NASA / OHIO SPACE GRANT CONSORTIUM

2021-2022 SCHOLAR / FELLOW STUDENT JOURNAL

Students Representing Ohio Congressional Districts

OHIO SPACE GRANT CONSORTIUM

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FELLOWSHIP AND SCHOLARSHIP PROGRAM

The Ohio Space Grant Consortium (OSGC), a member of the NASA National Space Grant College and Fellowship Program, awards graduate fellowships and undergraduate scholarships to students working toward degrees in **S**cience, **T**echnology, **E**ngineering and **M**athematics **(STEM)** disciplines at OSGC-member universities. The awards are made to United States citizens, and the students are competitively selected. Since the inception of the program in 1989, over 1,395 undergraduate scholarships and 274 graduate fellowships have been awarded.

The Consortium is additionally supported by matching funds provided by the 24 member universities/community colleges, the Ohio Aerospace Institute (OAI), as well as additional funds provided by the State of Ohio Department of Higher Education. With these funds, the Ohio Space Grant Consortium was able to award an additional 21 undergraduate scholarships, 9 Master's fellowships, and 28 internships.

The research conducted under a faculty mentor for the fellowships and scholarships are a prime aspect of the program by encouraging U. S. undergraduate students to attain higher levels of education and provide more qualified technical employees to industry. The Education scholarship recipients are required to attend a workshop conducted by NASA personnel where they are exposed to NASA educational materials and create a lesson plan for use in their future classrooms.

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- The University of Akron
- Baldwin Wallace University
- Case Western Reserve University
- Cedarville University
- Central State University
- Cleveland State University
- University of Cincinnati
- University of Dayton
- Kent State University
- Marietta College
- Miami University
- Ohio Northern University
- The Ohio State University
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- Wright State University
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Cincinnati State Technical and Community College

Professor Jeffery M. Woodson
Columbus State Community College

Professor Michelle S. Davis
Cuyahoga Community College

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Regan L. Silvestri, Ph.D.
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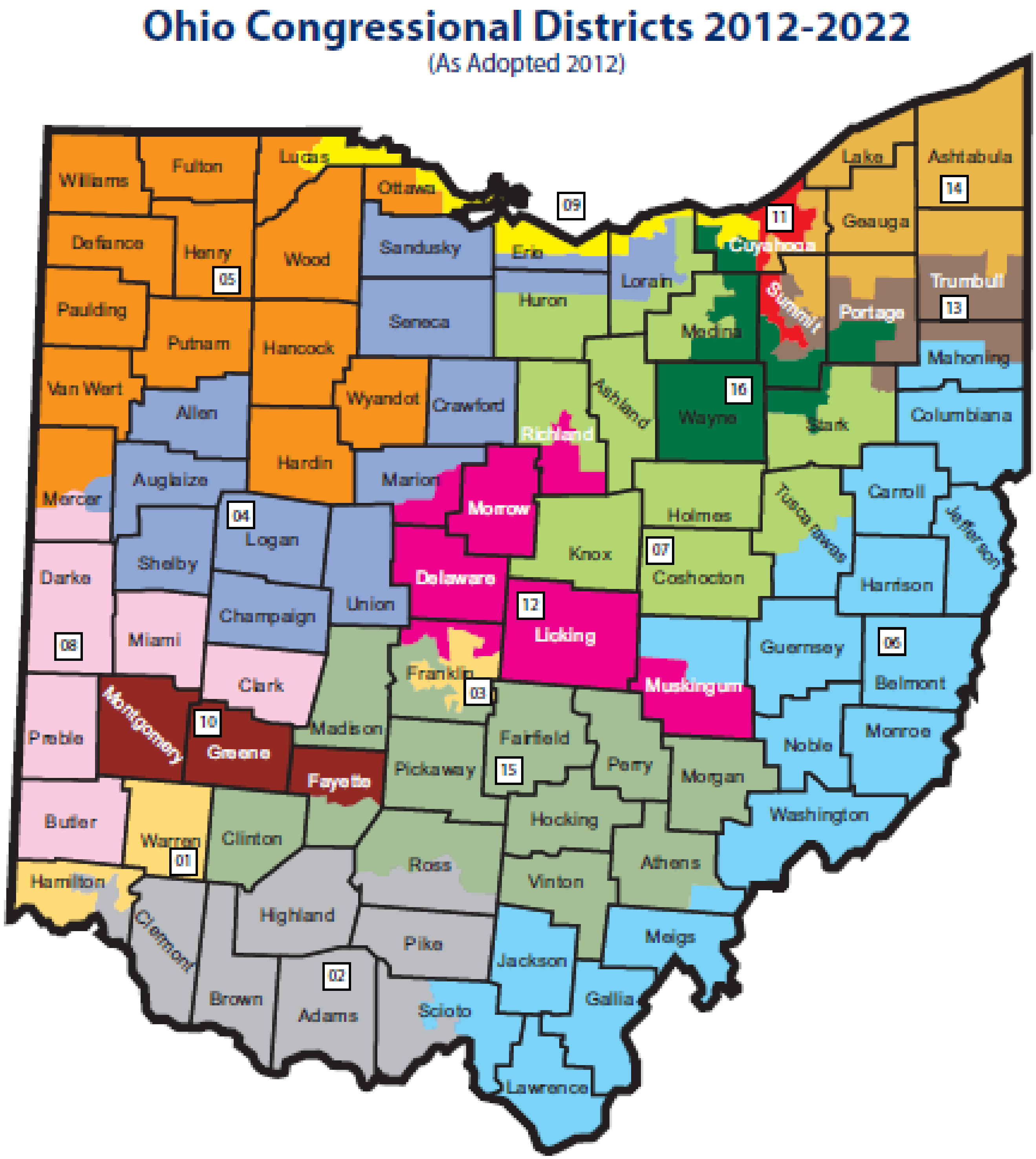

