COLLEGE OF
ENGINEERING, ARCHITECTURE AND TECHNOLOGY

SENIOR DESIGN EXPO

Fall 2022 Team & Projects Guide

Tulsa Senior Design Expo
Thursday, December 1
3:00p.m.-8:00p.m.
Helmerich Research Center
526 N. Elgin Avenue
Tulsa, OK

Stillwater Senior Design Expo
Friday, December 2
8:00a.m.-5:00p.m.
ENDEAVOR Lab
215 N. Hester Street
Stillwater, Ok

Presentation Schedule

OSU-STILLWATER PROJECTS

Friday, December 2 from 8:00 AM - 5:00 PM in the ENDEAVOR Lab (Stillwater, OK)

CIVE 8:30 AM-10:30 AM (3rd Floor)

The National Council of Examiners for Engineering and Surveying will present CIVE with an Engineering Education Award in their senior design team's presentation area from 8:45 AM-9:15 AM.
(CIVE) Osage Hills CCC Pump House Design
(CIVE) Boiling Springs State Park's Water Tower Design
(CIVE) Quartz Mountain State Park Trail Design
(CIVE) Detecting and Quantifying Microplastics in Reservoirs: Field Device Project

ECE 8:00 AM-5:00 PM (1st Floor and 3rd Floor)

(ECE) Moonbounce
(ECE) Team Solenoid-SAM Automation
(ECE) Smart Energy Management
(ECE) FAA ADS-B Image Fusion
(ECE) Low Cost AWOS
(ECE) Solar Sound

FPSET 8:00 AM-11:00 AM (1st Floor)

(FPSET) Occupant Evacuation Elevators (8:00 AM-10:00 AM)
(FPSET) Evaluation of Exposure to Heavy Metals from the Use of Suppressed, Gas-Operated Firearms (9:00 AM-11:00 AM)

IEM 1:00 PM-4:30 PM (Room 310)

Invitees only from 1:00 PM-3:30 PM
Presenting to the public from 3:30 PM-4:30 PM
(IEM) Ameristar
(IEM) Arcbest
(IEM) Constructing a Failure Model for J.B. Hunt
(IEM) Improving Data Acquisition and Processes to Enhance Operational Efficiency
(IEM) Inventory Management Plan Creation

Interdisciplinary Projects-Projects and presenters will be available from 8:00 AM-5:00 PM at ENDEAVOR (1st Floor, 2nd Floor and 3rd Floor). Some teams will also have an individual team presentation time in certain rooms in ENDEAVOR that are listed below.

(ID) Autonomous Firefighting Vehicle (8:00 AM-9:30 AM in Room 202)
(ID) BB-8 Robot "I Love U 3000" (9:00 AM-10:10 AM in Room 302)
(ID) Thermal Fatigue Test System Retrofit Kit (9:40 AM-10:50 AM in Room 202)
(ID) AI Foosbots (10:30 AM-12:00 PM in Room 302)
(ID) DOE Wind Energy Competition (11:30 AM-1:00 PM in Room 202)
(ID) Multi-Axis 3D Printer (1:55 PM-3:05 PM in Room 302)
(ID) IGVC Vehicle (Team Joyride)(3:30 PM-5:00 PM in Room 202)

MAE Projects and presenters will be available from 8:00 AM-5:00 PM at ENDEAVOR (1st Floor and 2nd Floor). Some teams will also have an individual team presentation time in certain rooms in ENDEAVOR that are listed below.

(MAE) Transparent Refrigeration (12:00 PM-12:50 PM in Room 302)
(MAE) 1207 Engineering (Thermal Energy Storage Tank Test Bed)(1:00 PM-1:50 PM in Room 302)
(MAE) Hypogravity Simulator-Leg Exoskeleton (4:00 PM-4:50 PM in Room 302)

MET Projects and presenters will be available from 8:00 AM-5:00 PM at ENDEAVOR (1st Floor and 2nd Floor). Some teams will also have an individual team presentation time in certain rooms in ENDEAVOR that are listed below.

(MET) Textron Gear Retract Actuator (2:00 PM-2:50 PM in Room 202)
(MET) Under Pressure (Textron Tire Pressure Monitor)(3:10 PM-4:00 PM in Room 302)

Awards presentation for ID/MAE/MET and ECE teams will be held in ENDEAVOR in Room 160 at 5:00 PM.

Seniors from the School of Architecture are featuring their work in the Architecture Gallery on the first floor of the School of Architecture building. Stop by and see what they have been working on! 8:00 AM-5:00 PM

