COLLEGE OF
ENGINEERING, ARCHITECTURE
AND TECHNOLGY

SENIOR DESIGN EXPO

Fall 2019 Team & Projects Guide

Friday, Nov. 22

ENDEAVOR

Welcome

The College of Engineering, Architecture and Technology is accelerating with levels of change and transformation not seen since its founding more than 120 years ago.

Interdisciplinary and hands-on learning with advanced analytic tools and laboratories is leading to more complex projects, entrepreneurial experiences and student competition victories. Today, at our Senior Design Expo you will get to take a live look at some of these industry-inspired and innovative senior design projects, of which many are interdisciplinary in nature.

We have awarded more than 1,050 degrees this year, a 40 percent growth in engineering bachelor's degrees in five years. We have worked with students, administration and alumni to continue to deliver 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 ENDEAVOR lab initiative opened in September 2018 to transform the undergraduate experience with large-scale, hands-on labs with entrepreneurial manufacturing space for student ideas and dreams. There is no change agent like it in the world. Faculty members are redesigning curriculum to better use the integrated capabilities, and students are being trained to prototype their own ideas to build their own future, which you get a glimpse of today.

It is exciting to be at Oklahoma State University and in the College of Engineering, Architecture and Technology. 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.

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

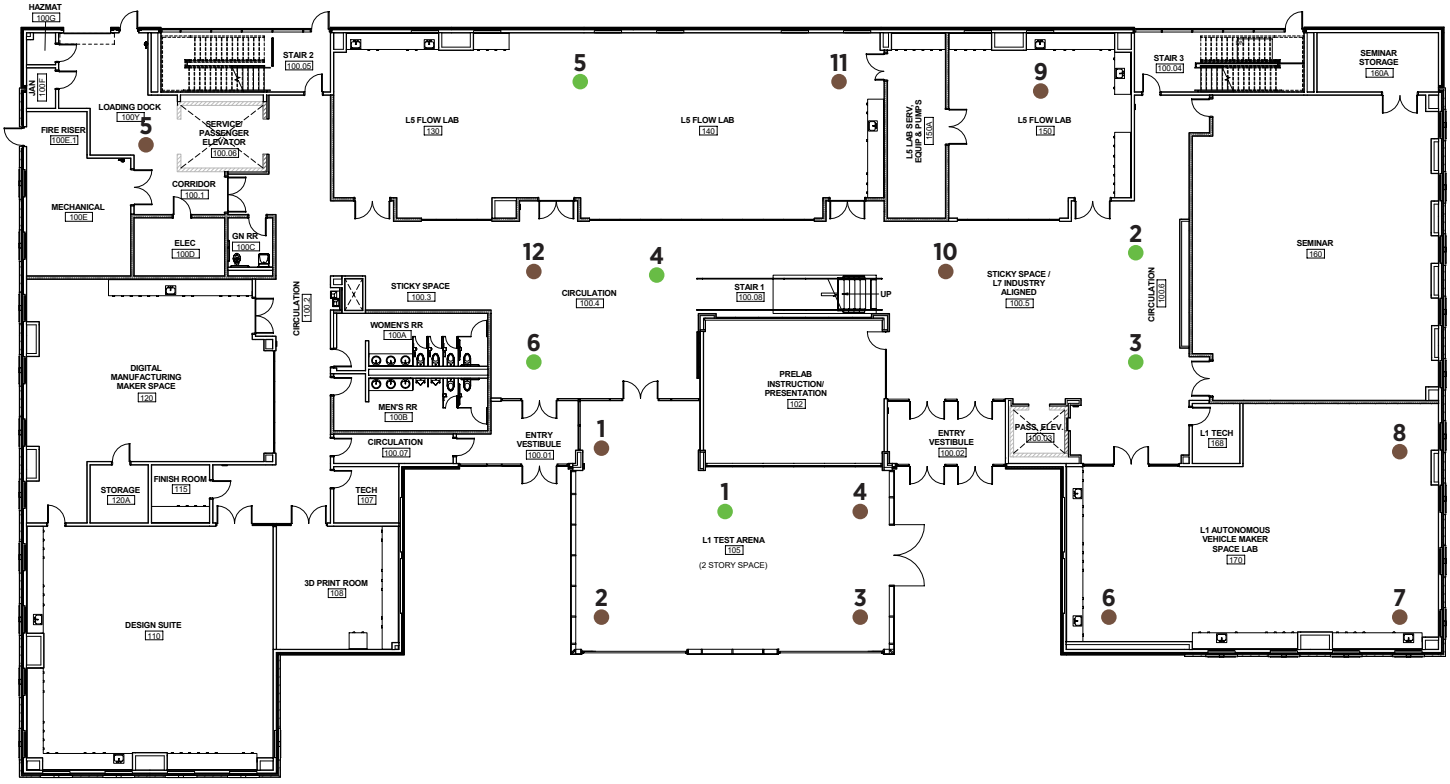
Go Pokes!

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

Schedule

Civil and Environmental Engineering (CIVE)	1P.M. - 5P.M.
Electrical and Computer Engineering (ECEN)	10A.M. - 5P.M.
Division of Engineering Technology (DET)	1P.M. - 5P.M.
Fire Protection and Safety Engineering Technology (FPSET)	9A.M. - 12P.M.
Mechanical and Aerospace Engineering (MAE)	12P.M. - 5P.M.
Mechanical Engineering Technology (MET)	9A.M. - 12P.M.
Industrial Engineering and Management (IEM)	1P.M. - 3P.M.
Interdisciplinary (ID)	12:30P.M. -5P.M.