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Fellows

Lily C. Behnke

Master's 1, Aerospace Engineering
Advisor(s): Dr. Joshua Heyne, Dr. Randall Boehm

Benefits of High Thermal Stability Sustainable Aviation Fuels for Improved Energy Consumption of Jet Engines

Biography: Lily Behnke is a graduate student at the University of Dayton (UD) working on the first year of a Master's degree in Aerospace Engineering. She works as a member of the Heyne Energy and Appropriate Technologies Lab at UD focusing on sustainable aviation fuels and combustion. Prior to pursuing her master's, she obtained a Bachelor of Science in Mechanical Engineering from UD. She also worked as an intern at Sandia National Laboratories in the biosciences department under the mentorship of Dr. Anthe George and Dr. Ryan Davis. At Sandia she studied the use of fusel alcohols from bioconversion pathways as gasoline blending additives. Additionally, she is a recipient of a National Science Foundation Graduate Research Fellowship. She looks forward to continuing her education with a PhD following the completion of her Master's.

Abstract: As anthropometric emissions continue to rise globally, reducing emissions from combustion systems is critical to environmental preservation. It is understood that a method for decreasing emissions contributions from the aviation sector is sustainable aviation fuel (SAF). SAF adoption relies on the ability to maintain or surpass the current performance metrics of petroleum derived fuels while also complying with critical operability limitations. High thermal stability SAFs have the potential to provide value in terms of reducing maintenance cost associated with coking and the ability to drive more heat into the fuel therefore increasing energy delivered to the combustor. Previous work has thoroughly investigated maximizing energy content for a respective composition of SAF candidates using the Jet Fuel Blend Optimizer (JUDO). A novel Engine Performance Model (EPM) has recently been used to investigate the effects of fuel properties significant to engine performance and the respective benefits of SAF candidates with high thermal stability. Higher thermal stability enables engine manufactures to increase the reliance on fuel as a coolant, which recovers waste heat, while reducing the reliance on air which wastes the energy used to compress it. Several fuel properties including viscosity, heat capacity, thermal conductivity, and energy density influence the performance of heat exchangers, while H/C and molecular weight influence burnt gas composition which affects combustor exit temperature and turbine performance in the EPM model. This work aims to leverage JUDO and the EPM to maximize both the energy content and savings benefits of SAFs.