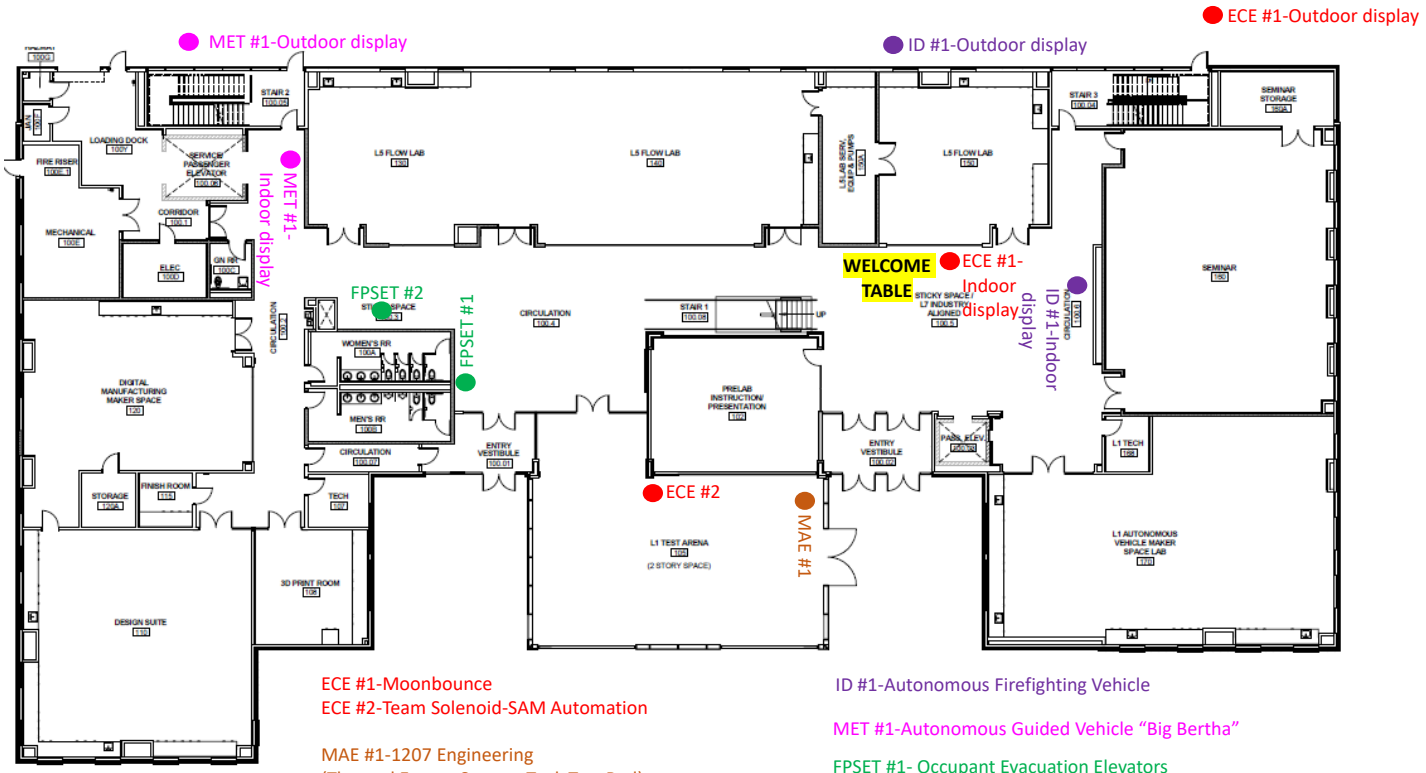
OSU-TULSA PROJECTS

This Expo will take place on Thursday, Dec. 1 from 3:00 PM-8:00 PM at the Helmerich Research Center Atrium (Tulsa, OK). Each team will also have an individual team presentation time that is listed below. Individual presentations will be held in room HRC 153.

(MAE) Thermoforming Protoyping-Seal Team Soda 4:30 PM-5:20 PM
(MAE) PET Project 5:25 PM-6:15 PM
(MAE) O2SU (Wearable Oxygen Concentrator) 6:20 PM-7:10 PM

Project Locations

1st Floor



ECE #1-Moonbounce
ECE #2-Team Solenoid-SAM Automation

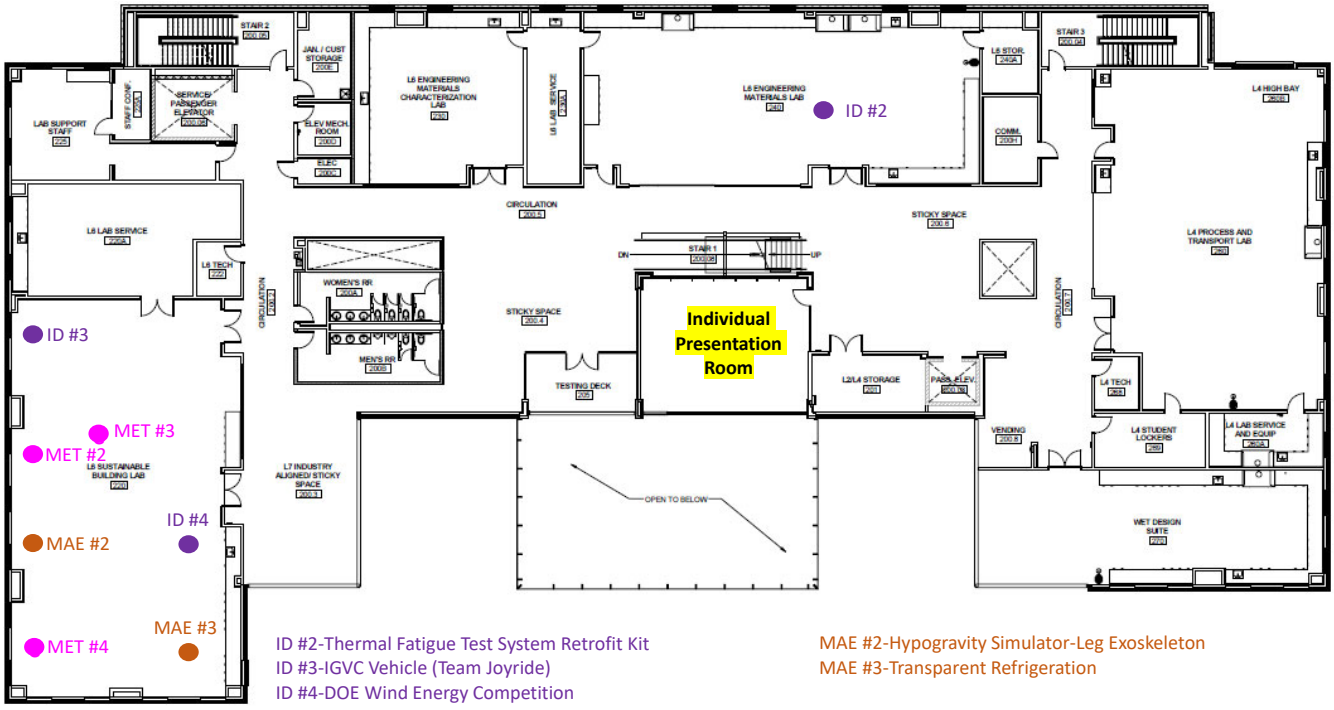
MAE #1-1207 Engineering
(Thermal Energy Storage Tank Test Bed)

ID #1-Autonomous Firefighting Vehicle

MET #1-Autonomous Guided Vehicle "Big Bertha"

FPSET #1- Occupant Evacuation Elevators
FPSET #2-Evaluation of Exposure to Heavy Metals from the Use of Suppressed, Gas-Operated Firearms.

