Engineering
Graduation: May 2018
Hometown: San Diego, California

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Mentor: Peter Crozier, associate professor
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Dallas Sigrist, Chemical Engineering
Graduation: May 2016
Hometown: Tempe, Arizona

Fourier Transform Infrared Spectroscopy Mapping Study of the Diffusion of Hexane through Zeolitic Imidazolate Framework-68

Mentor: Jerry Lin, Regents' Professor
Research Theme: Sustainability

The goal of the experiment was to find the rate of diffusion of hexane vapor through zeolitic imidazolate framework (ZIF) 68 crystals by Fourier transform infrared spectroscopy (FTIR) mapping. After analyzing the sample with FTIR, it was proven that ZIF-68 adsorbed hexane gas. When the sample was exposed to atmosphere for 24 hours, almost no hexane diffused out of the crystal and hydroxyl bonds were formed. When the sample was heated in a vacuum oven at 50 °C, all adsorbed hexane diffused out of the crystal. Future work will include calculating concentration, diffusivity and permeance.

Dallas Sigrist, Chemical Engineering
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Hometown: Tempe, Arizona

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Bryan Smith, Chemical Engineering
Graduation: May 2016
Hometown: Chandler, Arizona

Measurement Techniques for the Wettability of Powders

Mentor: Heather Emady, assistant professor
Research Theme: Education

This research's goal is to determine the factors that affect the contact angle, and therefore wettability, between a powder — microcrystalline cellulose and alumina — and a liquid — water and silicone oil — and to determine the best method of measuring said angle. It was discovered that fluids with a higher viscosity had a larger contact angle and an increased drop penetration time, making measurements considerably easier. Future work for this research includes performing a more indirect measurement technique for contact angle known as the Washburn method and comparing results to the work already performed.
Endoscopic submucosal dissection (ESD) is a procedure used to resect large lesions (usually larger than 2 cm) that reside within the submucosal space in the gastrointestinal (GI) tract. This procedure is minimally invasive, thereby reducing patient morbidity and recovery time. Due to the technical complexity and lack of sophistication in current manual tools, ESD is being seen as a prime candidate for robotic intervention. To improve upon the current standard-of-care, robotic systems must achieve a degree of yaw typical of circumferential lesions, generate the forces required by electrosurgical tools during cutting, and retract the tissue specimen to allow for effective removal. Force analysis from ex vivo animal models will allow us to more effectively design robust components that can both withstand and generate the required forces.

Study of Effects of Scaffold Polymers used as Support for Metal Organic Frameworks in the Application of CH\textsubscript{4}/CO\textsubscript{2}, Separation

Mentor: Bin Mu, assistant professor
Research Theme: Energy, Sustainability

Removing carbon dioxide from the atmosphere has become very important to the world. One such tool that has high promise in removing carbon dioxide is metal organic frameworks (MOFs). In order to support these metal organic frameworks, the permeability, selectivity and strength of the scaffolding polymer is important in deciding which polymer to use. This project involves finding the polymer to use as the scaffolding for MOFs, testing the separation of carbon dioxide from methane through various different polymers, as well as the strength of each polymer, being able to withstand higher pressures.

Project Build-a-Hero: Enhancing Biomedical Engineering as a Socially Relevant Discipline

Mentor: Tirupalavanam Ganesh, assistant dean of Engineering Education, associate research professor
Research Theme: Education, Health

The research goal is to empirically study a poster-based messaging campaign in comparison to that of a project-based learning approach, specifically regarding the effectiveness of these methods in conveying the scope of biomedical engineering to upper elementary school students. Sixth grade students received socially relevant messaging from ASU upperclassmen pursuing their biomedical engineering through engaging activities that stimulate making while emphasizing design-aesthetic appeal and engineering habits of mind such as creativity, teamwork and communication.

Circulating Tumor Cell Identification in Blood by Olfaction

Mentor: Barbara Smith, assistant professor
Research Theme: Health

Current methods of cancer detection are either highly invasive or possess low sensitivity. The identification of circulating tumor cells (CTCs) in blood could allow cancer metastasis to be detected early on, however, no clinical method currently exists. The objective of this project is focused on identifying the volatile organic compound (VOC) signature of ovarian cancer cells. Using the VOC signature, a limit of detection can be established for CTCs in a buffer, plasma and whole human blood that will allow researchers to determine if cancer metastasis is occurring.
Orthopedic infections due to biofilms are common after an open-fracture wound develops. These infections are usually difficult to eradicate due to the resistant nature of biofilms to antimicrobials. The antimicrobial concentration required to eradicate bacterial biofilms, minimum biofilm eradication concentration (MBEC), can be determined in vitro by exposing biofilms to different regimens of antimicrobial solutions. Previous studies have demonstrated that values of the MBEC vary depending on the material and surface the biofilm grows on. This study aims to investigate the effects of surface properties and material type on the MBEC of bacterial biofilms relevant to orthopedic infections.

