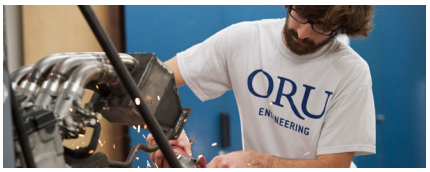
ORU MAKE NO LITTLE PLANS HERE

ENGINEERING DEPARTMENT NEWSLETTER



ORAL ROBERTS UNIVERSITY ENGINEERING GRADUATES OF 2014

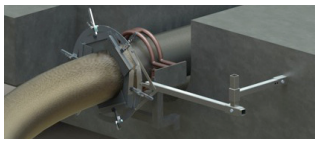
Nineteen engineering students graduated this year with B.S.E. degrees and five students with B.S. degrees.

2013 – 2014 SENIOR PROJECTS AT ORU ENGINEERING

Cojafex Water Containment System

Addison Cruz, Daniel Dunagan, and Alexander Seigel

Cruz, Dunagan, and Seigel worked with Tulsa Tube Bending (TTB), a manufacturing company in Tulsa, to improve the manufacturing process of one of their tube bending machines.



SolidWorks rendering of water containment system

The machine that was improved by the senior project was called the Cojafex machine. The Cojafex machine uses high temperature heat induction to heat pipes to a sufficient temperature for bending. While the pipes are being heated and bent, the edge of the heat zone is sprayed with high-pressured water to keep the heat zone localized. When the pipes are sprayed with water, a significant amount of the water sprays onto the shop floor. Due to insufficient water containment methods and poor drainage, the water accumulates into large puddles on the shop floor. These puddles are the biggest nuisance to the operators and have been a dilemma to the engineers and the operators who work in the area. The senior design project consisted of designing a mechanism that would be used to keep the water contained to an area with proper draining.

Due to multiple constraints it was a challenge to design the mechanism in such a way that it would not interfere with any other parts of the machine. The device also needed to be designed so that it would work for any size of pipe that the Cojafex machine bends. The results from the project were drawings to construct such a mechanism. After the design was fabricated from the drawings, the mechanism was proven to be easily installed on the machine and work for all of the different pipe sizes on the machine. From our final tests, it was seen that the mechanism stops 100% of the water that was previously flooding the shop floor.

Pinpoint: Positioning and Navigating on the GC First Floor

Caleb Penney and Raymond Onekon

In recent years, indoor location services have become the focus of much research and investigation. Many cannot rely on the already ubiquitous global positioning system and require new techniques and methods to provide a comparable service indoors. In this paper, we detail the creation and implementation of Pinpoint: an indoor positioning and navigation system for the first floor of the Oral Roberts University Graduate Center (GC). Pinpoint utilizes a technique known as wireless fingerprinting to characterize the received signal strength (RSS) of the many Wi-Fi access points at hundreds of locations throughout the GC first floor. Using this data, we compare a user's fingerprint with the database of existing fingerprints to find the closest match and thus position the user. After pinpointing a user, the user is able to navigate to the destination of their choosing using the directions provided by the application. Our implementation is accurate to the room and hallway level almost 80% of the time, ensuring a quality user experience while satisfying our definition of completeness.

Temporal Characterization of Homogeneous 802.11b Networks in the 2.437 GHz Band

Faith Richard and Joseph Taylor

Joseph Taylor working on his network

The objective of this project is to model an observation of an 802.11b homogeneous network, which consists of two or three node pairs operating in the 2.437 GHz band. This project will not consider the spatial effects on a network and will further the development of wireless coexistence testing as it is able to examine indirectly how the network behaves for various throughputs and the amount of nodes. Only the inactivity periods will be examined, and from this project, many probability density functions will be used to analyze the network through the use of MATLAB.