First Floor



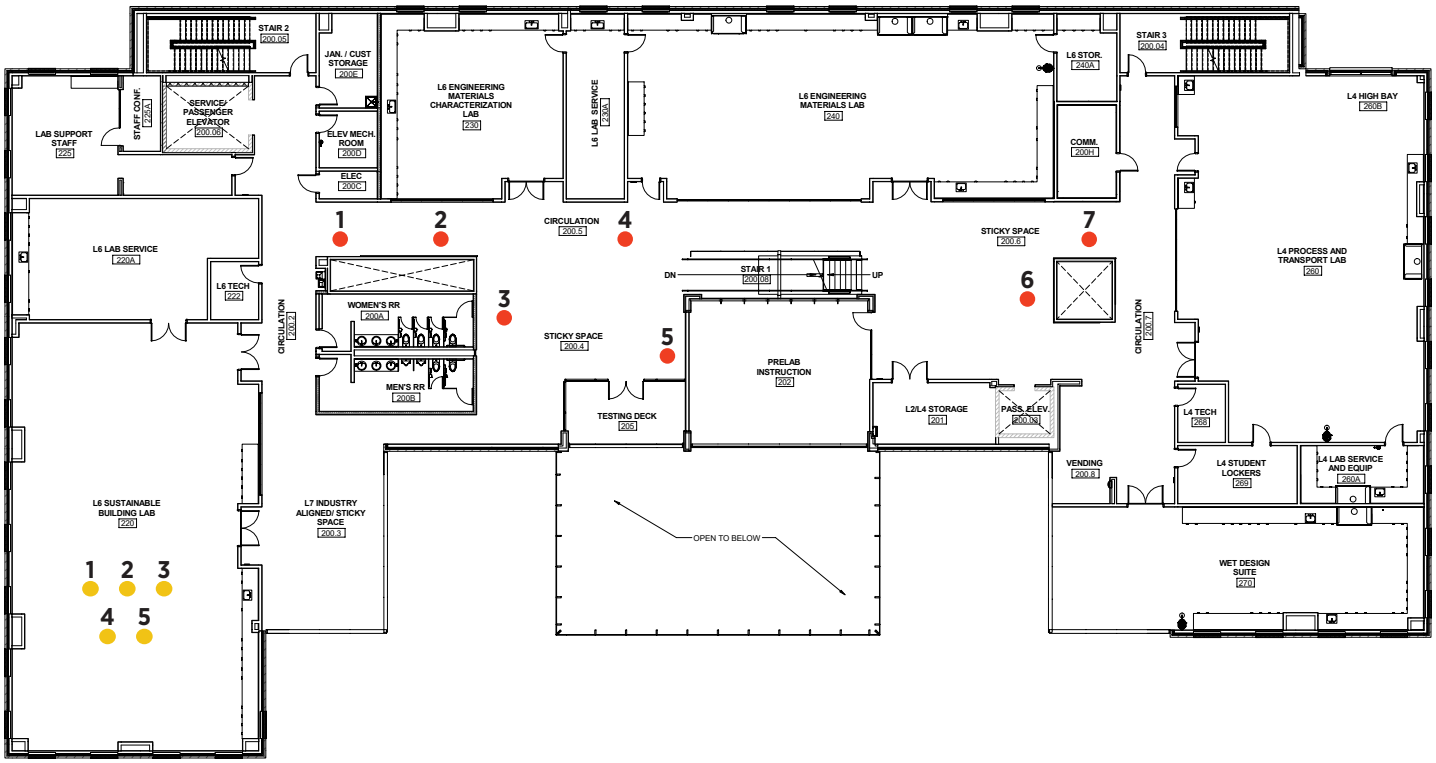
INTERDISCIPLINARY

1. ENDEAVOR Ground Source Heat Pump Stand Instrumentation II
2. Informal Settlement Fire Safety Test Apparatus
3. 3-D Concrete Printing
4. Turboelectric Fixed-Wing Unmanned Aircraft System
5. Fatigue Test
6. Renewable Energy STEM Education Prototype
7. Adaptive Kitchen Wall, Cabinet, Countertop System
8. Autonomous Golf Cart (AGC) Reactive Systems
9. Thermal Energy Systems Learning Environment
10. Wind Turbine / Light Show / Sculpture
11. Seperation Station / Old Distillation Refurbish
12. UAV Based Well-Site Inspection System

MAE

1. Down Hole Drone
2. Aquaponics System Energy Upgrade
3. Small Turbojet Windmill Prevention
4. Double Action Hydraulic Press
5. Performance Evaluation of Energy Recovery Ventilation
6. Scan Eagle De-icing

Second Floor



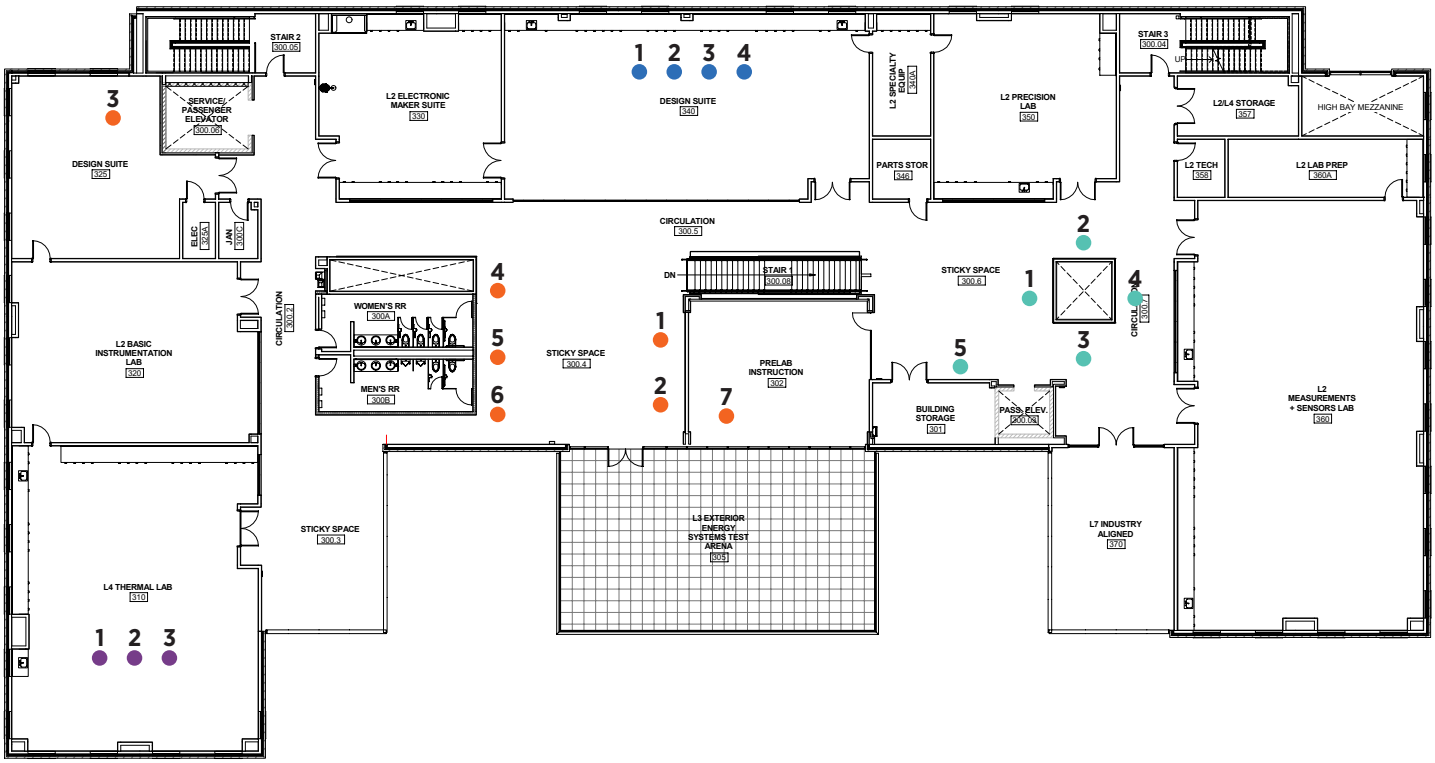
IEM

1. Stillwater Designs
2. Arrow Engine
3. Ameristar
4. Cowboy Academy
5. NORDAM

FPSET

1. Occupational Noise Exposure in Landscape Maintenance Operations
2. Human Error at the Work Place
3. Movement Speeds
4. Electrical Team
5. Wall Assembly Fire Characteristics
6. C Factor Testing
7. Effectiveness of firearm suppressors for hearing protection

Third Floor



MET

1. Boeing Wire Testing
2. Flightline Ethernet Controller Box
3. Car Wash System
4. Cross Trail-er
5. Emergency Door Stop
6. MOOG Heatsink
7. Penta Multi-Nozzle Hotend

CIVE

1. River Runners Environmental Engineering
2. Structural Team for Dementia Friendly Village
3. Grading and Drainage Team for Dementia Friendly Village

ECEN

1. Electronic Component Tester
2. Electronic Component Tester 2
3. Control Board Protection Circuit
4. ADS-B Telemetry Capture and Fusion
5. DOPPLER Radar

DET

1. Bucket Brigade-Speedfest
2. The Suppressors
3. Green Machine
4. The Jokers

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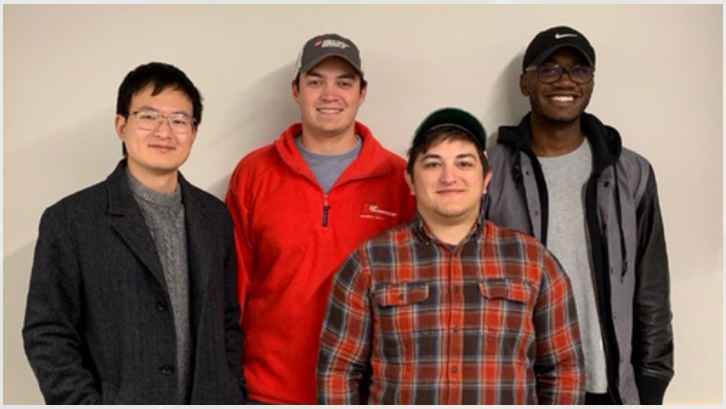
PROJECT: River Runners Environmental Engineering (CIVE)
TEAM: (from left to right) Anderson Berryhill, Fahad Alsuwaidan, Torrey Hickel, Alissa Hall & Destini Martin
ADVISOR: Greg Wilber

Our client is the Otoe-Missouria Tribe, and our project with them has two main parts. First, the tribes water treatment plant is exceeding the THM limits set by the EPA. THM's are a type of Disinfection By Product (DBP) caused by the chlorine used for disinfection, reacting with organics during the distribution of the water. These disinfection byproducts are serious health concerns that can increase the chance of cancer and cause nervous system problems. The second part of the project is a small pipeline extension to their current distribution system.