2nd Floor

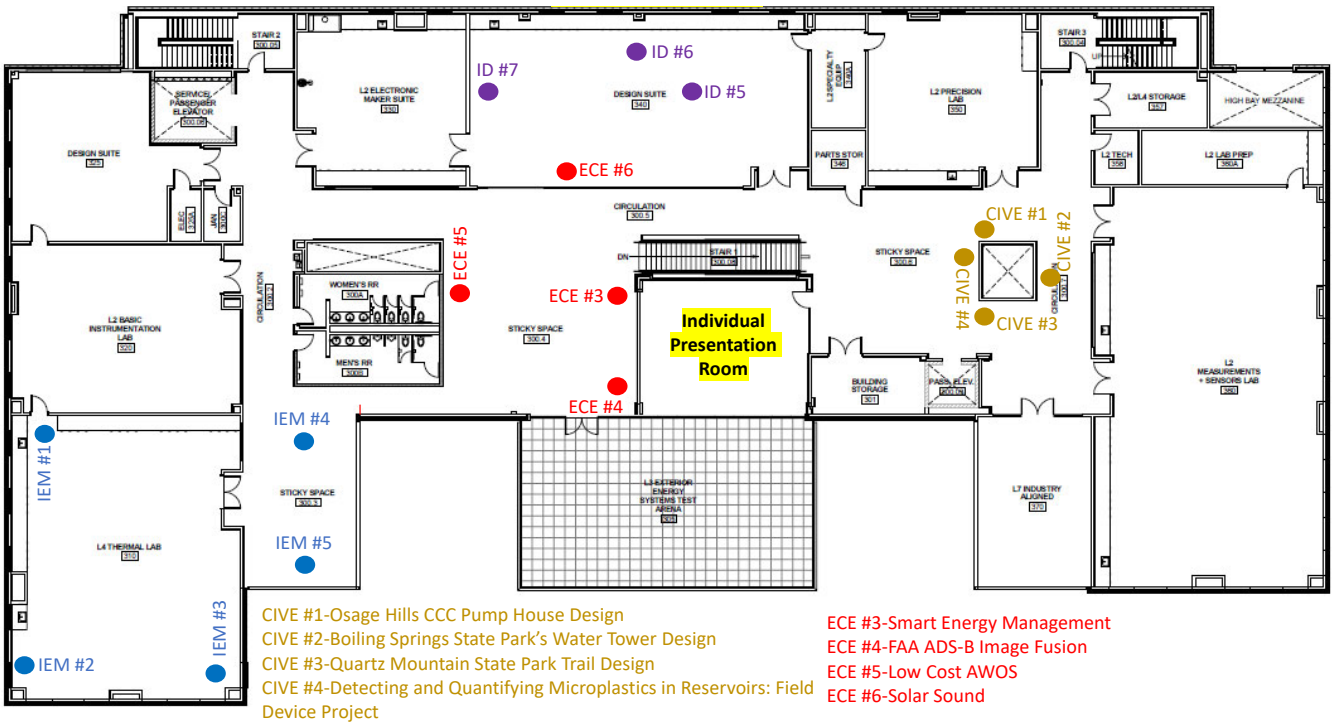


ID #2-Thermal Fatigue Test System Retrofit Kit
ID #3-IGVC Vehicle (Team Joyride)
ID #4-DOE Wind Energy Competition

MAE #2-Hypogravity Simulator-Leg Exoskeleton
MAE #3-Transparent Refrigeration

MET #2-Textron Gear Retract Actuator
MET #3-Under Pressure (Textron Tire Pressure Monitor)
MET #4-FAA Mechanical Switch

3rd Floor



CIVE #1-Osage Hills CCC Pump House Design
CIVE #2-Boiling Springs State Park's Water Tower Design
CIVE #3-Quartz Mountain State Park Trail Design
CIVE #4-Detecting and Quantifying Microplastics in Reservoirs: Field Device Project

ECE #3-Smart Energy Management
ECE #4-FAA ADS-B Image Fusion
ECE #5-Low Cost AWOS
ECE #6-Solar Sound

IEM #1-Ameristar
IEM #2-ArcBest
IEM #3-Constructing a Failure Model for J.B. Hunt
IEM #4-Improving Data Acquisition and Processes to Enhance Operational Efficiency
IEM #5-Inventory Management Plan Creation

ID #5-AI Foosbots
ID #6-Multi-Axis 3D Printer
ID #7-BB-8 "I Love U 3000"

A Word from the Dean

The College of Engineering, Architecture and Technology is continuing its transformation as a leading innovator in education, research and extension. Our ENDEAVOR and North Campus labs have become launching points for hands-on, interdisciplinary projects, driven by faculty and student efforts. Looking around the Senior Design Expo today, you will get to experience some of the results of those efforts.

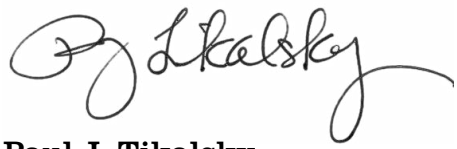
Our faculty are engaged at the cutting edge of energy, aerospace, computing, sustainable building technologies and our nation's future. They are building on a long-established, land-grant university mission of profession-oriented education that educates our graduates to lead the industries and communities of the 21st century.

We have awarded nearly 200 degrees this semester and have worked with students, administration and alumni to continue delivering world-class engineers and design professionals. By expanding our facilities and our undergraduate research opportunities, we are pushing forward in creating leaders for the next generation of industry.

The college could not be at the forefront of innovation without the accomplishments and investments of alumni, friends and industry partners in scholarships, internships, equipment and faculty support. In the coming year we will be adding the Zink Center for Competitive Leadership that will push our students even further into innovation with partner companies.

I hope that you enjoy getting a look into the bright young minds of these Oklahoma State seniors. They are preparing to solve the grand challenges that face us and become valuable contributors to their respective industries. Take some time to get to know them; you won't be disappointed.

Go Pokes!



Paul J. Tikalsky
Dean
College of Engineering, Architecture and Technology

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PROJECT: Osage Hills CCC Pump House Design (CIVE)
ADVISOR/S: Dr. Norb Delatte, Dr. Gregory Wilber

(Left to Right) Andrew Vanaman, Ali Bozobar, Ebrahem Alkhshman, Sergio Franco

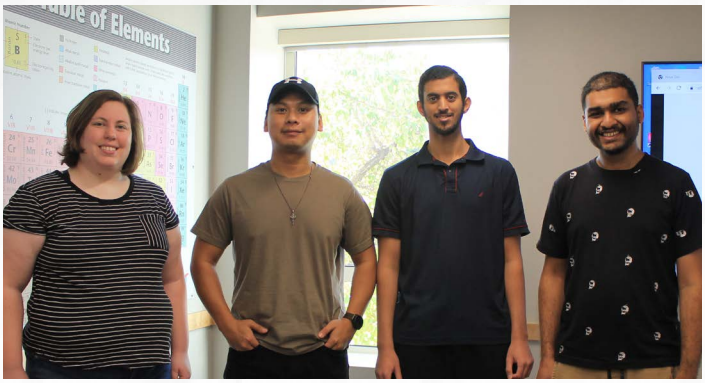
The Osage Hills Pump House is in need of a major restoration. The roof of the structure is caving in, with a section on the north side having already collapsed. The logs used to build the cabin are in bad shape and rotting is evident throughout the structure. The window openings have steel bars across them and are missing one window on the south side and three windows on the north side, so they must have new ones installed. A few of the logs are in good shape and may be reused but some are badly rotted or missing and need to be replaced entirely. We are designing a new roof made out of logs and wood shakes to look like the original pump house that was built in 1937. We will use structural analysis to calculate wind loads and timber design manuals to aid in the design of the wood and connections.

PROJECT: Boiling Springs State Park's Water Tower Design (CIVE)
ADVISOR/S: Dr. Norb Delatte, Dr. Gregory Wilber, Tucker Heglin

(Left to Right) Matthew Salamon, Nathan C. Hacker, Jordan Pfannenstiel, Hamad Alazemi

The existing historic Civilian Conservation Corps water tower is no longer functional. The team is determining the feasibility of restoring it to its original condition, for interpretive use only. Basically, ensuring the stability of an old water tower in Boiling Springs State Park.