Synthesis of Silver Nanoparticles for Use in the Medical Field

Jessica Fitzgerald and Chidumebi Nwokolo

This project was chosen for the purpose of directly benefiting the medical community by researching methods of preventing nosocomial infections, caused by microbial films adhering to the surface of medical instruments and equipment exposed to the body. Studies show that hospitals spend billions of dollars each year on nosocomial infection-related treatments. A solution to the dilemma is to modify the surfaces of medical instruments so that they actively disinfect themselves. One such method of creating antimicrobial materials is to employ silver nanoparticles as a coating for materials. The ultimate goal of this project is to develop these types of coating for use in future research, medical devices and instruments. This present work examines a three-fold project: nanoparticle synthesis, material coating, and biotesting.

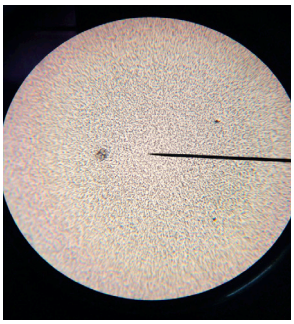
Due to the time constraints for this project, the main coating method was the "drop-drying" method, chosen for its straightforward approach and ease of production. Students dropped the solution onto glass microscope slides for observation, then transitioned to drop-drying on aluminum and stainless steel to compare.

The drops are prone to particle aggregation at the very edges of the drop as it dries, leaving an uneven distribution of particles. This is known as the coffee stain effect. To combat this, students dried solutions in a covered petri dish in an atmosphere infused with ethanol. The ethanol in the atmosphere creates what is known as Marangoni flow. The Marangoni effect occurs when "flow can be driven by surface tension gradients arising from spatial variations of composition or temperature." The ethanol reduces the surface tension of the droplet, flattening it and allowing for a more even distribution of particles. Microscope pictures of distribution are on the right.

This project produced a synthesis method that yielded stable solutions of silver nanoparticles within the desired size range based on absorption spectra. The stable solutions were found using the concentrations closest to the calculation of the acetone assay. This solution was then used as a coating by drop-drying on aluminum samples with uniform deposition. Finally, students were able to produce a solution that proved to prevent the growth of bacteria.

Future work includes perfecting a cleaning and synthesis method that yields a higher rate of success for solutions. Students will also benefit from electron microscope imaging of the aluminum coating for the observation of nanoparticle interaction with the metal. For the biotesting, students will work on developing a more thorough method for washing the wells.

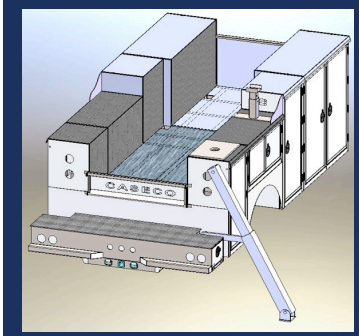
"Coffee-stain" droplet dried in air



Uniform deposition using ethanol

CASECO Outrigger

Morgen Beams, Sarah Pease, Kevin Schroeder, and Michael Wilson

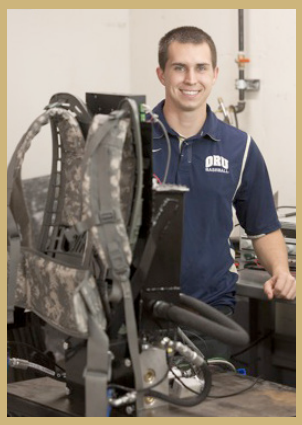


Upper Winged Outrigger Fully Deployed

An outrigger is a support structure that typically extends from a vehicle to prevent overturning. The vehicle is usually a truck that has a crane attached to lift large loads. CASECO Truck Company is a manufacturer of heavy-duty cranes and service bodies. CASECO's current outriggers have a 0.7 factor of safety, meaning the current outriggers fail at 70% of their rated load. The project is to design a new outrigger or upgrade the current one to have a factor of safety of 2.0. After several ideas for outriggers were put on paper, the group broke them down and designed each one in SolidWorks. Once simulations of the outriggers were run, only two came close to meeting the required factor of safety of 2.0, the H outrigger and the C outrigger. Due to the high price for parts and a change in the manufacturing process, the C outrigger was dropped and the H outrigger was then chosen. The H outrigger is an updated version of the one they currently manufacture and will not change the current process they use. It also fulfills the requirements of having a factor of safety of 2.0.