PROJECT: Structural Team for Dementia Friendly Village (CIVE)
TEAM: (from left to right) Hao Cheng, Justin Bennett, Curtis Coltharp & Dominic Winn
ADVISORS: Norb Delatte, Mohamed Soliman & Greg Wilber



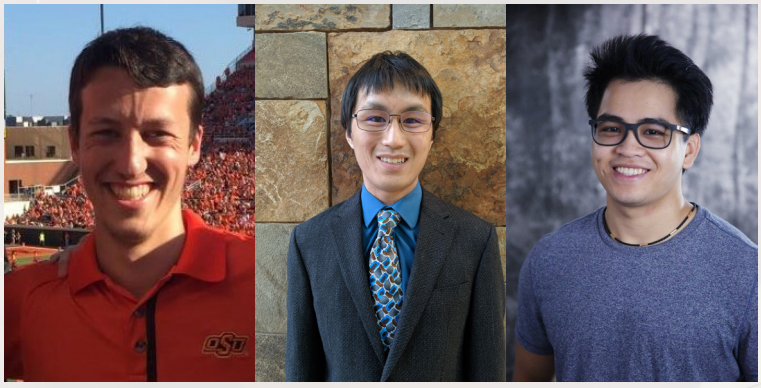
Our group was tasked by Dr. Emily Roberts, faculty at Oklahoma State University, with redesigning a portion of the Crossroads Mall in Oklahoma City, OK. This redesign covers demolition of a portion of the roof in order to create an open concept courtyard in the middle of the mall, renovating the walkways and ground floor to handle open weather conditions, and developing drainage support for the open courtyard.

We have devised plans in order to help bring Dr. Roberts' vision to light. We will be designing two new elevators and two new escalators for the courtyard area. We will also be grading and finishing the walkways and ground floors of our courtyard area. We will be creating a retention pond doubling as a water feature to hold water that may rise in extreme cases. In extreme case weather events, the excess water will be drained outside by a pipeline to a larger retention pond.

PROJECT: Grading and Drainage Team for Dementia Friendly Village (CIVE)
TEAM: (from left to right) Yongwei Shan, Nathaniel Morris, Abhay Godhania, Nick Burt & Lauren Breedlove
ADVISOR: Yongwei Shan

Our team, Moving Mountains Engineering, is producing the civil site design for the dementia-friendly village that is being done through adaptive reuse of the old Crossroads Mall in OKC. This includes the grading and drainage for the site. The main design element is a pond that is being installed on the south side of the Crossroads Mall site along with an aeration basin through the berm. Along with the pond, the team will be providing a new site design layout with the updated changes and regreening a good amount of the parking lot.

PROJECT: ADS-B telemetry Capture and Fusion (ECEN)
TEAM: (from left to right) Connor Begansky, Kelvin Leu & Nathan Nguyen
ADVISOR: James West



Design, build, commission and prove a working prototype that collects video data and synchronizes between existing aircraft tracking systems/data (ADS-B) and "light" spectrum (visual) video streams and data. Deliverables include hardware and software. Integration with existing, publicly available hardware is encouraged. It will require the inclusion of high definition video recording capabilities and an ADS-B receiver such as (https://flightaware.com/adsb/piaware/build). The resulting data streams would then be synchronized and the resulting output would be filtered and stored in a reasonable format. The sponsor encourages the use of openly available video encoding formats such as H.264, VP8, and other common data formats such as .csv, .json, postgres. The objective of using open formats is to enable processing of the data with common Python 3 tools.

PROJECT: Control board protection circuit:
Preventing 480 V damage to 30 kW Steam generator control board (ECEN)
TEAM: (from left to right) Omar Alchami, Cameron Jump & Austin Kirk
ADVISOR: Jerzy Kransinski

This team is to develop robust isolation devices that prevent over-voltage from reaching the control board while simultaneously maintaining functionality. The maximum voltage between TC and SCR control pins is 480 V (L-L and between decoupling devices) and needs to be survived by the decoupling electronics. A single 24V AC transformer is available as power source (no other devices connected). (1) We will develop a TC decoupling electronic that allows us to transfer the TC reading in a range of -30 F (broken TC) to 1500 F to the TC input. (2) We will develop a PWM output decoupling device to connect the DIN-A-MITE SCR DB20-60C0-0000 to the board's PWM output. (3) We may also develop a device that shuts down steam generator operation if element power consumption increases over the rated amount (e.g. indicating short circuiting).

One way to solve the project is to electrically separate the troublesome thermocouple from the control board. That can be done by designing an additional board where the signal from the thermocouple is digitized and sent in a serial fashion through an optoisolator that is able to survive the worst case overvoltage present in the system during a failure of the heating element. The serial signal is converted back to parallel on the output side of the coupler, fed into a D/A and scaled down to the original voltage of the input thermocouple. This way the control board would receive the thermocouple signal without electrical connection. The additional board must be powered with a power source able to survive electrical transients caused by the burning heater. Assuming that the 24V power transformer is correctly selected and can survive these transients, the system would provide total electrical isolation between the thermocouple end of the system and the control board while optically transferring the signal from the thermocouple to the board.

PROJECT: DOPPLER Radar (ECEN)
TEAM: (from left to right) Shawn Babu (not pictured), Kevin Glenn & Steven Mead
ADVISOR: Weili Zhang

One version of microwave RADAR uses Doppler effect to establish velocity of the target. Small radars of that type are frequently used for measurement of velocity of tennis or baseball balls in sports. Another application is automatic door opener.

There are many inexpensive microwave units for door openers on the market. They contain a transistor source operating at a frequency of 10GHz or 24GHz, a small transmitting antenna array, a receiver antenna array and a diode mixer producing the differential frequency proportional to velocity of the target.

There are also many microwave Gunn diode oscillators on the market.

It is relatively easy to modify such door opener units and produce a velocity measuring instrument. The signal from the mixer must be properly amplified and fed into frequency counter. The counter must be provided with a proper triggering pulse activated when a moving ball is detected.

The objective is to make an instrument that would be useful in sports training for measurement of velocity of thrown balls.

The system should be battery powered. Small size of the system is also critical.
The range of the radar should be within several meters.

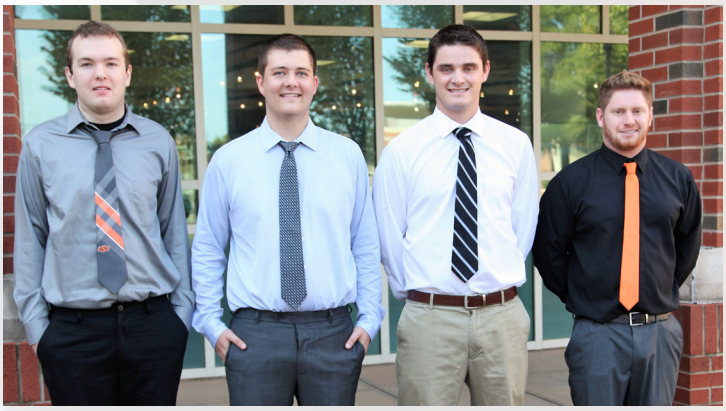
PROJECT: Electronic component tester 1 (ECEN)
TEAM: (from left to right) Jishuo Li, Carlos Cardenas, Berny Flores & John Ondiek
ADVISOR: James Stine

We are designing a simple microprocessor based device for identification of electronic components. The element is to be inserted into test sockets and after depressing the start button the system should display found type of the tested device and its basic parameters. The instrument should be provided with automatic shut down.

PROJECT: Electronic component tester 2 (ECEN)
TEAM: (from left to right) Tyler Barbee, Taryn Lewis, Garrick Prelesnick & Travis Lowe
ADVISOR: James Stine

We are designing a simple microprocessor based device for identification of electronic components. The element is to be inserted into test sockets and after depressing the start button the system should display found type of the tested device and its basic parameters. The instrument should be provided with automatic shut down.