PROJECT: Quartz Mountain State Park Trail Design (CIVE)
ADVISOR/S: Dr. Norb Delatte, Dr. Gregory Wilber



(Left to Right) Rebecca Means, Thawng Kap, Salah Alrashidi, Qasem Alhamyah

The project goal is to design a round trail path with recreational areas such as a fishing dock, playground and gymnasium equipment. The team's approach is to design the trail in phases, so the client is able to decide his priorities based on needs and financial ability. The design includes asphalt, trail and recreational areas.

PROJECT: Detecting and Quantifying Microplastics in Reservoirs: Field Device Design Project (CIVE)
ADVISOR/S: Dr. Norb Delatte, Dr. Jorge Gonzalez Estrella, Dr. Gregory Wilber

(Left to Right) Dominique Keller, Mason Egermeier, John Mark Mulder

Our project goal was to create an affordable, portable and speedy process to identify and quantify microplastics from freshwater reservoirs. Microplastics are found in reservoirs used for drinking water and have the potential to harm human health. Microplastics are polymers measured at less than 5 mm. Currently there is no efficient, field-friendly detection method. Our group designed a lab scale process to detect particles between 50 and 100 micrometers. Nile Red dye was used to stain plastics from freshwater samples. Nile Red fluoresces when exposed to blue light with wavelengths between 450 nm and 495 nm. An image was captured using a magnified camera and then uploaded to a computer. ImageJ software was then used to quantify the fluorescing particles. Future work is required to adapt this process to work in the field.

PROJECT: FAA ADS-B Image Fusion Team (ECE)
ADVISOR/S: Professor Nate Lannan

(Left to Right) Zeb Blew, Brian Charter, Harrison Dowell

This project addresses the issue of limited aircraft surveillance capabilities at small airports, which results in a lack of accurate flight behavior data. The solution is to create a portable and reliable ground station, which can be deployed at these airports to capture ADS-B data and images of incoming aircraft. ADS-B data retrieved from an aircraft provides accurate longitude and latitude but inaccurate altitude data. Using computer vision, distance information can be retrieved from the captured images and fused with ADS-B data to triangulate aircraft altitude more accurately than ADS-B alone.

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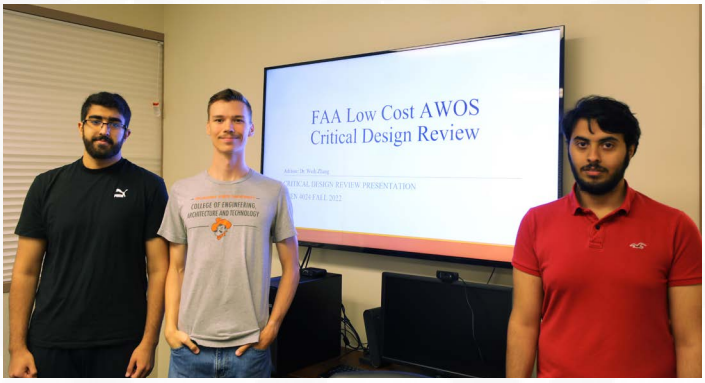
PROJECT: Low Cost AWOS (ECE)
ADVISOR/S: Dr. Weili Zhang



(Left to Right) Luke Thompson, Mohammed Alrefaei, Abdulrahamn Alajmi

The purpose of this project is to find and implement a more cost-effective anemometer for the FAA's AWOS (Automated Weather Observing System). The new ultrasonic wind speed and direction sensor should be at least equal in performance to the Vaisala WMT-702 anemometer currently employed by the FAA. Our second objective is to reduce costs for the AWOS by replacing the Windows XP-based software with Linux, an open-sourced operating system.

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PROJECT: Moonbounce (ECE)
ADVISOR/S: Dr. John O'Hara, Thomas Henderson


(Left to Right) Richard Hoepner, Levi Captain, Blake Barton

When communicating via radio, the radio horizon determines the farthest stations you can contact by “line of sight.” To achieve distances beyond the radio horizon, radio waves can be reflected off of the atmosphere to provide a larger range. However, even farther communications can be achieved utilizing specialized radio equipment to reflect signals off of Earth satellites. When the moon is employed as the satellite, this process is called Earth-Moon-Earth communications. We present a system designed to make radio contacts from all over Earth by utilizing a “moon bounce."

PROJECT: Team Solenoid-SAM Automation (ECE)
ADVISOR/S: Dr. Tyler Lay, Dr. Gary Yen, Professor Nate Lannan, Jake Leflore


(Left to Right) Douglas Edmondson, Parker Plank, Dawson Kinser

We are automating the Super Air Meter (SAM), which is a quality assurance device for concrete. In order to automate the device, we are using a microcontroller to control more than a dozen peripherals and the user interface. Our Arduino Mega microcontroller controls relays, which power solenoid valves, air and water pumps, a vibrator and two actuators to tilt the bucket on SAM.

PROJECT: Smart Energy Management (ECE)
ADVISOR/S: Dr. Hantao Cui

(Left to Right) Aaron Whittaker, William Geohart, Brady Prince

This project aims to develop and demonstrate a power monitoring system for an entire home. The system will be composed of power sensors and a datahub. The sensors will load currents for power, energy and other electrical quantities. The datahub accepts connections from sensors and stores data into a time-series database. The data will be displayed in a dashboard. Sensors are composed of a current-transformer sensor clamp, analog AC current sensor and an ESP32 microcontroller. The datahub is operating on a Raspberry Pi 3, using InfluxDB as the database and Grafana as the dashboard, data-visualization tool.

PROJECT: Solar Sound (ECE)
ADVISOR/S: Dr. Daching Piao

(Left to Right) Rashed Rashed, Josh Lemmon, Woseem Kittani

The photoacoustic effect was discovered in 1880 by Alexander Graham Bell. Bell had been experimenting with the long-distance transmission of sound. Using his invention, known as the "photophone," he was able to transmit voice signals by reflecting light, from the sun off a mirror to a selenium solar cell. A byproduct of his experiment was the discovery of sound waves being produced directly from a sample of selenium when exposed directly to light, known as the photoacoustic effect. Bell was then able to disrupt this sound by interrupting the light with a spinning wheel. This project seeks to demonstrate the photoacoustic effect, as well as energy conversion principles in an interactive way.