Publications:

L. Behnke, E. Monroe, A. Landera, R. Davis, A. George, K. Opacich, J. Heyne, "An Investigation into the Potential of Biomass Derived Fusel Alcohol Mixtures for Improved Engine Performance", Eastern States Section of the Combustion Institute, Colombia, SC, 2020.

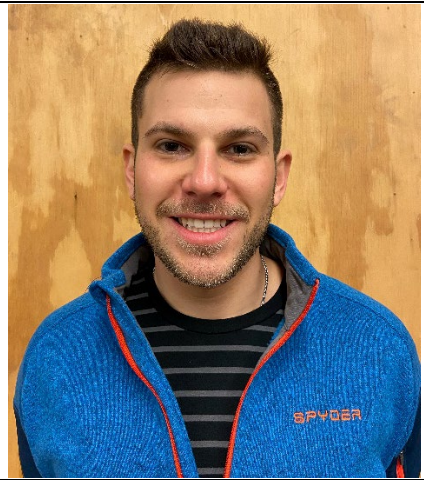
L. Behnke, R. Boehm, J. Heyne, "Optimization of Sustainable Alternative Fuel Composition for Improved Energy Consumption of Jet Engines", 59th AIAA Aerospace Sciences Meeting, San Diego, CA, January 2021.

G. Flora, S. Kosir, L. Behnke, R. Stachler, J. Heyne, S. Zabarnick, M. Gupta, "Properties Calculator and Optimization for Drop-in Alternative Jet Fuel Blends", 57th AIAA Aerospace Sciences Meeting, San Diego, CA, January 2019.

S. Kosir, L. Behnke, J. Heyne, R. Stachler, G. Flora, S. Zabarnick, A. George, A. Landera, R. Bambha, R. Denney, M. Gupta, "Improvement in Jet Aircraft Operation with the Use of High-Performance Drop-in Fuels", 57th AIAA Aerospace Sciences Meeting, San Diego, CA, January 2019.

10	Michael Turner

Isaac Bensignor



Masters II, Aerospace Engineering
Advisor(s): Dr. Matthew McCrink

Rotor Propulsion Modeling for Low Reynolds Number (Re < 10^5) for Martian Rotorcraft Flight

Biography: Isaac Bensignor is from Westchester, NY, and attended the Schechter School of Long Island for high school. Since being a young boy, he has been interested in space exploration, space robotics, NASA missions, and astronomy and astrophysics. His ultimate career goal is becoming a NASA astronaut and participating in a deep space exploration mission. Isaac attended The Ohio State University for his Honors B.S. in Aerospace Engineering and continued his Graduate education there as a Combined Degree Program student. As an undergraduate senior, he began his Master's degree and the research work currently funded by OSGC. Outside of class, Isaac served in the Undergraduate Student Government as a College of Engineering Senator, an executive board member of OSU's AIAA student chapter, and an executive board member of Sigma Gamma Tau (the national aerospace engineering honorary society). Isaac was also an Undergraduate Teaching Assistant for OSU's introductory aerospace engineering class as a 3rd year student. Currently, Isaac serves as the President of MEGA – the Mechanical, Aerospace, and Nuclear Engineering Graduate Student Association at OSU. During the last few summers Isaac has interned with NASA Johnson Space Center's Engineering Directorate in Houston, Texas, the Air Force Research Laboratory's Robotic Orbital Control Laboratory at Kirtland AFB in Albuquerque, New Mexico, and OSGC performing research in support of his Master's thesis at OSU's Aerospace Research Center.