PROJECT: Movement Speeds (FPSET)
TEAM: (from left to right) Cory Fenci, Andrew Kintz, Kory Parker & Gregory Mowles
ADVISOR: Bryan Hoskins



America's demographics have changed since the previous movement speeds data that is used in the industry today was calculated. This change in demographics may have caused an increase in the amount of time it takes for people to evacuate buildings, leaving a chance for people to become incapacitated when attempting to evacuate a building. The major challenge faced when analyzing movement speeds is that the data it is based on does not match today's demographic. In multiple locations, we tested a diverse population on flat surfaces, doorways, and stairs. With these results, we compare our movement speeds to previous data collected from different tests. With our results for current demographics, we hope to provide the industry with better knowledge on current movement speeds, allowing for possible updates in NFPA 101 for stair width, fire rated walls, maximum travel distance through buildings, calculation methods used in NFPA and SFPE handbooks, and further building requirements to better fit America's changing population.

PROJECT: Effectiveness of firearm suppressors for hearing protection (FPSET)
TEAM: Christopher Hall
ADVISOR: Virginia Charter

Noise emission from firearms has continuously presented a problem with recreational shooters. Reduction of impulse noise, unwanted instantaneous sharp sounds emitted during the discharge of firearms, has been a topic of concern within recreational shooting communities. Many seek to eliminate the need for personal protective equipment to protect hearing by the attachment of noise suppressor devices on their firearms. With increasing popularity, many suppressor manufacturers are marketing tested noise reduction levels of their products toward the recreational shooter.

This study presents and discusses problems within the current standard used for testing suppressed firearms. Evaluated in this research is the accuracy of the current impulse noise testing standard: Military Standard 1474D for firearm suppressor testing.

PROJECT: Electrical Team (FPSET)
TEAM: (from left to right) Hassan Alobaid, Chase Lockwood, Leslie Stockel, Hayden Miller & Levi Hazelton
ADVISOR: Leslie Stockel

Our project was to develop a lab and interactive demonstration unit to instruct students in electrical circuits, safe testing of electrical circuits, system isolation, and general Lock Out/Tag Out procedures. We built a demonstration unit containing several circuits with different types of switches, breakers, and fuses, as well as different means for isolation. The final component of the project was the development of a lesson plan designed to cover the subject in a three-hour lab. The lesson covers, fundamentals of electricity, circuits, standards associated with electrical systems testing and isolation, and the hazards and injuries associated with electricity.

PROJECT: Human Error at the Work Place (FPSET)
TEAM: Majid Abdulqader
ADVISOR: Leslie Stockel

This project focuses on understanding and analyzing the various factors that influence humans to become involved in a risky action. Understanding the factors that motivate an unsafe act, can help reduce risks and control the hazards.

PROJECT: Wall Assembly Fire Characteristics (FPSET)
TEAM: (from left to right) Haejun Park, Bo Winters, Steven Sharp, Justin Gardner, Paul Wilson, Rob Agnew & Evan Chesley
ADVISORS: Rob Agnew & Haejun Park

Throughout the progression of residential building materials and construction, a trend of hotter and more toxic fires has been observed from the 1950s to modern day. This trend has been observed because of decreased time until flashover as well as increased overall smoke production. No determination of how different construction types contribute to this effect has been made, as most studies focus on the change in interior contents. This type of research has not been undertaken for two reasons; the sampling of fire effluent is complex and possesses many obstacles to replicate accurate samples, in addition, scale fire tests data is difficult to represent real-world large-scale fire conditions. Our team is introducing a wall structure burn that will represent a scale corner fire test and flame propagation from interior to exterior wall. This will allow for the sampling of the smoke effluent in an oxygen abundant environment and allow us to study the changing fire properties as the fire spreads. The team conducted experiments by burning scale structures from 1950s, 2000s, 2010s, and 2020s, by sampling the smoke effluent and calculating the heat release rate, mass loss rate, heat of combustion, and heat flux from each era. The projects determine an increase in toxic fire effluent and heat release rate as the building constructions become more modern due to the increasing addition of hydrocarbon based building products.

PROJECT: Occupational Noise Exposure in Landscape Maintenance Operations (FPSET)
TEAM: Abdullah Alghandi
ADVISORS: Rob Agnew, Virginia Charter & Leslie Stockel

A survey was done of four workers, about the shop they have in Facilities Management and the machines they use. This survey was done to provide recommendations to employees that exceed the recommended noise exposure limit by NIOSH and permissible exposure limit by OSHA.

PROJECT: Stillwater Designs (Kicker) (IEM)
TEAM: (from left to right) Molly Day, Terry Collins, Kathryn Fulton & Alex Pick
ADVISOR: Terry Collins

Reduce labor cost per unit for Kicker's Tailgate Assembly product.

PROJECT: Arrow Engine (IEM)
TEAM: (from left to right) Mitchel Loiseau, Whitney Fillmore & Dylan Rowan
ADVISOR: Bing Yao

Design an efficient facility layout and engine testing procedure around new equipment to increase utilization.

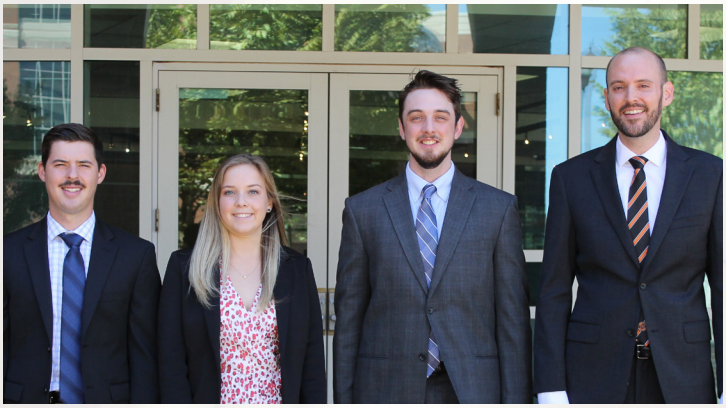
PROJECT: Ameristar (IEM)
TEAM: (from left to right) Chenang Liu, Omar Zain, Jackson Baker & Sarah Moore
ADVISOR: Chenang Liu

Design a distribution network of regional warehouses to reduce delivery lead time for Ameristar Fence's supply chain.

PROJECT: Cowboy Academy (IEM)
TEAM: (from left to right) Camille Frye DeYoung, Justin Hamilton, Omar Algannas & Aaron Madden
ADVISOR: Camille Frye DeYong

Develop an application to facilitate mentor/mentee relationship connection.

PROJECT: NORDAM (IEM)
TEAM: (from left to right) David Everly, Ashlyn Hughes, Nathan Green & Austin Buchanan
ADVISOR: Austin Buchanan



Reduce measurement variation at the NORDAM repair facility.

PROJECT: Scan Eagle De-icing (MAE)
TEAM: (from left to right) Gary Ambrose, Beau Davis, Riley Cooper & Jamey Jacob
ADVISORS: Gary Ambrose, Jamey Jacob & Laura Southard

Currently, the Scan Eagle Unmanned Aircraft System cannot fly in icing conditions because there is no de-icing functionality for the wing leading edges. Carburetor icing is a separate, but similar cold weather problem that restricts current flight capabilities. The aircraft needs a way to combat both problems so flight can be achieved in cold weather environments.

Naval Special Warfare (NSW) operates the Scan Eagle Unmanned Aerial Systems in cold weather environments and occasionally encounters icing conditions. Icing on aircraft (manned or unmanned) presents serious degradation to flight characteristics; destroying lift and increasing drag. A solution is needed to allow Scan Eagle UAS to operate within icing conditions without significantly degrading original flight characteristics.

PROJECT: Aquaponics System Energy Upgrade (MAE)
TEAM: (from left to right) Robert Taylor, Tristan Johnson & Casey Malone
ADVISORS: Robert Taylor, Laura Southard & Jim Beckstrom

Aquaponics is a form of agriculture that combines raising fish in tanks (recirculating aquaculture) with soilless plant culture (hydroponics).

Problem: Uninterrupted electrical power is critical for system control as well as HVAC/water temperature management. Power failure can result in loss of both fish and plants. There is no "non-interruptible power supply" system at the facility. Energy costs affect the bottom line of the viability of the system.