**Gamuchirai Tavaziva, Biomedical Engineering**

Graduation: May 2016  
Hometown: Harare, Zimbabwe

**Effect of Surface Properties and Material Type on the Minimum Biofilm Eradication Concentration of Bacterial Biofilms Relevant to Orthopedic Infections**

Mentor: Brent Vernon, associate professor  
Research Theme: Health

With the increasing need to create clean energy sources, the demand for solar power still continues to dominate our society today. Solar power has become a vital form of energy, with production cost decreasing over the years due to new developments in the growth potential of solar energy. Microwave annealing is a rapid, low-temperature self-encapsulation process. Using microwave annealing, higher temperatures were achieved thereby forming titanium oxide on the AgTi surface, inducing grain growth and reducing resistivity in the AgTi alloy. Future applications include contact metallization for silicon based solar cells.

**Melby Thelakkaden, Materials Science and Engineering**

Graduation: May 2017  
Hometown: Gilbert, Arizona

**Microwave Assisted Low Temperature Annealing of AgTi Alloy**

Mentor: Terry Alford, professor  
Research Theme: Energy

Mutations in the BRCA 1 and 2 genes can increase lifetime breast cancer risk by as much as seven times. Detection of these mutations facilitates preventive measures and early diagnosis. Current BRCA tests are costly and take weeks for results. This project aims to develop a point of care biosensor for BRCA mutations, which would greatly decrease costs and provide results in the time span of a doctor’s office visit. This sensor could potentially be multiplexed to detect a host of other cancer-associated genetic mutations as well.

**Emily Thompson, Biomedical Engineering**

Graduation: May 2016  
Hometown: Scottsdale, Arizona

**Point-of-Care Genetic Biosensor for Breast Cancer Mutation Detection**

Mentor: Michael Caplan, associate professor  
Research Theme: Health

The research’s purpose is to identify a better buffer solution in the cathode chamber to improve hydrogen peroxide production in a microbial fuel cell (MFC) for the treatment of gray water on U.S. Military forward-operating bases. Acid forms of the buffers were used in the cathode of an MFC, and peroxide concentration was measured using spectrophotometry. No buffers showed significant differences of pH in the cathode. Sodium phosphate was the most stable in peroxide production while sodium bicarbonate was the least stable. Further research on hydraulic residence time (HRT) will help understand the lifetime of peroxide in the cell.

**Julia Thompson, Chemical Engineering**

Graduation: May 2016  
Hometown: Phoenix, Arizona

**Characterizing Buffers to Maximize Peroxide Production in the Cathode Chamber of Microbial Fuel Cells**

Mentor: César Torres, assistant professor  
Research Theme: Energy, Sustainability

**Undergraduate Research Travel Grant Program**
Applications for Assessing Installation Requirements of Photovoltaic Systems

Mentor: Rong Pan, associate professor
Research Theme: Energy, Sustainability

This research seeks to uncover new decision-making methods for planning the construction of photovoltaic systems. Such methods are based on the indexing and ranking of essential parts (e.g., panels, inverters, batteries) as they pertain to the user's purpose in building the system. From the research, one can see how photovoltaic systems can be specialized for certain purposes by analyzing the unique properties of the parts that comprise it. The scope of the research is limited to residential locations, but could be scaled to serve the needs of industrial locations if the demand is sufficient.

Magnetic Resonance Imaging of Hypoxia in Cancerous Cells

Mentor: Vikram Kodibagkar, assistant professor
Research Theme: Health

It is the intent of this research is to design and build an RF coil that can provide high quality nuclear magnetic resonance (NMR) data when imaging siloxane markers in tumor spheroids. The siloxane markers act as an oximetry agent and can be used to detect and identify hypoxia in tumors, an indicator of malignancy. By providing a quantitative measure of effectiveness, it is the hope that the NMR process can be used to model cancer therapies, and better identify and treat cancer based on unique, personalized data.

Analysis of Power Efficiency and Aerodynamic of Propulsion of Electric Ducted Fan Engines (EDF)

Mentor: Timothy Takahashi, professor of practice
Research Theme: Sustainability

The objective of the research is to better understand the airflow and forces acting on a small scale airplane electric ducted fan (EDF) engine. To test these EDF engines a unique base was built that snuggly fits in the ASU wind tunnel allowing no air to escape. The key instruments used for the data recording are a pitot probes at the wind tunnel's entrance and a load cell, which measures both compression and tension forces. Accurate data from this research can aid in the redesigning of both small scale and commercial airplane engine nacelles.