Abstract: An analysis of a novel rotor geometry optimized for low Reynolds number and high subsonic Mach number flow was performed in support of NASA's next aerial mission on Mars. The rotor geometry adopted in the research consists of a sharp leading-edge and angled plate sections that mainly promote natural laminar flow at low angles of attack. The results from a two-dimensional CFD investigation on a wide range of flow conditions at discrete airfoil sections along the rotor span were coupled with a Blade Element Momentum Theory (BEMT) analysis for discerning rotor performance. Preliminary CFD analysis results demonstrate a 3.57% error of the linear portion of the lift curve slope with respect to a published literature condition for the same geometry and operating conditions. Further analysis of the CFD model developed is needed for refining the BEMT airfoil performance deck parameter inputs, such as coefficients of lift and drag. Moreover, results obtained from the CFD analysis will be compared to the experimental results generated by an 85.3% scale rotor tested at low Reynolds Number and high subsonic Mach number conditions in a simulated Martian. Experimental testing will occur within a large vacuum chamber at OSU's Aerospace Research Center at pressures near Martian atmospheric conditions in CO_2 gas. The conclusion sought by this research investigation is a correction to the BEMT analysis method for low Re flow that will be deduced from a comparison of the experimental and computational data collected.

Publications: Bensignor, I. S., Seth, D., McCrink, M. "Rotor Propulsion Modeling for Low Reynolds Number (Re < 10^5) for Martian Rotorcraft Flight", *AIAA Aviation Forum*, Chicago, Illinois, USA, June 2022.

3	Joyce Beatty

The University of Akron

Blake A. Bowser

Master’s 1, Mechanical Engineering
Advisor(s): Dr. Gregory Morscher

Characterizing the Mechanical and Microstructural Properties of an Additively Manufactured Nickel-Based Superalloy using Electrical Resistance, Digital Image Correlation, Acoustic Emission, and Microscopy

Biography: Blake grew up in rural Suffield Ohio, where he first fell in love with the field of engineering and engineering technologies. From working on cars in the garage, to building an 8’ tall trebuchet in senior physics class in high school, engineering became a dream. He then began seeking his degree in Mechanical Engineering at The University of Akron, where he participated in various student organizations, including the Akronauts Rocket Design Team. During his time on the Akronauts, Blake tenured as the Chief Engineer and previously the Lead Payload Engineer, which helped the team successfully place top 5 in two national rocket engineering competitions. Blake also set the team up for future success by pioneering the teams research and development group for collegiate-scaled bi-propellant liquid propulsion rocket engines and the testing systems capable of characterizing said engines, which sets UA’s Akronauts into an elite group of universities capable of liquid propulsion. He has since finished his undergraduate degree, and is pursuing his Doctorate under Dr. Gregory Morscher, in the high temperature composites and superalloys field performing research for various private sector aerospace and defense companies, as well as various government agencies including the Air Force Research Lab, and NAVAIR.

Abstract: Jet propulsion and gas turbine engines are presently extraordinary systems that require materials that can withstand high load, high temperature, and highly corrosive environments. Considering this, components within these propulsive systems can be highly complex and made from advanced materials and alloys. When repairs are needed, it can cause significant downtime for a flight vehicle due to component lead times as well as a consistently high cost of repair when using conventional manufacturing techniques for advanced materials. With the advent of additive manufacturing, methodologies such as Directed Energy Deposition (DED) can be used to provide repairs on an existing wrought component, significantly reducing repair lead times, and considerably decreasing cost of service. Due to this, Nickel-based superalloys optimized for additive manufacturing processes are of high interest regarding this application. The Nickel-based superalloy (ABD-900AM) provided by the Air Force Research Lab (AFRL) will be analyzed using Non-Destructive Evaluation (NDE) techniques such as acoustic emission, digital image correlation, and electrical resistance to characterize flaw propagation in the material in various build orientations and manufacturing techniques under uniaxial tension and fatigue testing. The microstructural properties of the material will also be characterized via SEM, digital microscopy, and other analysis techniques.

Publications: None yet.