Project: 1) Develop "block diagram" of the existing electrical energy system (loads/supplies) for the Aquaponics system. 2) Study and analyze options and recommend an uninterruptable power supply system for the facility. 3) Study and analyze options, recommend and specify a back-up natural gas (if available) fired generator for the facility. 4) Design, install and commission a solar panel system to maintain charge of the UPS and feed excess power into the operating grid of the system. Additionally: 5) Estimate the heating and cooling loads for the HVAC and water temperature systems. 6) Study, analyze and design a GSHP system as the "heart" of the HVAC/water energy system. 7) Study, analyze and recommend viability of stand alone renewable energy system and/or natural gas fueled power generation for the facility.

PROJECT: Double Action Hydraulic Press (MAE)
TEAM: (from left to right) Aaron McMillen, Hadi Noori & Andrew Martinez
ADVISOR: Hadi Noori

Double action presses are used in sheet forming applications. The stretching, drawing, bending and shearing processes require a clamping force as well as a punching force. Two independent press actions exert these two forces.

Students will remodel the H-frame press and its control system at the North Campus Labs. They will also design and manufacture a combined die set which will be utilized for bending a steel sheet followed by punching a hole on its surface.

PROJECT: Down Hole Drone (MAE)
TEAM: (from left to right) Robert Taylor, Dylan Hagan & Russel Scovill
ADVISORS: Robert Taylor, Laura Southard & Jim Beckstrom

The goal of this project is to design a novel, feasible petroleum borehole robot. This autonomous down hole drone is to run self-sufficiently in a down hole bore with a minimum diameter of 3.995 inches in the vertical and horizontal parts of the well while carrying a modular sensor and tool payload. The robot will be subjected to a bottom hole temperature of 250°F and a bottom hole pressure of about 4,500 psi. There will be sands, chemicals and other solid, suspended particles within the fluid that must be protected against. These particles have the potential to cause damage to the structure, drivetrain, and electronics that the robot will carry. Additionally, the gas to oil ratio in the pipe can exceed 90 percent. The robot should also have the ability to move a load of 500 lbs. of equipment or heavy objects and maneuver them back to the surface or other objective point.

The team will develop an operation concept to satisfy all of the requirements, but will design and evaluate a demonstrator that demonstrates only a portion of the objectives.

PROJECT: Small Turbojet Windmill Prevention (MAE)
TEAM: (from left to right) Colton Swart, Kara Stead, Robin Eldridge & Kurt Rouser
ADVISORS: Kurt Rouser & Colton Swart

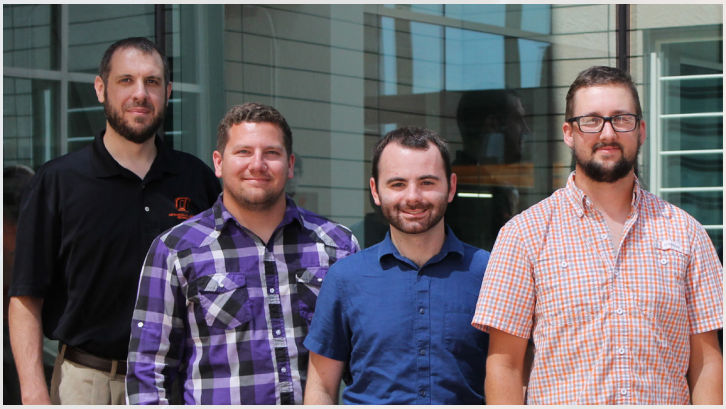
Continually and rapidly evolving small unmanned aircraft system (UAS) requirements drive the need for increased engine performance in terms of speed, range, endurance, maneuverability and payload weight. The 2019-2020 Aerospace Propulsion Outreach Program (APOP) research activity sponsored by the Air Force Research Laboratory requires undergraduate students, working as a team, to research and develop a modification to the JetCat P100-RX engine that prevents the rotor from free spinning at high Mach numbers and gives the engine thrust vectoring capabilities. Currently, if a JetCat was exposed to high inlet/vehicle Mach numbers while carried on the wing of the drop vehicle, the engine would windmill at significant RPM when powered off. This is an issue during prolonged periods of high Mach, since the bearings are not properly lubricated while the engine is off. The additional thrust vectoring requirement would provide additional maneuverability of the full system and address the challenge of moving components and/or electronics near the hot exhaust of the engine. The fall 2019 research team's responsibility is to modify the engine and demonstrate the ability to prevent windmill in an engine exposed to high Mach number inlet conditions. A practical solution would also provide a means for using the same mechanism and controls to accomplish both tasks, windmill prevention and thrust vectoring, while minimizing size, weight, and form factor and preserving straight-line thrust (i.e., without thrust vectoring employed). There is also a desire that this device would be simple in nature, minimizing the number of controls are required.

PROJECT: Performance Evaluation of Energy Recovery Ventilation (MAE)
TEAM: (from left to right) Christian Bach, Jennifer Chapman & Evan Hawk
ADVISORS: Christian Bach & Omer Sarfraz

Enthalpy wheels supply buildings with fresh air, limiting concentration of pollutants (CO2, VOCs, particulate matter) and ensuring occupant health and comfort. Unfortunately, many engineers are unaware of their advantages – causing specifying engineers to use substantially more energy costly fresh air preconditioning methods. The goals of this project are two-fold: (1) develop a testing environment for enthalpy wheels to demonstrate their capabilities and (2) provide input data to subsequent projects.

Enthalpy wheels allow the transfer of heat and moisture between two airstreams allowing the good proportion of the heat and moisture from the fresh air to be transferred to the exhausted stale air. Only a minimal additional conditioning is needed to then provide the remaining cooling and dehumidification for the occupied space. Their use becomes increasingly important as buildings become less leaky and better insulated – with ventilation increasing in contribution to total energy use. Our goal is to develop a testing environment that allows the air conditions of fresh and exhausted air flowrates and enthalpy wheel rotational speed to be changed. The setup will then allow future students to determine wheel effectiveness and optimal wheel speed as a function of operational parameters and wheel type (e.g. aluminum, synthetic fiber, polymer).

PROJECT: Penta Multi-Nozzle Hotend (MET)
TEAM: (from left to right) Aaron Alexander, Daniel Bruton, Benjamin Davenport & Gannon Griffith
ADVISOR: Aaron Alexander



The design for our Senior Project incorporates five different nozzles with diameters ranging from 0.4 to 1.2 to be used on a 3D printer. The advantages of blending faster print times with higher resolution prints.

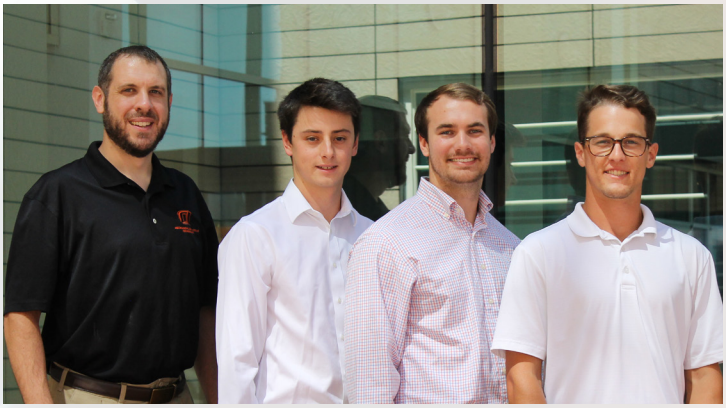
PROJECT: MOOG Heat Sink (MET)
TEAM: (from left to right) Aaron Alexander, Nickolas Herrin, Daniel Carne & Connor Fischer
ADVISOR: Aaron Alexander

With the rise of 3D metal printing, unique designs for many systems are now possible. We are working with MOOG, who has recently started using more metal 3D printers in their production. Their goal for us is to create the best possible heatsink design to be printed for the aircraft they service.