Aspect ratio affects on the mean circulation time for two-dimensional Rayleigh-Bénard convection

Mentor: Yulia Peet, assistant professor
Research Theme: Energy, Sustainability

Rayleigh-Bénard convection (RBC) is a type of natural convection that occurs when a fluid is heated from below and cooled from above. These conditions are known to lead to large-scale circulations in the system (roll cells). The goal of this research is to investigate how the large scale circulation time is affected by the aspect ratio in the RBC domain using 2D numerical simulations with a computational fluid dynamics research code Nek5000. The circulation time of the roll cells is to be evaluated for five different aspect ratios.
In real-world applications, materials undergo a simultaneous combination of tension, compression, and torsion as a result of high velocity impact. The split Hopkinson pressure bar (SHPB) is an effective tool for analyzing stress-strain response of materials at high strain rates but currently little can be done to produce a synchronized combination of these varying impacts. This research focuses on fabricating a flange which will be mounted on the incident bar and struck perpendicularly thus allowing for torsion without interfering with simultaneous compression or tension. Timing will then be established such that the waves impact the specimen simultaneously.

Throughout life, traumatic events, diseases and conditions may challenge one’s walking ability. Arduous physical therapy attempts to counteract such negative effects, but progress is slow due to uncertainty and inefficiency in the process. In some cases, progress is even too slow to maintain walking capability. Tools exist, though, to hasten efforts. Smart Shoes are one such tool, which connect pressure sensors to tubing placed underneath a typical shoe’s sole, collecting pertinent gait data. Proven effective, Smart Shoes tragically remain underdeveloped. This research works towards their development, aiming to improve data quality, heighten battery life and streamline the design.

A series of iron-(III) porphyrin complexes were sensitized on p-type NiO to examine photoelectrochemical activity for O₂ reduction. Electrochemical responses obtained from characterization experiments indicate at a current density of 1 mA/cm², the oxygen reduction onset overpotential increases under the exposure to light. In this work, it is shown for the first time that NiO electrodes sensitized with iron-(III) porphyrins are able to photocatalytically drive the reduction of O₂. The shift in the current density for O₂ reduction under illumination confirms the possibility of utilizing photocatalysts that have better thermodynamic potential alignments.

Measurements of four times ionized nickel (Ni V) wavelengths in the vacuum ultraviolet have been taken using the National Institute for Standards and Technology Normal Incidence Vacuum Spectrograph. The wavelengths observed in those measurements make use of high resolution photographic plates with the majority of the wavelengths having uncertainties of approximately 3 mÅ. Additionally, this wavelength region was observed with phosphor image plates. By pairing the observed wavelengths of Ni V with accurate line intensities from the image plates, this project demonstrates that it is possible to create an energy level optimization for Ni V providing high accuracy Ritz wavelengths.
In Situ SEM Fatigue Crack Growth Testing for Inconel 617 at Elevated Temperatures

Mentor: Yongming Liu, associate professor
Research Theme: Energy, Sustainability

The nuclear power industry is exploring Inconel-617 as a potential material for a critical component in the next generation of power plants. Current models of crack growth for the material are based on the average crack growth seen over the course of hundreds of cycles of loading. The goal of this investigation is to confirm a more detailed model for the crack growth in Inconel-617 through the use of Scanning Electron Microscopy (SEM) to establish a model based on crack growth at the subcycle level. This will provide a more precise model for the safe design of efficient power plants.

Animal Locomotion on Granular Media

Mentor: Hamid Marvi, assistant professor
Research Theme: Health, Sustainability

The objective of this project is to use nature-inspired locomotion to create a robotic system that can move efficiently on multiple granular media. One can obtain all the necessary information by scanning the specimen's footprint, calculating the drag force of the feet, and studying its movement pattern. These are found by using a laser scanner for footprints, multi-axis actuators for drag force and high-speed cameras to record motion. Most of this research is done on dry granular media such as sand; further research will study wet granular media such as mud.

Thermogalvanic Waste Heat Utilization from Automobiles

Mentor: Patrick Phelan, professor
Research Theme: Energy, Sustainability

Internal combustion automobiles waste significant energy as heat is expelled through the exhaust pipe. In effort to improve the efficiency of automobiles, this project seeks to harness this wasted heat energy via thermogalvanic cells. To maximize the energy utilized, efficient heat transfer from the exhaust air to the cell is necessary. Extensive calculations have been performed to determine an optimal configuration of fins within the cell while maintaining considerations such as cost, construction feasibility, and practicality. The future of this project includes prototype construction, testing, and data analysis; eventually, considerations for pressure drop and mass production will be made as well.