16	Anthony Gonzalez

Scott L. Brooks

Master's 2, Biomedical Engineering
Advisor(s): Dr. Andrew Weems

3D Printing Orthopedic Tissue Scaffolds Using *In Situ* Inverse Vulcanization and Polyester Ring Opening Polymerizations

Biography: Scott Brooks is a graduate student at Ohio University in the second year of the Biomedical Engineering Master's program. Prior to attending OU, Scott received a Bachelor of Science in Biomechanical Engineering from Hope College. He currently is a part of the polymer and additive manufacturing lab led by his advisor Dr. Andrew Weems. Scott's interest in medical devices and materials led him to directing his research toward polymer/material system design for application in 3D printing of orthopedic medical devices. Scott plans on continuing his academic career in pursuit of his doctorate in Mechanical Engineering with aspirations of moving to industry post-graduation to start his own company designing material systems and producing medical devices.

Abstract: Bone grafting procedures are the second most frequent tissue transplantation being performed over two million times annually. Autologous bone grafting is the gold standard; however, the availability of natural bone is far from meeting the clinical demand. Synthetic bone substitutes would ideally meet this need but are limited by technical and economic characteristics, and current availability.

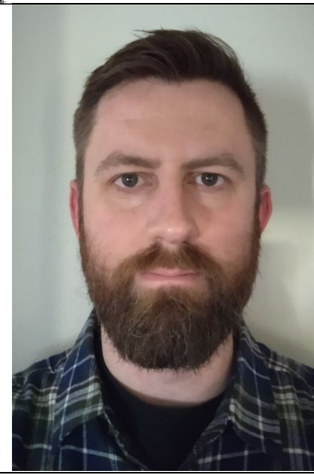
The synthesis of polyesters through ring opening copolymerization of cyclic anhydrides and epoxides has the capability to yield stereoselective copolymers with a diverse range of polymer backbones. Once formed into photopolymer resins, these polyester systems can be efficiently 3D printed into complex structures with high resolution through light processing and deposition methods. Along with their printability, post fabrication functionalization of the resins will improve cytocompatibility and osteogenic cueing. These thermosetting resins paired with elemental sulfur using *in situ* inverse vulcanization create inorganic-organic systems with application in orthopedics and additive manufacturing systems.

Publications:

[1] S. Brooks, *et al.,*, "4D Aliphatic Photopolymer Polycarbonates as Direct Ink Writing of biodegradable, Conductive Graphite-Composite Materials," *Polymer Composites,* 2021.

[2] S. Brooks, *et al.,*, "Leveraging Stereochemistry and Stoichiometry in ROCOP-Produced Aliphatic Polyester Photopolymers to Tailor 4D Printable Material Properties " *Polymer Chemistry,* 2021.

15	Steve Stivers



Jared Brum

Master's 2nd year, Geology
Advisor(s): Dr. Claire McLeod

Advancing our Understanding of Lunar Geological Processes: An Investigation of Lunar Meteorite Allan Hills (ALHA) 81005

Biography: Jared Brum is a second year Master's student at Miami University studying geology with an emphasis on planetary science. He graduated from Miami University with a Bachelor of Science in Geology in 2020. Prior to pursuing higher education, Jared spent 10 years in the U.S. Air Force as a Nuclear Weapons Specialist. He has a wife, Julie, and three children, Bronwyn, Scarlet, and Phillip. His love for the outdoors, as well as his highly technical background led to his pursuit of an education in geology. Throughout his undergraduate career, Jared participated in several faculty-led research projects. The first project he worked on was with Dr. Mark Krekeler studying the spectra and evaporation rates of various fuels on different substrates to develop a library for use in aerial identification of fuel spills. The next project he took up became the focus for his Master's thesis; investigating the chemical and mineralogical components of lunar meteorite ALHA 81005. Outside of research, Jared practices Muay Thai Kickboxing and enjoys hiking and spending time with his family.

Abstract: Advancing our understanding of the fundamental processes through which the rocky objects of our Solar System formed, including Earth, relies on interrogation of physical samples derived from those rocky objects. Due to plate tectonics resurfacing Earth's crust, early Solar System processes are poorly recorded in terrestrial samples. However, plate tectonics do not exist on Earth's Moon, thus lunar samples can provide new insights into early Solar System geological processes. While samples returned from Apollo missions are spatially constrained, lunar meteorites likely represent a broader sampling of the lunar surface permitting more holistic views of lunar evolution. This research focuses on lunar meteorite Alan Hills (ALHA) 81005, the first meteorite identified as lunar in origin.