ARES Autonomous Robotic Exo-Skeleton

Joseph Krause, Robert Kreis, and Taylor Tryon



Taylor Tryon with his Autonomous Robotic Exo-Skeleton

This project analyzed and engineered a knee brace designed to optimize and assist the user in lifting heavy loads. The device actuates a hydraulic pump in response to a robust control system in order to create the most efficient design for the project.

The success of the project relied on measuring the human-exerted force with the system on versus having the system off. This was accomplished by measuring the force output curves with our available FlexiForce sensors. First, a test subject was fitted with a 50-pound load and then asked to perform one-legged deep knee bends until fatigue. The force sensors, along with an adjacent program, plotted the force-stress relationship that goes along with the activities. This same process is then repeated for a test subject wearing the ARES device. The two force plots are then compared to determine how much force was relieved from the user directly from the implementation of the ARES.

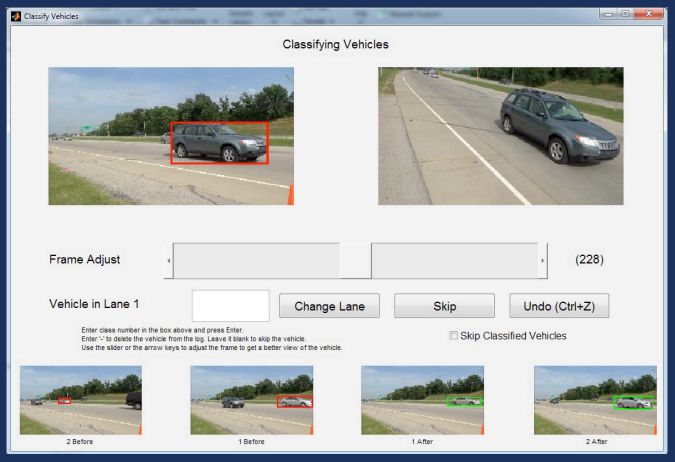
A hydraulic system was implemented to assist the user with the team's objectives. Calculations needed to be made in order to decide the pump, motor and hydraulic cylinders to use with respect to commercially available products. The frame was designed and manufactured utilizing SolidWorks and Mastercam programs. It was then built by the team using materials supplied by the ORU Engineering Department. An Arduino microcontroller was chosen for the control system. The force sensor is placed in a heel plate that the user straps to his or her foot. The Arduino receives this signal from the foot sensor and actuates the cylinders when the weight on the sensor exceeds the programmable threshold.

The hydraulic components are driven by an electric motor in order to provide a resisting force. Testing and calculations show the ability for a user to lift well over 400 pounds of load with minimal effort.

The team analyzed and engineered an autonomous exo-skeleton designed to optimize and assist the user's overall carrying capacity. This technology has multiple medical implications involving rehabilitation and strengthening procedures. Also, this device is well suited for military applications, in order to allow military personnel to carry heavier loads over longer distances without excessive fatigue.

Semi-Automatic Vehicle Classification

Michael O'Brien and Jesse Schettler



Classification User Interface

The Oklahoma Department of Transportation (ODOT) uses Automatic Vehicle Classification (AVC) devices to determine the type and volume of traffic using the highways. This information helps predict future costs and construction needs for highway maintenance and repair, so it is vital that the AVC devices accurately count and classify the vehicles. Customarily, the accuracy of these devices is tested by filming a specific AVC site, manually recording the traffic from the video, and comparing the results to the output of the AVC device. The objective of this project is to semi-automate the process of validating the accuracy of these devices. Specifically, videos are automatically processed to identify and count vehicles, determine the lane number of each vehicle, and classify at least 65% of Class 2 compact cars with 97% accuracy. Using an adaptive background detection algorithm, vehicles are identified and tracked from frame to frame. A lane detection algorithm identifies the lane each vehicle occupies and helps determine whether or not vehicles are overlapping. Once the program locates isolated vehicles, it uses calculated blob characteristics and a method of linear discriminant analysis to automatically classify them. The final program was tested on two videos from separate AVC sites and classified 85.55% and 81.58% of Class 2 compact cars respectively. For both videos, the accuracy was 100%, meaning that the program was correct any time it automatically classified a vehicle.