Undergraduate Research Travel Grant Program

Efficacy testing of a self-stirring syringe is conducted through quantitative analysis via fluorescent spectroscopy and micro-bead concentrations for given infusion volumes. It has been found that the self-stirring syringe is able to agitate fluid using magnetic fields and a specialized stirring device in a manner that particles are homogenously suspended throughout an infusion. Creating a more efficient, cheaper and sustainable device while maintaining efficacy are some future research ideas to explore.
John Woodward, Mechanical Engineering  
Graduation: May 2017  
Hometown: Scottsdale, Arizona

Characterization of Interlaminar Fracture Properties of Advanced Polymer Matrix Composites Interleaved with Buckypaper

Mentor: Masoud Yekani Fard, assistant research professor  
Research Theme: Security

This investigation examines the effects of manufacturing procedures on the interlaminar fracture properties of buckypaper based composites. Buckypaper was fabricated using both novel surfactant-free and the conventional dispersion/filtration techniques. Characterization of structural properties is necessary in determining the viability of new procedures as industrial scale solutions. Microstructural properties such as permeability, porosity, pore size and distribution are being investigated using scanning electron microscopy and Brunauer-Emmet-Teller method. Buckypaper will be integrated into CFRP composites, and the interlaminar fracture properties of buckypaper based composites will be investigated. An envelope function will be developed that can be used for designing buckypaper-based nanocomposites.

Undergraduate Research Travel Grant Program

Jiaqi Wu, Computer Science  
Graduation: May 2018  
Hometown: Peoria, Arizona

Examining the Natural Diversity of Quorum Sensing for Orthogonal Pathways

Mentor: Karmella Haynes, assistant professor  
Research Theme: Health

Homoserine lactone (HSL) quorum sensing (QS) is a bacterial cell-to-cell communication method. Bioengineers incorporate QS into genetic circuits by using the bacteria's signaling pathway as a “bio-wire.” Complex genetic circuitry is inhibited by pathway overlap (crosstalk) and lack of pathways (4 percent have been used in synthetic systems to date). The researchers designed a decoupled system to test pathways for orthogonality (lack of crosstalk) using a sender cell, which carries the HSL synthase, and receiver cell, which carries the QS promoter and regulator. The research will expand the synthetic biology toolbox and increase flexibility when building complex gene circuitry.

Undergraduate Research Travel Grant Program

Jimmy Xu, Chemical Engineering  
Graduation: May 2018  
Hometown: Gilbert, Arizona

Construction and In-Vivo Application of Synthetic Transcription Factors

Mentor: Karmella Haynes, assistant professor  
Research Theme: Health

The engineering of transcription factors can provide key insights into the mechanisms involved in gene regulation. This project will focus on the construction of synthetic "Polycomb" transcription factors (PcTFs) to form a combinatorial library, which will be used to test the effects of certain linker, binding domain or activation domain parts on gene regulation in-vitro. The synthetic transcription factors were engineered using BioBrick assembly, which will be structurally analyzed using Circular Dichroism (CD). Of the 68 target constructs, 59 have been successfully synthesized. Future considerations will employ PcTF candidates identified by CD to be tested on a human cell line.

Undergraduate Research Travel Grant Program

Jason Yang, Biomedical Engineering  
Graduation: May 2017  
Hometown: Litchfield Park, Arizona

Developing Conformal Process for Contouring Biomedical Material Implant Shape for Personalized Precision Regenerative Medicine

Mentor: Vincent Pizziconi, associate professor  
Research Theme: Health

The goal of this research is to utilize biomaterials science and engineering techniques to provide Mayo ENT (ear, nose and throat) surgeons with 3D conformal biomaterial implants for the regeneration of patient-specific vocal fold tissue. Preliminary results indicate that a thermally based biomaterials process can be developed that allows ENT surgeons to reshape 2D porous polyethylene sheets (Medpor®) into patient-specific conformable 3D implants on site using 3D printed templates. Future work will further develop this concept into a biomaterials conformation process that can reliably produce 3D porous polyethylene substrates for the precision bio-manufacturing of vocal folds.

Undergraduate Research Travel Grant Program
**Shengjie Zhu, Engineering (Robotics)**
Graduation: May 2016  
Hometown: Shanghai, China

**Human-Robot Interactions**
Mentor: Angela Sodemann, assistant professor  
Research Theme: Health
This research's goal is to determine what social cues influence the degree of trust between humans and artificially intelligent (AI) agents. To reach this goal, the researchers will build a physical robot that can make certain movements like a human, develop the game of logic based on “Wumpus World,” then have participants play the game with the AI agent, change the robot social cues and measure how much the person trusts the robot based upon the person’s likelihood of accepting the robot’s gameplay suggestions. Future work will focus on programming a robot to make facial movement like human beings.