A combined mineralogical, textural, and chemical investigation of lunar meteorite components via Scanning Electron Microscopy (SEM)-Energy Dispersive Spectroscopy (EDS) was completed. Elemental HyperMaps collected from SEM-EDS work are guiding in-situ spot (1µm to 20µm) chemical analyses via Electron Probe MicroAnalysis (EPMA) and Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS). The distribution and association of elements in ALHA 81005 will be used to evaluate distinct mineral (e.g., olivine) and rock (e.g., gabbro) types. This will provide insights into lunar lithological diversity and differentiated rocky objects within our Solar System. Data collected from LA-ICP-MS will be analyzed to complete a comprehensive chronological study of dateable mineral phases using long-lived chronometers (e.g., the U-Pb system) to constrain the timing of crystallization and/or impact events. Geochronological results will be considered within the context of the Moon's history, and will evaluate the timing of impacts throughout the early (inner) Solar System.

Publications: 1) **Brum, J.**, Schlegel, C., Chappell, C. *et al.* Reflective spectra of gasoline, diesel, and jet fuel A on sand substrates under ambient and cold conditions: Implications for detection using hyperspectral remote sensing and development of age estimation models. *Environ Earth Sci* **79,** 463 (2020). **2)** Michelle Burke, Claudia Dawson, C. Scott Allen, **Jared Brum**, Jessica Roberts, Mark P.S. Krekeler. Reflective spectroscopy investigations of clothing items to support law enforcement, search and rescue, and war crime investigations, Forensic Science International, Volume 304, 2019, 109945, ISSN 0379-0738 **3)** Mark Krekeler, Michelle Burke, Scott Allen, Barrett Sather, Caleb Chappell, Claire McLeod, Cynthia Loertscher, Seth Loertscher, Claudia Dawson, **Jared Brum**, Debbie Fackey. A Novel Hyperspectral Remote Sensing Tool for Detecting and Analyzing Human Materials in the Context of Forensic Investigations and Emergency Response Operations. *Forensic Science International*. (in review)

8	Warren Davidson

Oliver Eby

Master's 1, Bioengineering
Advisor(s): Dr. Eda Yildirim-Ayan

In Vitro Co-culture Interaction and Differentiation of Macrophages and Human Dermal Fibroblasts in a Simulated Microgravity Environment

Biography: Oliver Eby is a Master's student working in the Engineered Biosystems Laboratory at the University of Toledo. While born and raised in northwest Ohio, Oliver attended school out west and earned a B.A. in Liberal Arts from Wyoming Catholic College before returning to Ohio to study Bioengineering. A lifelong curiosity and passion for biology and medicine has driven his research interests into the realm of regenerative medicine and specifically engineered constructs for modulating the body's immune response and expediting tissue repair and healing. Oliver completed 4 co-op rotations while an undergraduate at the University of Toledo, including research positions both in academia and in industry. Directly after earning his B.S. in Bioengineering in 2021, he began his Master's degree and started research involving studying the interactions between macrophages and fibroblasts when co-cultured in 3D collagen-based tissue constructs. After graduation, he plans to pursue a career in biotechnology and bio-weapons defense.

Abstract: Recent studies have made it clear that space travel and the microgravity environment can change human physiology over time. The immune system is affected by this change in environment and that means that the ability to regenerate tissue changes accordingly. Macrophages are the primary cells involved in immunomodulation in the body and are some of the first cells to arrive at a site of injury. Aside from other immune cells, macrophages interact most often with fibroblasts, which are the most common type of cell in bodily tissues. It has been shown that both macrophages and fibroblasts exhibit a full spectrum of immunomodulatory behaviors from naïve, to pro and anti-inflammatory phenotypes. Literature reviews show that in a typical *in vitro* environment, macrophages naturally begin differentiating into the pro-inflammatory phenotype in the presence of fibroblasts. However, this might depend upon the relative ratio of cells in the co-culture and certain cytokines such as interleukin 4 (IL-4). As such it is crucial to understand the interaction mechanisms between these cell types under both normal gravity and microgravity conditions. The Engineered Biosystems Laboratory at the University of Toledo has developed a random positioning machine (RPM), which utilizes a randomly spinning platform to effectively neutralize the forces of gravity. This enables the study of *in vitro* cell cultures to be conducted in microgravity conditions without the excessive costs of actual space travel. Using this technology, 3D collagen matrices were used to co-culture macrophages and fibroblasts to determine the effects that the microgravity environment has on the phenotypic expressions of each cell line as related to their individual immunocompetencies.