Sponsored by:

The Martin Family Foundation

PROJECT: Evaluation of Exposure to Heavy Metals from the Use of Suppressed, Gas-Operated Firearms (FPSET)
ADVISOR/S: Dr. Robert Agnew

(Left to Right) Trevor Pool, Carl Neal, Denham York

Firearm suppressors are manufactured and marketed to minimize the adverse effects of noise exposure; but when you solve one problem, sometimes a new issue arises. Research suggests that the addition of a suppressor to a gas-operated firearm inadvertently increases shooter exposure to lead, copper, and total particulate matter. Military, law enforcement and civilian shooters have all created a larger demand and interest for the use of suppressors; therefore, the number of suppressors being used has increased rapidly, and subsequently the possibility of metal fume exposure.

This experiment was conducted in order to evaluate heavy metal exposure levels and test exposure reduction devices from gas operated firearms. Two series of tests were conducted using two common firearm cartridges, 9x19mm NATO and a 5.56x45mm NATO. The 9x19mm NATO test set out to analyze the heavy metal exposure levels and reduction techniques, while the 5.56x45mm NATO test focused solely on the exposure reduction devices.

An air sampling device was utilized to collect gases and particulate matter from a gas-operated firearm. NIOSH Method 7301 was followed for calibration and setup of the air sampling device, along with the lab analysis of the heavy metals. NIOSH Method 0500 was used for the total particulate matter analysis. The data from the 9x19mm NATO and 5.56x45mm NATO test results were both analyzed using graphs for visual comparisons. Additionally, a two-sample t-test assuming unequal variances was used on the 9x19mm NATO testing. From the data analysis a determination was made, the data shows that the use of suppressors causes a marked increase in heavy metal exposure and that exposure reduction devices only modestly reduced exposure to heavy metal gases and fumes. On the other hand, using the correct techniques can significantly decrease the heavy metal gasses a shooter is exposed to while shooting a suppressed firearm.

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SILENCERCO LOUTHAN GUNWORKS BOOTLEG INC

PROJECT: Occupant Evacuation Elevators (FPSET)
ADVISOR/S: Dr. Bryan Hoskins

(Left to Right) Collin Andrews, Emily Young, Matt Ketchen

Understanding decision-making during a fire emergency evacuation from high-rise structures with the choice of a stairwell or an evacuation elevator will enable the evaluation of how people make decisions influenced by certain factors. Research has not adequately addressed how educating occupants would alter queuing behavior and decision-making during an evacuation. The focus of existing research is on modeling occupant behavior because of the scarce number of occupant evacuation elevators that have been constructed, which limits the ability to perform real-world experiments. The experiment collected qualitative and quantitative data on how humans make decisions affecting their evacuations through observations of egress selection after providing egress elevator education. Participants were given an option to either take the stairs or the elevator during a simulated evacuation. Software modeling was used to reinforce the findings of the original in-person experiment, utilizing the information gathered to guide the simulation's parameters. When using evacuation elevators and traditional stairs together, increasing elevator capacity and assigning exits had the most impactful results regarding minimizing evacuation time. However, the shortest evacuation simulation time recorded occurred when no evacuation elevators were utilized. This result may be challenged as not being realistically applicable to real scenarios because of the software's parameters as well as human interaction during a real combined evacuation.

PROJECT: Ameristar (IEM)
ADVISOR/S: Dr. Baski Balasundaram, Dr. Chenang Liu

(Left to Right) Rawan Albahraini, Bradyn Newberg, Walt Penn, Samantha Harizal

Ameristar currently uses an excess of forklifts to transport materials, and they have noticed these lifts are vastly underutilized. Our team was tasked with finding the optimal number of lifts to increase their overall utilization. Our team created a model to simulate the forklift's movement and activity in the facility to find the highest utilization of forklifts when the amount of lifts vary.

PROJECT: ArcBest (IEM)
ADVISOR/S: Dr. Baski Balasundaram, Dr. Juan Borrero

(Left to Right) Grace Voth, Caleb Triplett, Darcie Golden

ArcBest is a large logistics company based in Arkansas, offering a full suite of logistic solutions for their customers. Due to the company's rapid growth in the past couple of years, ArcBest has started reevaluating 40 to 50 service center locations per year. The evaluation process of comparing current service center locations to potential locations in a given service area currently takes one week to complete, crossing multiple departments and employees. The aim of this project is to streamline ArcBest's data collection and input of relevant data informing the selection and evaluation of a new service center location based on shipment volume and road distances using the Houston service area as a guide.

Sponsored by:

ArcBest

Erica Crain

Chris Cristanti

PROJECT: Constructing a Failure Model for J.B. Hunt (IEM)
ADVISOR/S: Dr. Paritosh Ramanan, Anthony Minor

(Left to Right) Alex Rodriguez, Jamayel Alnalem, Jared D Jenkins

For our project, we were tasked with developing a way to predict operational failures related to weather for J.B. Hunt. We did this by analyzing climate similarities to establish climate regions throughout the continental U.S., developing a weather severity index and finally formulating various predictive models.

PROJECT: Improving Data Acqusition & Procceses to Enhance Operational Efficiency (IEM)
ADVISOR/S: Dr. Jennifer Glenn

(Left to Right) Abdularahman Alijouher, Hallie Hopper, Jared Johnson

The Stillwater Medical Foundation is at the center of receiving donations, coordinating fundraising events, allocating the donated funds to its respective area in the hospital system and all communications with donors. The Foundation finds itself in a position of needing to dedicate much of its employees' time to fundraising and improving donor stewardship. The Foundation currently has four full-time employees and primarily uses the customer relationship management database, Raiser's Edge, to hold donor information and pull query reports when needed. Many changes are in process with the Foundation, including role changes, new employees and bigger goals for fundraising. The focus of this project is to improve the processes currently used by different employees to alleviate inefficiencies and save time to allow for more fundraising. Having an initial assumption of checks and cash being the main form of donations received, it was the specific process the senior design team chose to focus on for the data collection storage.

First, the team interviewed the accountant, coordinator, and executive director. After the first meeting, we determined that there are three different root issues that each group member has focused on. The first is overall process improvement, as the first meetings have shown that the processes being looked at had to be expanded. The second, is to find more efficient ways to handle data entry and cleansing to solve the root cause of duplicated and untrustworthy data. The third, is to find an efficient way to create data visuals, as the Foundation currently has the needed data but there are betters ways to understand the immense amount of data stored.

PROJECT: Inventory Management Plan Creation (IEM)
ADVISOR/S: Dr. Akash Deep

(Left to Right) Luke Ratke, Rachel Bebb, Marco Pina-Perez

This report was written to develop process flow and inventory management solutions for Phillips66 and their fuel cell pilot lines. The fuel cell lines are composed of two sub-assemblies, a fuel stack and a fuel shell, which are later assembled into a fuel cell. The scope of the project was limited to determining the amount of inventory required, order quantities, optimal placement of storage items and the modes of storage.