UAV Quadrotor Project

Aaron Olsson, Jeffrey Sugiyama, David Timoshenko, and Jordan Wheeler

The original idea for the project came when one of the project members, Jeff Sugiyama, was informed by a professor in the Biology Department that one of the department's senior projects had run into difficulty tracking wasp populations on campus. The Biology Department wanted a way for future project groups to track the wasps on the tops of buildings. After considering various options, it was decided that a quadrotor UAV with a camera attachment would enable the tracking of wasps to be conducted safely.

With this goal in mind, the students decided to build a UAV that would be able to take useful footage of wasp populations in a safe and convenient way. This UAV would have an attachment for a GoPro HD camera that would be capable of taking high quality video footage that could be analyzed later.

The resulting craft is a flightworthy craft capable of lifting weight and maneuvering to the necessary locations. Since there is a lack of GPS monitoring, the pilot must always be aware of the craft's orientation. A failure to do so may result in a crash. Thus, piloting the craft requires experience and practice before sufficient competence is available to pilot it to the necessary locales.

The mounting bracket for the GoPro camera is a flat Plexiglas plate that is offset from the craft so that a GoPro camera's adhesive mount can be attached and rotated any which way. This also allows for future mounting of a gimbal if necessary. The motors and propellers all allow for an upgrade if the craft, through use by the Biology Department, is found insufficient for their needs.

UAV Quadrotor

As a result of various constraints, such as budget, time, and technical expertise in the area of programming, the craft does not meet the desired level of quality that the team wished for, but it does complete its intended task. The limiting factors in the quality were budget, resources, manufacturing capabilities, and size constraints. For a more efficient craft, it would need to use larger propellers and motors, which require larger arms, and for larger arms, a stiffer material is required. All of this amounts to one main limiting factor: budget. Although the team was able to stay within its intended budget, had more been available, the quality would have increased significantly.

ORU Engineering Major Interned at UOP Callidus

Matthew Fulton

This summer I worked as an intern at UOP Callidus. Callidus is a local company in the Oil and Gas industry that specializes in refinery flares, thermal oxidizers, and burners. My job in the flares sales support group helped lighten the engineers' workload by breaking down customer specs and sorting proposals. The biggest project, so far, was creating a structural database of the flares they had built since 2009. In the sales support group, the turnaround time to get a bid out on a job is paramount, which can often be expedited by having access to previous similar jobs. Consequently cataloging the structural design of the different flares served two purposes, it gave me experience reading drawings and will help the group turn out bids faster. If they can find a similar job via a searchable database, they can determine in a few minutes what jobs were relevant and what can be reused.

As part of the internship, we volunteered for a day at a local charity. Through one of the contacts of my fellow interns, we found an opportunity to help with a fundraiser for The Little Lighthouse, a local school for disabled children. I appreciated

this opportunity. As an ORU student, we are often encouraged to volunteer and it was a pleasant surprise to find similar encouragement at Callidus.

Management has been excellent, providing projects to focus my energy towards, while allowing me the opportunity to organize my day and efforts within their priorities. With Callidus coming under the new management of UOP, they are bringing in a lot of new faces and are very welcoming to newcomers. I have enjoyed the experience and the ability to see how this part of the business world works.