**Haley Gjertsen, Chemical Engineering**
Graduation: May 2016  
Hometown: Scottsdale, Arizona

**Investigation of Cell Media and Aminoglycoside Hydrogel Properties for Cancer Cell Dormancy**
Mentor: Kaushal Rege, associate professor  
Research Theme: Health
In a dormant state, cancer cells survive chemotherapy leaving the opportunity for cancer cell relapse and metastasis ultimately leading to patient death. A novel aminoglycoside-based hydrogel “Amikagel” developed in Dr. Rege’s lab serves as a platform for a 3D tumor microenvironment (3DTM) mimicking cancer cell dormancy and relapse. Six Amikagels of varying mechanical stiffness and adhesivities were synthesized and evaluated as platforms for 3DTM formation through cell viability and cell cycle arrest analyses. The impact of fetal bovine serum concentration and bovine serum albumin concentration in the media were studied for their impact on 3DTM formation.
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 course work, 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 both 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.

**Hope Jehng, Chemical Engineering**
Graduation: May 2019
Hometown: Fort Mohave, Arizona

Non-Invasive Drug Delivery Imaging Techniques
Mentor: Michael Caplan, associate professor
Research Theme: Health

Infection prevention or treatment after orthopaedic total hip arthroscopy is a critical medical problem — 0.5 percent to 2 percent of total hip arthroscopies result in infection, and the failure rate of infection treatment is approximately 10 percent. How can clinicians non-invasively measure antimicrobial concentration delivered subsequent to placement of a local drug delivery depot? This research will convert MRI images of a delivered contrast agent to concentration in the tissue of an animal model. Measuring the concentration of drugs delivered can help clinicians understand how to optimize treatment protocols. This data is important for FDA approval of the drug delivery product created by collaborators.

**Alex Maltagliati, Chemical Engineering**
Graduation: May 2017
Hometown: Avondale, Arizona

Optimization of Zeolite Particle Content on Microporous Support Membrane with Bioadhesion Agent for Thin Film Nanocomposite Membranes
Mentor: Mary Laura Lind, assistant professor
Research Theme: Sustainability

This research focuses on the first step of membrane synthesis, which is creating the initial polymer-zeolite thin layer on the substrate. The ultimate goal is to optimize the coverage of zeolites on the support layer with this novel approach. The primary parameters investigated include the weight percent of polydopamine and LTA zeolites as well as drying conditions. Despite the wealth of data that has been gathered from research this semester, the process has room for improvement by continuing to explore variations of these parameters.
Improving Object Detection and Recognition in an Augmented Reality Environment

Akhila Murella, Computer Science
Graduation: May 2018
Hometown: Phoenix, Arizona

The goal of this research is to improve a method of object detection and recognition for the Kinect and augmented reality glasses through the use of OpenCV and Support Vector Machines that aide in designing learning algorithms. During the semester, the uses of OpenCV and SVM were explored and an algorithm was developed and implemented in a trial and error format on the Kinect over the course of two months. Testing is ongoing, the object detection system is roughly working and the Kinect can identify and learn what different objects are.

Frederick Sebastian, Biomedical Engineering
Graduation: May 2017
Hometown: George Town, Malaysia

The Development of a Comfortable Myoelectric Prosthetic Socket – Fishbone

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

Existing prosthetic sockets have two major problems: limited functionality and discomfort due to poor fitting. The goal of this project is to create a socket with high electrical conductivity that will be attached to a lightweight myoelectric transradial prosthesis while also assuring comfort to the user. Electroactive poly(amideamine) (EPOP) have been found to have high biocompatibility and electrical conductivity. Therefore, lining the inside of a socket with EPOP mixed with a polymer might create a compressive surface that provides a better fit to users, and the electrical conductivity allows for attachment to a myoelectric prosthesis with higher functionality.

Robert Tichy, Mechanical Engineering
Graduation: May 2019
Hometown: Chicago, Illinois

Effective Learning Management System Capabilities

Mentor: Robert Atkinson, associate professor
Research Theme: Education

The objective of this project is to understand what aspects of learning management systems (LMS) make them more effective for users and why it makes them “user friendly.” The interactive capabilities of learning programs come into question with students and teachers, and most systems struggle with providing adaptive learning for a student's needs. Part of the work on this project focuses on comparing and contrasting three popular LMSs on their constraints and affordances (e.g., discussion board features, announcements, etc.). This work explores the aspect of stand-alone vs university-backed programs and the correlation between the programs used.