PROJECT: Car Wash System (MET)
TEAM: (from left to right) Aaron Alexander, Guo Jiachen, Ebrahim Alsoleebi & Ali Alzouri
ADVISORS: Aaron Alexander & Avimanyu Sahoo

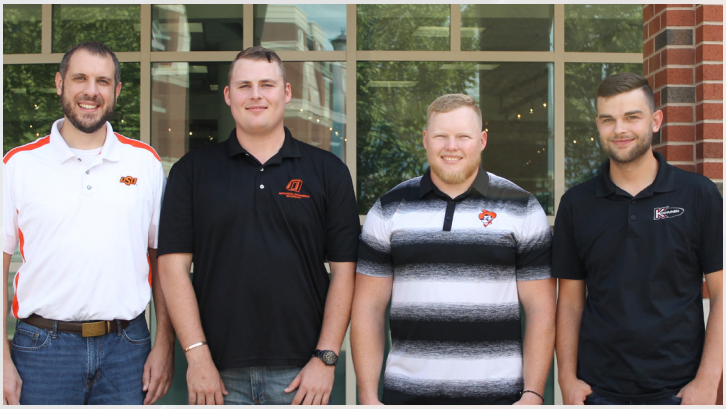
The project is a carwash system. It is a tutorial project that can help to instruct how the bully moves a car at a certain speed. This project will use the new pneumatic system to wash cars. Programing will be involved in this project.

PROJECT: Boeing Wire Testing (MET)
TEAM: (from left to right) Aaron Alexander, Chris Doidge, Cole Bibee, Aaron Parks & Colton Jung (not pictured)
ADVISOR: Aaron Alexander



Electrical issues on aircrafts can be difficult to diagnose due in part to intermittences during flight, and the inability to replicate them on the ground. Being unable to replicate them costs time and money as the root problem goes further unidentified. One of the biggest detriments to wiring performance in aircraft is vibration in the wiring and wire bundles experienced during flight. For Boeing this means a solution is needed in the form of vibrational testing equipment. This equipment is needed to produce controlled vibrations similar to those while in flight. Boeing wants this to be done by attaching mechanical equipment to the wire bundles while on the ground. This test rig is required to perform in various conditions such as small areas of an airframe, and be capable of fitting known vibration profiles specified by the technician and recorded in real time. The purpose of our project is to explore and improve upon potential designs for a mechanical vibration system that meets these needs while utilizing lessons learned by previous groups.

PROJECT: Cross Trail-er (MET)
TEAM: (from left to right) Aaron Alexander, Ben Farris, Karl Crick & Chance Alley
ADVISOR: Aaron Alexander

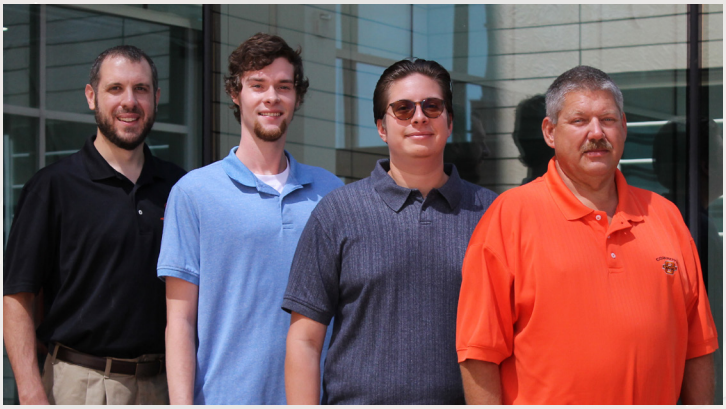


The Cross Trail-er is a lightweight and portable game/gear carrier for outdoorsmen. With the detachable wheels the loaded Cross Trail-er can be pushed or pulled transfering the weight into the ground, and if the wheels are removed the Cross Trail-er makes a great lightweight bridge or ladder with a fully expanded length of 6.5 ft. Made of 6061 aluminium it weighs less than 15 pounds but will easily hold 350 pounds, and it is designed to fold down to 1/4th of its expanded length and fit in a backpack to easily carry or store when not in use.

PROJECT: Emergency Door Stop (MET)
TEAM: (from left to right) Aaron Alexander, Garrett Negen & Mitchell Graf
ADVISOR: Aaron Alexander

The general idea of Zip Stop is to provide a device to the public that could be used to barricade a door to deny entry of an assailant, but also be small and light enough to encourage people to keep one with them in their backpack or purse. The device is designed to be user friendly and that is easy to deploy and easy to remove. Zip Stop is a device that will be primarily marketed to individuals because there are other products on the market that may better suit the needs of institutions or businesses.

PROJECT: Flightline Ethernet Controller Box (MET)
TEAM: (from left to right) Aaron Alexander, Corey Rhees, Jared Pierce & Norman Howard
ADVISOR: Aaron Alexander



The focus of our project was to create an enclosure that will house a computer chip and will reduce vibrations, withstand an impact load of 40 g's and dissipates heat from the chip. Additive manufacturing will be utilized for more complex geometry and heat-dissipating properties.

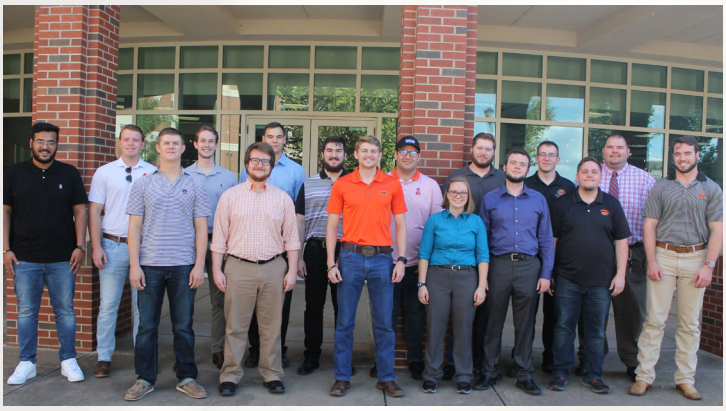
PROJECT: Bucket Brigade-Speedfest (DET)
TEAM: (from left to right) Zaki Alhashem, Nicholas Kozakis, Ben Andrews, Will Smith, Kahlil Martin, Keith Geddie, Abdulaziz Alharthi, Jacob Jester, Joshua Nightingale, Parker Newton, William Arndt, Josh Cunningham, Alison Paris, Nicholas Walsh, Matthew Bloomfield, Tucker Karman, Tyler Penick & Killian Bussey (not pictured)
ADVISORS: Jeeyeon Hahn & Avimanyu Sahoo

Design, develop, and test, a high-speed Autonomous Aircraft Rescue and Firefighting (AARFF) vehicle, which can navigate through a prescribed ground course autonomously, extinguish a pot fire, and return to the "fire station" while avoiding obstacles. The AARFF must be electrically powered with wheelbase up to 24 inches and carry a fire extinguishing system as a payload.

PROJECT: The Suppressors (DET)
TEAM: (from left to right) Ahmed Alanazi, Taylor Kemmann, Devin Jurko, Benjamin Heymann, Anthony Aguilera, Dillon Buck, Justin Rogers, Joseph West, Jeffrey Terronez, Christopher Murphy, Cale Turner, Corbin Hutchison, Tanner Gore, Jacob Smith, Caleb Carter, Austin Grellner & Ryan Templin (not pictured)
ADVISORS: Jeeyeon Hahn & Avimanyu Sahoo

Design, develop, and test, a high-speed Autonomous Aircraft Rescue and Firefighting (AARFF) vehicle, which can navigate through a prescribed ground course autonomously, extinguish a pot fire, and return to the "fire station" while avoiding obstacles. The AARFF must be electrically powered with wheelbase up to 24 inches and carry a fire extinguishing system as a payload.