Sponsored by:

Mark Jensen

Brian Besecker

Project Video

PROJECT: Hypogravity Simulator-Leg Exoskeleton (MAE)
ADVISOR/S: Dr. Jerome Hausselle

(Left to Right) Grayson Harman, Mohammed Alsalman

The Hypogravity Simulator is a way we can simulate low gravities on the human body here on Earth. The low gravity will be applied to a subject as they are walking on a treadmill to study the effects of low gravity on the subject's body. In the future, academics can use this simulator to gather data and further their understanding of lack of gravity for the future of space travel. For this year's Hypogravity Simulator team, we have designed a leg exoskeleton to simulate low gravity on the lower torso of the human body.

Project Video

PROJECT: Transparent Refrigeration (MAE)
ADVISOR/S: Dr. Christian Bach, Dr. Dan Fisher, Professor Laura Southard


(Left to Right) Jay Clardy, Elysa Donoho

This design project seeks to build and test a fully transparent refrigeration system to be utilized in a research application. This project will last two semesters. Our team, this first semester, will design and build the system and run preliminary tests using an A1 safety group refrigerant. The system is a closed-loop refrigeration cycle that encompasses a recovery pump that contains a compressor and condenser. This project is focused on designing an evaporating heat exchanger that utilizes clear polycarbonate tubing to enhance refrigerant visibility. The scope of the second semester will be to test the system using more modern, A2L safety group refrigerants.

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Project Video

PROJECT: 1207 Engineering (Thermal Energy Storage Tank Test Bed) (MAE)
ADVISOR/S: Dr. Christian Bach, Dr. Dan Fisher, Dr. Jeffrey Spitler, Professor Laura Southard


(Left to Right) Alexander Roubik, Drew White

The team was assigned the task of developing a test bed for a thermal energy storage (TES) tank system. TES systems rely on renewable energy, primarily wind and solar sources, to heat and/or cool water during non-peak hours of energy production that will be used later during peak hours when the cost of energy is more expensive. By implementing this system, there is potential for energy cost savings for the consumer as well as a potential to maximize renewable energy use.

A typical TES system is a closed system and consists of a large volume tank with inlets and outlets that connect to a circulation pump and a heat pump. Depending on whether the system is being used for heating or cooling applications, hot or cold water will be stored in the tank, again being heated or cooled during non-peak hours, and discharged to the heat pump to heat or cool a structure.

The issue facing TES tanks, and the one that this project sought to address, is the mixing of hot and cold water. For example, If hot water is being discharged to the heat pump to heat a structure, it cools down as it circulates throughout the piping system store before returning to the tank. When the cooler water returns to the tank, it will mix with the hot water and, in turn, lower the overall temperature of the water in the tank, thus lowering the effectiveness of the water to heat the structure. The solution to this is to implement a baffle system, which will help to prevent mixing and increase the overall effectiveness of the system. The team developed the TES system with an adjustable baffle system that will allow future teams to test the effectiveness of various baffle configurations at limiting mixing within the tank.

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CENTER FOR INTEGRATED BUILDING SYSTEMS
College of Engineering, Architecture and Technology

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Project Video

PROJECT: O2SU (Wearable Oxygen Concentrator) (MAE-Tulsa)
ADVISOR/S: Dr. Masoud Allahkarami, Dr. Jay Hanan, Chris Scott

(Left to Right) Miguel Benitez, Presley Williams, Steve Lovell, Robert Lucas, Kurtis Ewing

The main objective of this project is to design and manufacture a small, wearable, oxygen concentrator that takes in atmospheric air, and outputs oxygen to the user. There is a set of requirements we must complete to consider this project successful. These include: an output of >80% oxygen concentrated air, an output flow rate of 2-5 liters per minute of oxygen, weigh less than 5 lbs., operate at safe listening levels (<70dB) and be wearable and ergonomic.

We have inherited Spring 2022's oxygen concentrator. Currently the system does not meet the design requirements given. It weighs over 30lbs, is not in a wearable format, and has maximum O_2 output of 26%. However, it does accurately use pressure swing adsorption (PSA) technology, which we want to continue using. We are tasked with redesigning the system using new components to better meet the requirements. Ultimately, this project will be passed on to an independent engineering firm (ISPS Inc.) who will further refine the design and build off the knowledge we have acquired in the early building stages.

As a team, we recognize trying to meet every design requirement for this oxygen concentrator is a significant challenge. We have spoken to Dr. Hanan regarding limitations including time, budget and class scope. In doing so, we have formulated a list of what to prioritize to consider this project a success. Our first goal is to have a fully functioning system (in its current laid out state) that safely and reliably produces >80% O_2 concentration for an extended time period. Once this is achieved, the next step in the design process would be to consolidate the components into one unit, and make sure it is safe as a wearable device.

Sponsored by:
Innovative Safety and Performance Solutions, Inc.

Bamidele Ali, CCO

Project Video

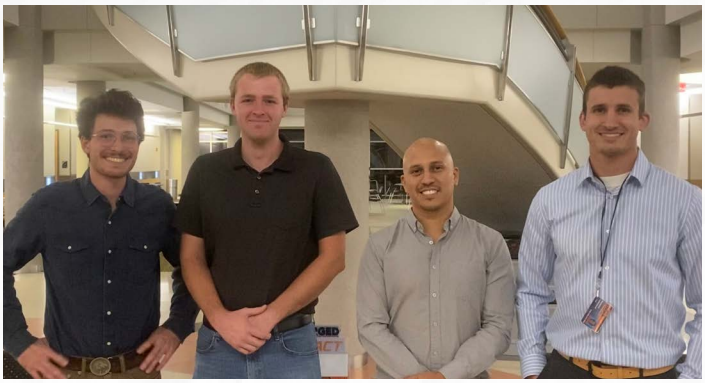
PROJECT: PET Project (MAE-Tulsa)
ADVISOR/S: Dr. Masoud Allahkarami, Dr. Jay Hanan, Zachary Cain, Erick Pepek

(Left to Right) Michael Pickett, Zam Thang, Ashley Pennyman, Gabe Moya, Luis Agureo, Stephen Paris

This is a continuation from last semester's design project of determining the capability of generating good PET filament that will be used for sustainable 3D printing developed from proprietary filament. This will be accomplished through the testing of the proprietary filament and its 3D printed specimens. This will be compared against filament and 3D printed specimens of PLA, PETG and PET from other manufacturers.

The overarching scope for this project of sustainable 3D printing can be summarized by determining the capability of producing good PET filament from proprietary pellets in a market where PET filament is not as easily accessible of a product as compared to other polymers such as PLA and PETG, due to it being difficult to produce. The objective for this project summarizes the steps that the team will follow to accomplish the goals set for this team, and concerns the extrusion of pellets into filament, and the testing of the filament and 3D printed specimens to help better understand the viability of using the proprietary PET versus polymers that are already available on the market.