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

Electrospinning nanoscale fibers from a polymer solution is a cost-effective, efficient way to produce polymer mats for water filtration. However, spinning a purely hydrophobic polymer results in membranes with a limited flux. Adding a hydrophilic polymer to the mat can improve the “wettability” of the membrane. Using poly(vinyl chloride) (PVC) as the hydrophobic polymer and poly(vinyl alcohol) (PVA) as the hydrophilic polymer, different polymer ratios are examined to tune the hydrophilicity. Polymer solutions and mats were characterized using solution rheology, solution conductivity, scanning electron microscope, and water contact angle measurements. An ideal concentration ratio of PVC:PVA was obtained.
Where are they now?

Cody Anderson (Civil, Environmental and Sustainable Engineering '11, FURI Fall '10–Spring '11) is an engineering instructor at Scottsdale Community College.

Maria Regina Arreloa (Chemical Engineering '11, FURI Fall '09–Spring '10) recently completed an MBA from l'Ecole Nationale des Ponts et Chaussées in Paris and is currently working in London for a Management Consulting firm focusing on marketing and sales, particularly for pharma companies.

Rachel Austin (Biomedical Engineering '12, FURI Fall '11–Spring '12) is a Senior Manufacturing Engineer in the IC Test Systems group at Medtronic, where they manufacture the circuit boards for all of Medtronic’s implantable medical devices.

Jaclyn Avallone (Material Sciences and Engineering '12, FURI Spring '12) is pursuing a Ph.D. in Materials at the University of California, Santa Barbara.

Joel Ayala (Biomedical Engineering '13, FURI Fall '11–Spring '12) is currently pursuing a Master of Engineering at Duke University in Biomedical Engineering.

Celia Barker (Biomedical Engineering '13, FURI Fall '10–Fall '11) is pursuing a Master’s in Management at the W. P. Carey School of Business at Arizona State University.

Zack Berkson (Chemical Engineering '13, FURI Summer '11–Fall '12) is a Ph.D. student in chemical engineering at the University of California, Santa Barbara and beginning to get involved in research in molecular interactions in organic solar cells.

Amy Blatt (Biomedical Engineering '14, FURI Spring '13–Spring '14) is currently pursuing a Ph.D. in Biomedical Engineering at the University of Michigan Ann Arbor. Her project is titled “Matrix mechanics drive runt-related transcription factor 2 (Runx2)-mediated breast cancer aggression and metastasis.”

William Bowman (Materials Science and Engineering '12, FURI Spring '11–Spring '12) is currently a materials science and engineering Ph.D. student at Arizona State University and is a National Science Foundation Graduate Research Fellow.

Colton Bukowsky (Material Science and Engineering '11, FURI Fall '08–Fall '09) is a materials science graduate researcher at the California Institute of Technology studying nanoimprint lithography for advanced light trapping structures in thin-film photovoltaics.

Katherine Cai (Chemical Engineering and Statistics '13, FURI Spring '10–Fall '12) is a Ph.D. student in the Statistics program at Arizona State University.

Dillon Card (Mechanical Engineering '14, FURI Spring '12–Fall '13, Spring '14) works at Lockheed Martin Aeronautics Company in Fort Worth, Texas on the F-35 program.

Amelia Celoz (Civil Engineering '13, FURI Summer '09, Fall '11–Spring '13) is a master’s student in the Sustainable Design and Construction program at Stanford University.

Katherine Driggs Campbell (Electrical Engineering '12, FURI Summer '10–Spring '12) is currently an electrical engineering Ph.D. student at the University of California, Berkeley.

Nate Dunkin (Civil, Environmental and Sustainable Engineering '11, FURI Spring '09–Spring '11) is a doctoral candidate at the Johns Hopkins University’s Bloomberg School of Public Health.

Laila El-Ashmawy (Civil, Environmental and Sustainable Engineering '11, FURI Spring '10–Spring '11) is a second-year Ph.D. student in Electrical Engineering at Arizona State University.

Tina Hakimi (Biomedical Engineering '12, FURI Spring '10–Spring '12) is completing a Whitaker International Fellowship with the Brien Holden Vision Institute in Sydney, Australia, working to redefine the design of soft contact lenses using new information about the ocular surface shape.

Neekta Hamidi (Biomedical Engineering '13, FURI Summer '10–Spring '11) is currently at the Executive Office of the President in Washington, D.C.

Brittney Haselwood (Biomedical Engineering '12, FURI '10–Spring '12) is currently a research associate and Ph.D. student at Arizona State University and is continuing her FURI research working toward a point of care diagnostic biosensor based on nanotechnology for traumatic brain injury.

Carly Hom (Biomedical Engineering '13, FURI Spring '12–Spring '13) is currently employed as a Senior Post-Market Quality Engineer for Stryker Sustainability Solutions in Tempe, Arizona and will be starting a dual degree MBA/MS in the Industrial Engineering program at ASU.

Zahra Hussaini (Physics/Mathematics '13, FURI Spring '12–Summer '12) is currently a research assistant at the National Institute of Standards and Technology.