PROJECT: Green Machine (DET)
TEAM: (from left to right) Mohammed Alfarhan, Adam Casey, Jake Standridge, Kyle Lewis, Patrick Roeber, Warren Goucher, Demetrios Tsaras, Evan Parscale, Kaleb Gfeller, Kelly Welzheimer, Colby Watts, Luke Green, Jordan Fogg, Tyler McDonald, Justin Moore, Garrett Reed & Nick Hilger (not pictured)
ADVISORS: Jeeyeon Hahn & Avimanyu Sahoo



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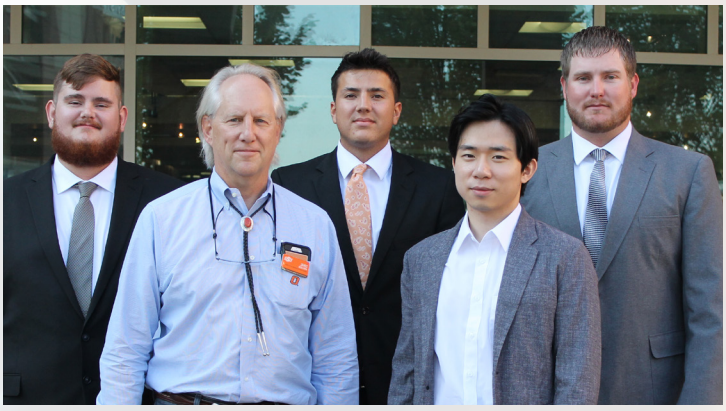
PROJECT: The Jokers (DET)
TEAM: (from left to right) Justin Messner, Jan Dudzinski, Jarrett Talbott, Hasan Jaha, Lex Giddings, Jassim Alshouwmley, Leon Graham, Thomas Miller, Matthew Bennett, Tantiana Mooneyham, Raj Tiwari, Jake Foster, Ian Lodriqueza, Gerald Thomas, Shannon Reid, Hank Denyer, Steven Box & Cameron Austin (not pictured)
ADVISORS: Jeeyeon Hahn & Avimanyu Sahoo

Design, develop, and test, a high-speed Autonomous Aircraft Rescue and Firefighting (AARFF) vehicle, which can navigate through a prescribed ground course autonomously, extinguish a pot fire, and return to the "fire station" while avoiding obstacles. The AARFF must be electrically powered with wheelbase up to 24 inches and carry a fire extinguishing system as a payload.

PROJECT: Renewable Energy STEM Education Prototype (MAE,ECEN)
TEAM: (from left to right) Clint Dillard, James Beckstrom, Matthew Barksdale, Hyunseok Koh & Austin Weathers
ADVISORS: James Beckstrom, Joseph Connor, Brian Norton & Laura Southard



This is the second semester of this project. A "prototype" produced in Spring 2019, was “proof of concept” and needs further improvement: 1) We will convert the control/data management module of the system from RaspberryPI to the "Industry 4.0 class" National Instruments MyRio. 2) We will rebuild/redesign the website based on NI STEM software and align with Regional STEM K-12 education curriculum. 3) We will add an electronic rain gauge to the weather station on the system, connect to the MyRio and include in the webpage. 4) We will reduce the "cut in" wind speed of the wind turbine to 3 m/s or less (which will likely require replacement of the existing wind turbine and possibly the power control/inverter system). The forces created by the new or modified turbine must align with the load capacity of the existing pole and foundation. 5) We will move the wireless connection from OSU network to a local provider. 6) We will develop a plan to reduce manufactured cost to less than $2,000 per unit for a production run of 100 units. 7) We will design, optimize, specify, construct, and demonstrate shipping/packaging for the full system (including a shipping and receiving a mock up version of a $2,000 unit). 8) We will develop business/manufacturing/logistics/operations plan to produce 100 units and support operations for five years (including IT and "hardware") support. 9) We will conduct a market/user/funding study and develop a marketing/funding plan.

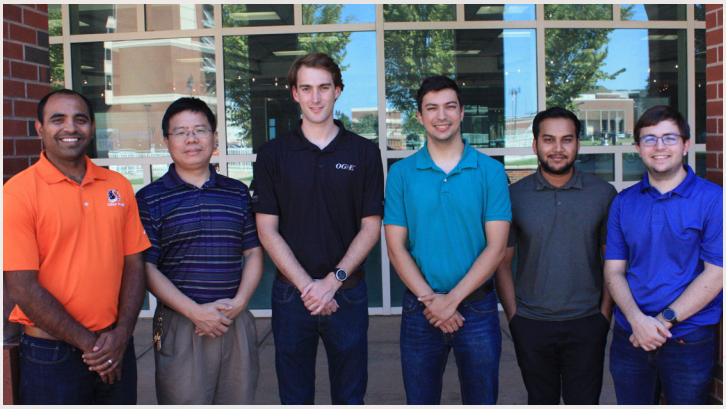
PROJECT: Wind Turbine / Light Show / Sculpture (ECEN)
TEAM: (from left to right) Travis West, Jim Beckstrom & David Phillilps
ADVISOR: Jim Beckstrom

This is the second semester of work on this feature. The objective of this project will be to: 1) design the control system and connect two more 275 watt solar panels to the existing system (already purchased and installed), 2) replace the Arduino controller with a National Instruments MyRio system, 3) design and install a data collection network incorporating the MyRio System, 4) connect the MyRio system to a local internet service provider, 5) develop a webpage via NI that enables monitoring the system, 6) redesign the "light show" system to be more dramatic with substantially more brightness/contrast, and modify/expand the lighting system per stakeholder input including evaluation to redesign the entire system to operate on 24V, 7) enable "light show" design/control via the "web", 8) design a light and light control system for the Bocce Ball Courts to be run off of the system, 9) recommend modifications /additions to the battery storage system to power the Bocce Ball Court lighting system.

PROJECT: 3-D Concrete Printing (CIVE, ECEN, IEM, MAE, MET)
TEAM: (from left to right) Jim Beckstrom, Teague Crotty, Tyler Tinker, Cody Sheets, Anna Rywelski, Yahn Francis, Braden Boyd, Mustafa Alfakih, Ellie Eakin, Josh Young, Paul Clemencich Christina McCoy & Qinang Hu
ADVISORS: Jim Beckstrom, Christina McCoy, Qinang Hu, Tyler Ley & Sundaresh Heragu

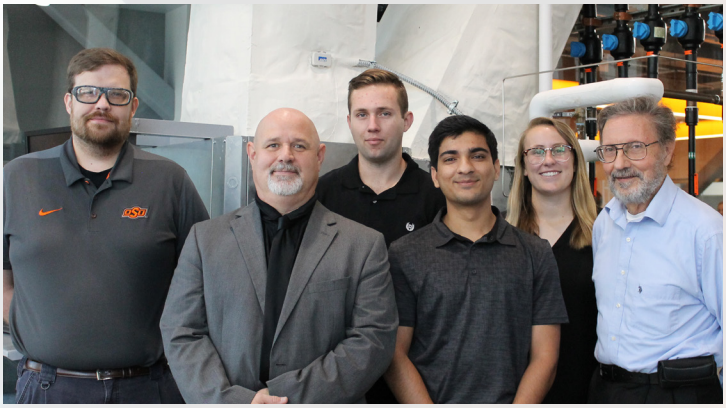
Continue the development of "home scale" 3D printing technology, including the progression of the design/ development of the electro-mechanical printing system, the concrete pumping, piping and nozzle system, the "concrete" slurries, the 3D printed building and the printed building envelopes.

PROJECT: Autonomous Golf Cart (AGC) Reactive Systems (MAE, ECEN)
TEAM: (from left to right) Rushikesh Kamalapurkar, Weihua Sheng, Mitchell Sperle, Sheldon Hair, Shabab Chowdhury & James Hood
ADVISORS: Rushi Kamalapurkar, Weihua Sheng & He Bai



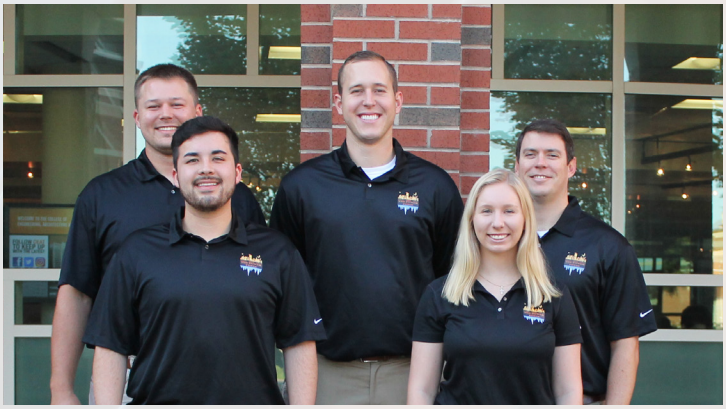
The goal of this project is to design and develop a sensor package for the MAE Autonomous Golf Cart. There are two major components to this project. The first involves design and implementation of machine vision algorithms and their integration with radar/lidar sensors for obstacle detection and obstacle motion prediction. The other involves design and implementation of reactive obstacle avoidance algorithms on the golf cart that utilize camera/radar/lidar feedback. The team will be expected to make any structural and/or electrical circuit modifications required to mount the cameras, and to effectively control the automatic breaks and the motorized steering wheel mechanisms to achieve obstacle avoidance.