ORU Engineering Student Has Summer Internship at MIT

ORU Engineering student Gregory Butron's interning with the Singapore-MIT Alliance for Research and Technology (SMART: **http://smart.mit.edu/**). He is currently working on a project with the Future Urban Mobility Group (**http://smart.mit.edu/research/future-urban-mobility/research-projects.html**) involving a self-driving car and self-driving golf buggies. Gregory is creating a power monitoring system to look at the energy consumed by the different sensors and control systems as well as monitor the battery levels of the vehicle.

The research is directed by Professor Emilio Frazzoli (MIT) and Professor Marcelo Ang (National University of Singapore).

ORU Engineering Student Attends ASEE Annual Conference in Indianapolis

Indianapolis Memorial Tower

This past June, Wesley Odom attended the American Society for Engineering Education's (ASEE) 2014 Annual Conference in Indianapolis, Indiana. Wesley is an Engineering, Physics and Mathematics student who actively participates in a variety of clubs and organizations on campus. Last summer he presented a paper he co-authored with Dr. Dominic Halsmer at ASEE's 2013 Annual Conference. While at the conference last year Wesley was elected as the Secretary and Treasurer for ASEE's national Student Division. While at this year's conference, aside from acting as a moderator for technical presentations and fulfilling other duties as an officer, he managed to win the election a second time and will continue serving as the Student Division's Secretary and Treasurer.

The highlight of this conference for Wesley was the privilege of participating in the Interdivisional Town Hall Meeting. Division leaders gathered to discuss the current barriers and issues within the nation's approach to engineering education. As the only student participating in the collective brainstorming for long-term national solutions, he was both humbled and excited. Wesley plans to continue participating in the ASEE as part of meeting his goal to eventually become a professor of engineering and physics after graduate school.

Dr. Ma Finishes His Four-Year NSF Project and Visits China to Give Invited Talks

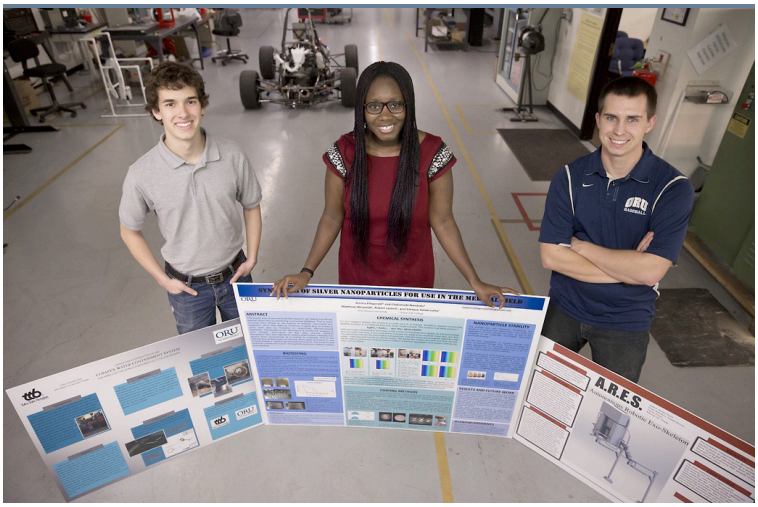
Dr. Xiaomin Ma is working with three Engineering students as research assistants (Brandon Braun, Jessica Fuentes, and Anh Tran) to wrap up his four-year NSF project "NSF grant: Collaborative Research: Analytic Modeling and Enhancement of Vehicular Ad Hoc Networks for Safety Critical Applications, Aug. 2010-July, 2014, PI." More than 13 ORU Engineering students have been involved in the project. Four of them are co-authors of four published papers out of 24 papers resulting from the project. This project also supports one Ph.D. student in Electrical and Computer Engineering Department at Duke University.

In May 2014, Dr. Xiaomin Ma visited two universities in China: College of Electronics and Information at Tongji University in Shanghai, and College of Information Engineering at China University of Petroleum in Qingdao. He gave two invited talks titled "On QoS of Vehicular Ad Hoc Networks for Safety Related Services" and "Research on Vehicle-to-vehicle Communication for Safety Applications: Current Status and Future Perspectives."