Lisa Irimata (Biomedical Engineering '15, FURI Fall '12–Spring '14) is currently pursuing a Ph.D. in bioengineering at the University of Notre Dame.

Sebastian Husein (Materials Science and Engineering '13, FURI Fall '11–Fall '12) is currently a Ph.D. student at ASU studying wide bandgap semiconductors for solar cell applications, and working at the NSF-sponsored Quantum Energy & Sustainable Solar Technologies Engineering Research Center. He worked at the Ernst Ruska Centre for Microscopy in Juelich, Germany in summer 2015.

Joshua James (Chemical Engineering & Finance '12, FURI Summer '10–Fall '10) is a Process Engineer at Intel Corporation from June '12–August '13. Joshua is currently a second-year Ph.D. chemical engineering student at ASU focusing on light paraffin/olefin and hydrogen/carbon dioxide separations using inorganic membranes.

Amit Jha (Biomedical Engineering '13, FURI Fall '12–Spring '13) is currently an engineering consultant for Tata Consultancy Services.
Paul Juneau (Biomedical Engineering '14, FURI Spring '13–Summer '13) is currently a software engineer for Tata Consultancy Services.

Eric Kincaid (Materials Science and Engineering '13, FURI '11–'12) is pursuing an Erasmus Mundus Master's degree in the SERP-Chem program (www.serp-chem.eu) with a specialization in chemistry and materials science with each semester spent at a different university in Europe.

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

Dwight Lane (Biomedical Engineering '12, FURI Summer '11–Spring '12) is currently a second-year Ph.D. student in bioengineering at the University of Utah.

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

Xuan Liang (Chemical Engineering '13, FURI Spring '12) is starting a master’s in chemical engineering at the University of Maryland this semester.

Brian Lines (Chemical Engineering '10, FURI Fall '08–Spring '09) is an assistant professor in the Civil, Environmental, and Architectural Engineering Department at the University of Kansas.

Michael Machas (Chemical Engineering '13, FURI Fall '11–Spring '13) received his master’s in chemical engineering in the spring of 2014 and began pursuing his Ph.D. in chemical engineering at Arizona State University in fall 2014.

Beth Magerman (Mechanical Engineering '13, FURI Fall '11–Spring '13) is pursuing a master’s in mechanical engineering at Arizona State University as a research assistant studying remote measurement and modeling of wind development for wind turbine control.

Ryan Manis (Mechanical Engineering '10, FURI Spring '08–Spring '10) is currently working as a dry etch process development engineer at Intel in Oregon.

Joy Marsalla (Civil, Environmental and Sustainable Engineering '12, FURI Fall '08) is an environmental engineer and LEED Green Associate at Intel Corporation in Oregon where she supports technology development through chemical review to ensure proper wastewater, air and waste management.

Michael Mast (Aerospace Engineering '12, FURI Spring '11–Fall '11) is currently a systems engineer at Honeywell Aerospace. He is the lead focal for auto-throttle and flight director for the Gulfstream program and is pursuing a master of science in aerospace engineering.

Kevin McMillin (Computer Science '11, FURI Fall '09) is working as a user experience designer at NASA Ames Research Center in Moffett Field, CA.

Isha Mehta (Civil, Environmental and Sustainable Engineering '12, FURI Fall '11–Spring '12) is currently working as a structural designer at Caruso Turley Scott Inc., creating engineering art structures, high rises and more.

Megan Mincelli (Mechanical Engineering '14, FURI Fall '12–Spring '14) is a product engineer in component engineering at Medtronic in Fort Worth, Texas, on precision drills for cranial and spinal surgery.

Divya Geetha Nair (Materials Science and Engineering '12, FURI Fall '10–Spring '12) is working as a process engineer in Intel Micron Flash Technologies, in Utah.

Alisha Nanda (Chemical Engineering and Biochemistry '13, FURI Summer '10–Spring '12) is currently pursuing a M.D. at the University of Arizona College of Medicine - Phoenix.

Meelad Nikpourian (Mechanical Engineering '12, FURI Fall '11–Spring '12) finished a master's in mechanical engineering at Arizona State University and is working as a marketing and product manager at Honeywell Aerospace.

Elizabeth Nofen (Mechanical Engineering '12, FURI Summer '10–Spring '11), a prestigious National Science Foundation Graduate Research Fellow, is currently a third-year Ph.D. candidate in chemical engineering at ASU.

Gabe Oland (Biomedical Engineering '13, FURI Summer '11–Spring '13) is currently pursuing a M.D. at the Medical College of Wisconsin in Milwaukee, Wisc.