PROJECT: Thermoforming Prototyping - Seal Team Soda (MAE-Tulsa)
ADVISOR/S: Dr. Masoud Allahkarami, Dr. Jay Hanan



(Left to Right) Charley Walton, Jackson Wilson, Aldo Albinagorta, Ben Lamoreaux

Our project goal is to create a thermoformed part that can seamlessly replace the industry standard part. The part must satisfy three main design goals: effective mechanical engagement, sufficient fluid interaction and a frangible requirement. Prior teams were successful in thermoforming parts which exhibit mechanical and fluid requirements, so our team was tasked with implementing the frangible component. To accomplish this goal, we have designed two mechanical systems which remove the excess material from the thermoforming process, deform the edge of the part to finalize the geometry and cut the perimeter to finish forming.

Project Video 1 **Project Video 2**

PROJECT: Autonomous Guided Vehicle "Big Bertha" (MET)
ADVISOR/S: Dr. Joe Conner

(Left to Right) Brittany Kelley, Nathan Albro, Cameron Ayers, William Randall, Kyle Lucas, Sean Bouchery, Luis Brito, Travis Thomas

In this project, an America in Motion AGV unit needed to be activated and made operational. Following the initial startup, translational and rotational motion about the center platform was achieved. After all functional needs were met, an evaluation and inventory of all internal components was documented. A plan was created to disassemble, reduce the size, reassemble and reboot the machine under a reconstructed frame. After alterations, testing was conducted to ensure all movement capabilities and the original system functions were still in working order. Once completed, the machine would be able to fit in a smaller space and hold a load of 300lbs. The envisioned future use of this machine would include the ability to carry different loads, or function as a glass rack where glass can be transported throughout a warehouse or factory.

Project Presentation | Project Video

PROJECT: FAA Mechanical Switch (MET)
ADVISOR/S: Dr. Aaron Alexander, Dr. Joe Conner, Dr. Brad Rowland, Professor Warren Lewis, Paul Thai

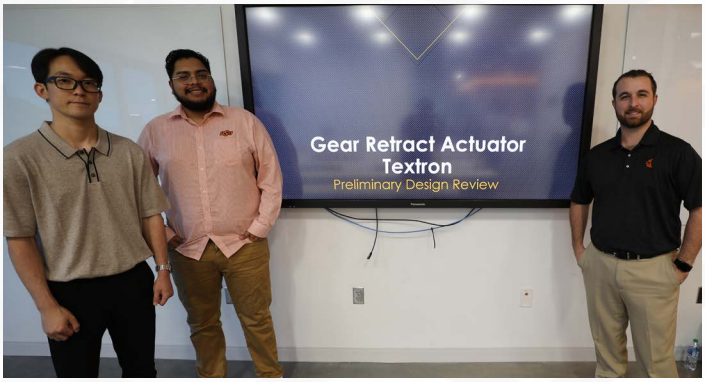
(Left to Right) Chance Krumsiek, Zachary Patterson, Garret Shields, Cameron Thomas

The FAA is in charge of movable, reconstructible towers, and they came to us with a problem and we are driven to find a solution! These towers were not used during the pandemic and when the technicians went to re-certify the towers they noticed corrosion had occurred in the switch components. These switch components are a very important safety factor for the operation of the towers. The screws in the components were what had corroded. Our goal was to find out why the screws corroded and fix the problem so that the towers could be repaired and ready for the field.

Sponsored by:
Paul Thai
Andrew Matteisen
Bryan Scagnetti
Brian Person

Project Video

PROJECT: Textron Gear Retract Actuator (MET)
ADVISOR/S: Dr. Robert Taylor



(Left to Right) Gwangmin Kim, Gabriel Guerra, Taylor Groom

This project, from Textron, is to design an extension/retraction system that is electric. Textron has removed all of the hydraulic components and would like us to present them with a design that will meet the requirements that they have given.

Sponsored by:
Steve Eddy
Joe Phillips

Project Video

PROJECT: Under Pressure (Textron Tire Pressure Monitor) (MET)
ADVISOR/S: Dr. Robert Taylor

(Left to Right) Kyler Martinez, Aaron Houtchens, Austin Wilkins

For our project, we are working on a Tire Pressure Monitoring System to be implemented for Textron turbo prop planes. This project is being done because there is a need for tire pressure communication on landing gear to the cockpit so pilots and personnel aboard the plane know that their gear is working as it should and safe for landings. We are striving to make a system that allows for proper pressure readings, is covered and safe from a harsh environment, and a system that allows for refilling of air to the tire without having to remove the sensor from the valve stem for ease of use.

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Project Video

PROJECT: AI Foosbots (ECE, MAE, MET, Computer Science)
ADVISOR/S: Dr. Joe Conner, Dr. Christopher Crick, Dr. Robert Taylor, Dr. Gary Yen, Professor Laura Southard


(Left to Right) Alex Gaines, Andrew Mandrona, Riley Howell, Jalen Grier, Vignesh Ravi, Cade Bailey, Hunter Collins, Tim Sullivan, Jake Franzen, Damon Meadows, Jacobo Rosillo

This project is a continuation of the Spring 2022 AI Foosball table project. The primary objective of this project was to create a completely new Foosball table, that improved upon the concepts of the original table, while primarily focusing on the artificial intelligence (AI) capabilities of the table and the transportability of the table between locations. The mechanical system was re-engineered to be contained within the table itself, while also adding AI utilizing a neural network and machine learning that continually improves as it plays. This table will be used as a teaching tool for students in STEM fields as well as a platform for further development of the table by future OSU design teams.

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Project Video

PROJECT: Autonomous Firefighting Vehicle (ECE, FPSET, MET)
ADVISOR/S: Dr. Rob Agnew, Dr. Aaron Alexander, Dr. Joe Conner, Dr. Scott Mattison, Professor Nate Lannan

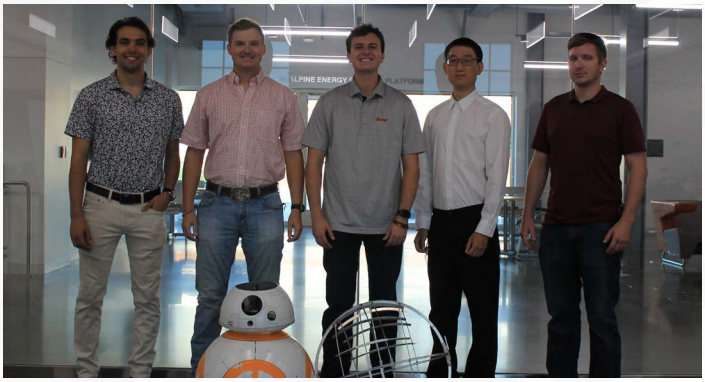
(Left to Right) Alex Aispuro, Nick Flewallen, Dillon Schmidt, Andrew Hart, Payton Fack, Megan Brown, Mark Dodson, Liza Fonseca, Blake Moore, (not pictured) Andi Tice

The team's overall objective is to design and build a fully autonomous firefighting vehicle (AFV) that has the capability to locate and fully extinguish an open pan fire. The pan fire and vehicle are scaled to represent an aircraft rescue and firefighting vehicle (ARFF) and a Boeing 737-800. The team is focused on successfully using path finding capabilities to avoid objects, finding the quickest route to the fire, extinguishing the fire completely with a foam launching system that is controlled through RC, and autonomously returning to the base station after completing the mission.