Dr. Ma also is serving as one of three Guest Editors in Special Issue on "Reliable and secure VANETs" in an IEEE journal: IEEE Transactions on Dependable and Secure Computing.

2013 – 2014 ENGINEERING STUDENT ACHIEVEMENTS

ORU Engineering student Chidumebi Nwokolo won first place in the undergraduate Old Guard Technical Poster Competition at the annual Student Professional Development Conference of the American Society of Mechanical Engineers hosted by Texats Tech in Lubbock, Texas on April 3 - 5, 2014. Taylor Tryon won second place in the Old Guard Oral Presentation Competition at the same conference, and Addison Cruz received fourth place. Chidumebi Nwokolo and Jessica Fitzgerald's poster also won first prize at the OSPE Oklahoma Engineering Conference Student Poster Contest on June 12, 2014 at Doubletree Warren Place, Tulsa.



Addison Cruz, Chidumebi Nwokolo, and Taylor Tryon

ENGINEERING FACULTY ACCOMPLISHMENTS

- Dr. Gregg submitted a Case Study and Success Story for Cengage Learning (Instructor Engagement Center) and Web Assign Cengage: "Physics Students Boost Test Scores with Enhanced Web Assign at Oral Roberts University"
- Dr. Halsmer co-edited and co-authored the book *Engineering and the Ultimate: An Interdisciplinary Investigation of Order and Design in Nature and Craft*, Ed. by Jonathan Bartlett, Dominic Halsmer, and Mark Hall, Blyth Institute Press, Broken Arrow, Oklahoma, 2014.
- Dr. Leland organized the April meeting of the Tulsa Section of the IEEE, held at the Hammer Center on April 22. The meeting brought students from ORU, TU and OU Tulsa, who presented posters on their research and design projects, as well as electrical engineers from the Tulsa area. Michael O'Brien and Jesse Schettler's poster on a Semi-Automatic Vehicle Classification System was voted the best poster for an undergraduate student project.
- Dr. Ma has published the following paper together with ORU Engineering students:

  "Packet Delivery Ratio in k-dimensional Broadcast Ad Hoc Networks" Xiaomin Ma, X. Yin, Gregory Butron (ORU Eng. Student), Caleb Penney (ORU Eng. Student), and K. S. Trivedi, IEEE Communications Letters, 17(12): 2252-2255, Dec. 2013.
- Dr. Matsson brought a group of 15 students to the ASME Annual Student Professional Development Conference in Lubbock, Texas on April 3-5. Chidumebi Nwokolo won the Old Guard Technical Poster Competition with her poster titled "Synthesis of Silver Nanoparticles for Use in the Medical Field." Taylor Tryon received the second place in the Old Guard Oral Presentation Competition with his presentation on an Autonomous Robotic Exo-Skeleton (ARES), and Addison Cruz received fifth place with his presentation on a "Water Containment System for a Heat Induction Tube Bending Machine."
- Dr. Liu served on the Globalization Task Force Committee. She hosted the Sonia Kovalevsky Day for a Female Math Competition at ORU on September 24, 2013.
- Dr. Zhang acted as a judge for FIRST Robot Competition Oklahoma Regional, 3/27-29/2014 at Cox Convention Center in Oklahoma City.

Dear ORU Engineering Alumnus,

You can make a difference in our recruitment efforts of our students at ORU! Many prospective students express a desire to attend ORU but, unfortunately, they do not have a sufficient level of scholarships. We have, for this purpose, a restricted scholarship fund and are requesting your donation to this fund.

You can donate at **webapps.oru.edu/new_php/give.** Click on **Academic Department** and select **Engineering/Physics/Physical Science Department.** Please make sure to comment that your donation is specifically for Engineering scholarships.

You are welcome to contact me at **jmatsson@oru.edu** or **918.495.6935** with any questions that you may have.

Sincerely,
John Matsson, Ph.D.
ORU Engineering Chairman