Brian Perea (Chemical Engineering '12, FURI Spring '09–Spring '11) is a Ph.D. Candidate in chemical engineering at the University of California, Berkeley, and his research focuses on developing a highly automated system for the rapid investigation of stem cell responses to environmental stimuli.

Guy Pickett (Mechanical Engineering '12, FURI Summer '11–Fall '11) is currently working as a process engineer at Alta Devices in Sunnyvale, Calif., a thin-film, high-efficiency solar cell manufacturing company.

Tiffany Pifher (Biomedical Engineering '15, FURI Spring '13) is currently working as a process engineer on the Advanced Manufacturing team at Stryker Sustainability Solutions where they reprocess single use medical devices.

Spencer Prost (Computer Science '13, FURI Fall '11–Spring '13) is currently a post bachelor’s research associate at Pacific Northwest National Laboratory, engineering robust acquisition software for Agilent Acqiris digitizers for use with ion mobility spectrometry.

Tim Reblitz (Electrical Engineering '12, FURI Summer '11–Spring '12) is a graduate research assistant and Ph.D. candidate studying silicon photovoltaics at Arizona State University in the OESST Engineering Research Center, working to develop solar cells using only aluminum for metallization to minimize the use of costly and/or toxic materials typically used.

Mariela Robledo (Chemical Engineering '13, FURI Summer '11–Spring '13) is a manufacturing engineer at General Mills-Albuquerque. She is involved in the community as the Vice-President of External Affairs for the Society of Hispanic Professional Engineers NM Professional Chapter, and as Chair for the SHPE National Conference Meals and Podium committee. She is actively involved in STEM outreach and is passionate about promoting post-secondary education.
Josh Romero (Aerospace Engineering '12, FURI Fall '10–Fall '11) is a Ph.D. candidate in the Aerospace Computing Laboratory at Stanford University and his current research focus is on the development of high-order methods for computational fluid dynamics simulations.

Neil Saez (Biomedical Engineering '13, FURI Spring '10–Spring '12) is pursuing a M.D. at the University of California, Irvine’s School of Medicine, and is also a member of the Program in Medical Education for the Latino Community (PRIME-LC).

Rafael Santana (Computer Science '13, FURI Spring '12–Spring '13) is currently a consultant for Avolve Software to develop electronic planning with a focus on planning and building plan reviews.

Jared Schoepf (Chemical Engineering '13, FURI Spring '12–Spring '13) is currently pursuing a Ph.D. in chemical engineering at Arizona State University. He is also the co-founder and president at SafeSIPP, which both transports and purifies contaminated water in developing countries. He is also the president of Sustainable Storm Solutions which works to remove trash from stormwater before it contaminates fragile aquatic ecosystems.

Tyler Stannard (Materials Science and Engineering '13, FURI Summer '12–Fall '12) is a National Science Foundation Fellow and Ph.D. research assistant at Arizona State University, researching stress corrosion cracking in aluminum alloys.

Eric Stevens (Chemical Engineering '13, FURI Summer '11–Spring '12) is a Ph.D. candidate in chemical engineering at North Carolina State University.

Matt Summers (Aerospace Engineering '11, FURI Fall '09–Spring '10) is currently working as the Lab Manager for the Advanced Propulsion Lab and a Principle Investigator of multiple R&D projects at Raytheon Missile Systems in Tucson, Arizona. He is also pursuing a Ph.D. in Mechanical Engineering at the University of Arizona.

Ben Teplitzy (Biomedical Engineering '11, FURI Fall '08–'09) is a fourth-year Ph.D. student and NSF Graduate Research Fellow in biomedical engineering at the University of Minnesota studying applications and mechanisms of deep brain stimulation using computational, translational and clinical models neural pathologies.

Michael Thompson (Mechanical Engineering '12, FURI Fall '10–Spring '11) is pursuing a Ph.D. in mechanical engineering on modeling, analyzing, controlling, designing micro air vehicle robotic systems at Arizona State University.

Luan Trinh (Aerospace Engineering '11, FURI Fall '11) is finishing a master's in mechanical engineering at Arizona State University.

Logan Van Engelhoven (Mechanical Engineering '12, FURI Fall '11–Fall '12) is a M.S./Ph.D. student at University of California, Berkeley working with the Human Engineering and Robotics Laboratory.

Stephen Warren (Mechanical Engineering '13, FURI Spring '12–Fall '12) is participating in the 4+1 Graduate Program at Arizona State University in mechanical engineering and works with the Human Oriented Robotics and Control Laboratory.

Reed Wittman (Material Science and Engineering '13, FURI Fall '12–Spring '13) is a Bredesen Scholar pursuing a Ph.D. at the University of Tennessee.

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At Arizona State University, we’ve been educating engineers for Arizona and the world for nearly 60 years. With more than 19,000 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, 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