The AFV will then ready itself for full shutdown or another mission. In the Spring 2023 semester, the team will expand upon these goals by modifying the vehicle so that it is able to enter areas that are not safe for human entry, and to have the ability to extinguish more than one fire with one charge and one tank of foam. There is also room for growth electrically by the addition of an autonomous fire suppression module instead of remote-controlled suppression.

Project Video 1 | Project Video 2

PROJECT: BB-8 "I Luv U 3000" (MAE, MET)
ADVISOR/S: Dr. Joe Conner, Dr. Amanda De Oliveira Barros



(Left to Right) Samuel Sibley, Drake Wooldridge, Jacob Hamill, Tianming Li, Brandon Coppedge

This project is focused around recreating the BB-8 Droid from Star Wars, in real life. The end goal of this project is to have a fully functioning BB-8 replica that has the ability to maneuver itself.

At the beginning of the fall 2022 semester, the existing prototype we inherited was made from mostly PLA with the drivetrain and head being 3D printed. However, these 3D printed parts were warped due to heat, and the assembly of the drivetrain system was unnecessarily complex. The previous design used a Carrie V3 drivetrain, and we moved to Joe's MkIII drivetrain.

The warping can be caused by a multitude of reasons but excessive heat is the most frequent problem. When the BB-8 robot is moving, the internal temperature can be high due to the robot being enclosed, and while the outside surface is contacting the ground, heat from the ground and ambient air could possibly cause warping.

Our team focused on the mechanical aspect of this project, and for this semester, our goal was to improve the functionality of BB-8 by simplifying and redesigning the drivetrain and gimbal with reinforced materials to improve performance and prevent any potential future warping problems.

Project Video

PROJECT: DOE Wind Energy Competition (ECE, MAE, MET)
ADVISOR/S: Dr. Aaron Alexander, Dr. Dan Fisher, Professor Nate Lannan

(Left to Right) Marshall Cook, Alyssa Miller, Ryan Lawson, Tristan Rohn, Benjamin Marquis, Ethan Fiddler, Hunter Reitze, Anusha Suraf, Jeremy Goodwin, Wesley Dodson, Sahir Virani

The Department of Energy created the Collegiate Wind Competition to prepare students to enter the wind energy workforce by providing real-world experience in this industry. The competition is divided into three parts, which our team will focus on: turbine design, project development and outreach. For turbine design, we will build an effective wind turbine that is reliable for testing in a wind tunnel with a sea simulation tank. In the project development portion, we will create a site plan and cost-of-energy analysis for producing an offshore wind farm. Finally, the outreach team will forge connections between competition participants, the wind industry, other students and the local community.

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COLLEGIATE WIND COMPETITION
U.S. DEPARTMENT OF ENERGY

MAD COMPONENTS

The Martin Family Foundation

Project Video

PROJECT: Multi-Axis 3D Printer (ECE, MAE)
ADVISOR/S: Dr. He Bai, Dr. Scott Mattison, Dr. Hadi Noori, Professor Laura Southard

(Left to Right) Jay Sperry, Preston Stout, Conner Pine, Garrett Johnson

Multi-Axis 3D printing potentially allows for increased manufacturing efficiency, increased designer control and unique mechanical properties not available with traditional additive manufacturing. With a secondary extruding head placed orthogonally along the frame of the printer allows for filament extrusion with 3 degrees of freedom in the printing area. The primary arm and print bed retain the 3 degrees of freedom that current traditional additive manufacturing provides. Currently, the print software does not interface between both printer heads simultaneously, so the design is manually sliced before being sent and processed by external software to translate instructions intended for the primary print head to be processed by the secondary print head. Coordination between printer heads is paramount, as collisions between heads will result in loss of print quality and potential equipment damage and failure. The primary print head first operates until it has finished the prescribed part, then an onboard microproccesor, Arduino, will send instructions to the secondary print head autonomously. The extended nozzle on the second print head allows for the control and maneuverability necessary for fabricating components with complex shapes while maintaining accuracy. Early results show potential for multi-axis 3D printing to fabricate complex designs with advanced geometric, spatial and mechanical properties while retaining accuracy and increasing manufacturing efficiency, while decreasing material usage.

Project Video

PROJECT: IGVC Vehicle (Team Joyride) (ECE, EET, MAE, MET)
ADVISOR/S: Dr. He Bai, Dr. Rushi Kamalpurkar, Dr. Weihua Sheng, Dr. Robert Taylor, Professor Nate Lannan

(Left to Right) Lucas Hudson, Brenden Wickman, Luke Johnson, Brandon Dang, (not pictured) Kenya Williams, Troy Willoughby, Max DeSantis, Luke Johnson, Josephine Wade, Jason Aquino, Bailey DeSpain, Jack Funderburgh

Team Joyride has the adventurous task of converting a Polaris GEM e2 into a fully autonomous vehicle for the Intelligent Ground Vehicle Competition (IGVC) in June 2023. The foremost problem was making the vehicle drive-by-wire. The team interconnected the custom braking, steering, gearing and throttle system with a fitted wire harness that connected to printed circuit boards and computers that allowed for complete vehicle mobility. The team is also developing autonomous driving functionality by working with the Robot Operating System (ROS) and sensors.

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Allied Motion phytools

Project Video

PROJECT: Thermal Fatigue Test System Retrofit Kit (EET, MAE)
ADVISOR/S: Dr. Kurt Rouser, Dr. Hadi Noori, Haden Glasgow

(Left to Right) Bryan Pizana, Nicholas D'Cruz, Madison Cooper

The objective of this project is to design, build and test a thermal mechanical fatigue (TMF) test system for inducing thermal cycles on high-temperature, high-strength metal aerospace materials, such as Inconel 718. The temperature range will be capable of at least 900 degrees Celsius and have a cooling system to enable rapid thermal cycles. The test articles will be machined from 5mm-diameter circular rod machined to about 3mm-diameter midway along the span. The system must be compatible with tensile test machines in the Bert Cooper Lab, and it must include an induction heater, air cooling system, controller and power supply. This project supports aircraft gas turbine engine repair development research aligned with workload needs at Tinker Air Force Base.