PROJECT: ENDEAVOR Ground Source Heat Pump Stand Instrumentation II (MAE, ECEN)
TEAM: (from left to right) Scott Achelpohl, Brad Rowland, Cameron Mehmken, Ali Khan, Emily Modglin & Carl Latino
ADVISORS: Brad Rowland, Scott Achelpohl & Carl Latino



This is phase 2 of the development of the ENDEAVOR ground source heat pump education system. Air-side instrumentation will be added to the system including flow rate, temperature and humidity sensors. Instrumentation will be compatible with NI data acquisition devices and will be programmed in LabVIEW. Calibration methods will be provided for all sensors, and undergraduate laboratory experiments will be developed and demonstrated.

PROJECT: Thermal Energy Systems Learning Environment (MAE, ECEN)
TEAM: (from left to right) Kalen Gabel, Gerardo Toth, Garrett Weber, Victoria Bauer & Craig Bradshaw
ADVISOR: Craig Bradshaw



A learning environment will be developed to highlight all major thermal system components including refrigeration, ducted, and power generation systems. It will include equipment to enable lab modules to support systems and measurements. This environment will enable hands-on opportunities for a multitude of undergraduate courses at OSU. Instrumentation will be compatible with NI data acquisition devices and will be programmed in LabVIEW. Calibration methods will be provided for all sensors, and undergraduate laboratory experiments will be developed and demonstrated.

PROJECT: Separation Station / Old Distillation Refurbish (CHE, MAE, ECEN)
TEAM: (from left to right) Collin Hicks, Brad Rowland, Emilee Drumwright, Carl Latino, Alex Turner & Caleb Thomas
ADVISORS: Brad Rowland & Carl Latino

Design, prototype, and test a distillation stand/system for the ENDEAVOR Lab. The system will include measurement devices/systems (temperature and flow meters, gages, sensors, etc.). Instrumentation will be compatible with NI data acquisition devices and will be programmed in LabVIEW. Calibration methods will be provided for all sensors, and undergraduate laboratory experiments will be developed and demonstrated.

PROJECT: Fatigue Test (MAE, MET, ECEN)
TEAM: (from left to right) Landon Burleson, Benjamin DeVary, Cochanna Coleman, Brandon Gambrell, Ahmed Ajaimi & Liuyi Yang
ADVISORS: Robert Taylor, Mike Gard & Lewis Warren

Design/build/test a stainless steel tubing stress test apparatus for tubing used in deep water oil and gas umbilicals. Ultra-high reliability and durability is the key performance metric for this tubing and this test apparatus is part of the quality control/assurance process for Webco and its clients. Tubing sizes range from 0.5 inches to 2.5 inches, and up to 0.22 inch wall thickness. The apparatus will need to put a pressurized section of tubing through up to thousands of cycles of bending over a range of diameters, from 12 inches to 24 inches. The project will involve controls and a control system, and a loading apparatus to cover a wide range of loads.

PROJECT: Informal Settlement Fire Safety Test Apparatus (MAE, ECEN, FPSET)
TEAM: (from left to right) James Beckstrom, Mark Zajac, Majed Alsharif, Anderson Lin, Raed Alnassir, Myles Jefferson, Mohammed Menkabo, Mazen Alkashram, Virginia Charter & Haejun Park
ADVISORS: James Beckstrom, Virginia Charter, Haejun Park & Michael Gard

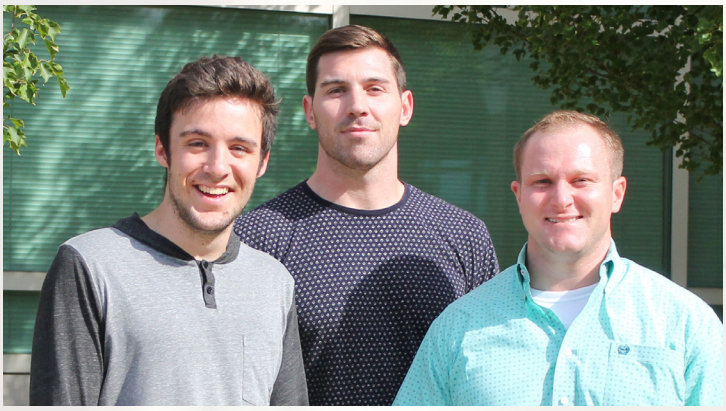
This project is designing and building a testing apparatus for walls and insulation materials related to informal settlement in South Africa. Our client, Dr. Haejun Park, has requested that this testing apparatus follows ASTM E119 standards. However, the apparatus for this project must have a test section with dimensions of 26 inches by 26 inches. Also, the furnace must be able to reach temperatures of 1200° Celsius, and be able to sustain the temperature for one hour. This apparatus consists of a furnace, test wall, and DAQ system similar to the ASTM E119. The other aspect of this project is to select two fire resistant materials of low cost that can be used as insulation for these settlements. These materials are needed to prevent the spread of fire from one settlement to the surrounding settlements, and will be tested extensively using the furnace and data acquisition systems in order to determine their effectiveness.

PROJECT: Turboelectric Fixed-Wing Unmanned Aircraft System (MAE, ECEN)
TEAM: (from left to right) Alex Ott, Dolan Motter, Barrett Schwandt, Skylar Dennis, Kylar Moody, Chase Holland & Kurt Rouser
ADVISORS: Kurt Rouser, Chase Holland & Kylar Moody

Over the past decade, hybrid electric aircraft concepts with distributed power and propulsion have emerged for large commercial transport and urban air mobility to improve aircraft efficiency, reliability and maintainability with reduced need for hydraulic, mechanical and pneumatic systems. Previous studies in aircraft hybrid electric propulsion have addressed conceptual design and analytical modeling; however, there is a critical need to address practical considerations for integration of electrical generation, distribution, control and storage. This design project will enable development of practical recommendations for certification, validation and safe integration of turboelectric aircraft distributed power and propulsion systems, providing data to address safety implications of electrical system components associated with more-electric aircraft (MEA) concepts.

Researchers at Oklahoma State University (OSU) are in the process of experimentally assessing a subscale (5-7kW) turboelectric power system designed for an unmanned aircraft system (UAS), including multi-rotor vertical takeoff and landing for fixed-wing aircraft. The power system includes an active throttle control to ensure key parameters such as voltage, current, and battery charge level and rate are monitored and fluctuations minimized. The objective of this fall 2019 design project is to complete the throttle control system design with a battery regulator, integrate the turboelectric power system onto an existing fixed-wing UAS platform, and assess integration challenges such as thermal management, structural loads, acoustic emissions and electrical system performance/compatibility.

PROJECT: UAV Based Well-Site Inspection System (MAE, ECEN)
TEAM: (from left to right) Travis Fout, Kyle Cowan & Drew McKechnie
ADVISORS: Jamey Jacob & Daqing Piao



This UAV based Oil and Gas Wellsite Inspection System will include sensors (methane, IR,magnetometer), and gather visual/spatial data from abandoned wellsites, and save/store data in an oil and gas well management database.

PROJECT: Adaptive Kitchen Wall, Cabinet, Countertop System (MAE, MET, ECE, DHM)
TEAM: (from left to right) Robert Taylor, Nate Robertson, Kevin Strait, Luke Boevers, Dalton Green, Kate Korneva & Emily Boughan
ADVISORS: Emily Roberts & Robert Taylor

Design, fabricate, commission and test prototype kitchen cabinet systems to enable safer, more efficient access by individuals with mobility challenges that prevent them from effectively using "standard" systems. It is envisioned that this project will include the development of both movable as well as static "elements." Clients/ sponsors for this project include the Spanish Cove Retirement Center in the OKC area and may include other stakeholders in the Stillwater area.

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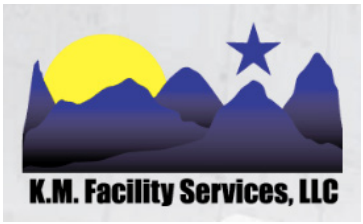
The Martin Family Foundation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