[1] **Publications:** Kanan, M.*, **Eby, O**.*, Kelkar, A. Serhan, H., Zodak, Y., Aldoohan, S., Elsamaloty, H, Goel, V and Yildirim-Ayan,E. "Electrical Stimulation-Mediated Tissue Healing in Porcine Intervertebral Disc Under Mechanically Dynamic Organ Culture Conditions", Spine Journal. (*Manuscript Submitted for Approval). *Contributed equally,* Submitted for approval

5	Robert Latta

The University of Akron

Christopher A. Ferguson

Master's 1, Mechanical Engineering
Advisor(s): Dr. Gregory Morscher

Burner Rig Optimization for High Temperature Materials and Coating Systems

Biography: Christopher Ferguson is a current master's student at the University of Akron where he received his bachelor's degree in mechanical engineering in May of 2021. He is from Munroe Falls, Ohio, and attended Stow-Munroe Falls Highschool which made enrolling in the University of Akron an easy decision. As an undergraduate, Chris was an active member of ASME and Tau Beta Pi, eventually becoming President of both engineering student organizations in his final year. This was coupled with his involvement in undergraduate research working under Dr. Gregory Morscher. In this he studied a non-destructive evaluation (NDE) technique called Acoustic Emission (AE) which was used on ceramic matrix composites (CMC). After graduation the Ohio Space Institute funded a summer internship to study CMCs under a combustion environment and to begin the automation process of the test rig as described below in the abstract.

Abstract: The burner rig optimization project will utilize the University of Akron's pre-existing combustion rig to simulate the environment within the combustion chamber of a jet engine and optimize it for different flight conditions. The main improvement being proposed for this project is in the optimization and automation of the testing capabilities of the system. Aircrafts operate at different conditions depending on its stage of flight. At takeoff, the engines are at full throttle, placing a high stress on the internal components of the jet engine due to the temperatures and thrust generated. After takeoff, the aircraft reaches its cruising stage which significantly reduces the stress experienced. The material cycles through high stress and high temperature and low stress and low temperature through the duration of the flight which represents a gap in the capabilities of the burner rig in its current iteration.

Due to the conditions that high temperature materials undergo, thermal fatigue and thermal mechanical fatigue are considerations that need to be discussed to understand their true capabilities. A system will be built that will coordinate the temperature the specimen experiences as well as alter the axial load applied in accordance with the different stages in a typical flight. After this system is completed, testing will begin on various high temperature materials at either a hypersonic velocity or lower to determine the performance during a simulated flight path.

Publications: None yet.

14	David Joyce

The University of Dayton

Lanna Klausing

Master's 1, Mechanical Engineering
Advisor(s): Dr. Megan Reissman and Dr. Tim Reissman

Effects of Hypoxia on Vehicle Motor Control during Matched and Mismatched Vestibular Feedback

Biography: Lanna is a master's student at the University of Dayton studying Mechanical Engineering. She graduated with a bachelor's degree in Mechanical Engineering and a Human Movement and Biomechanics minor in December of 2020, from the University of Dayton. Lanna began her biomechanics research with Dr. Megan Reissman in the EMPOWER Lab in 2019, researching upper extremity motor control within Virtual Reality environments. Lanna has presented her undergraduate research at the Midwest ASB 2021 Conference. Her research interests are focused on the application of Virtual Reality within biomechanics.

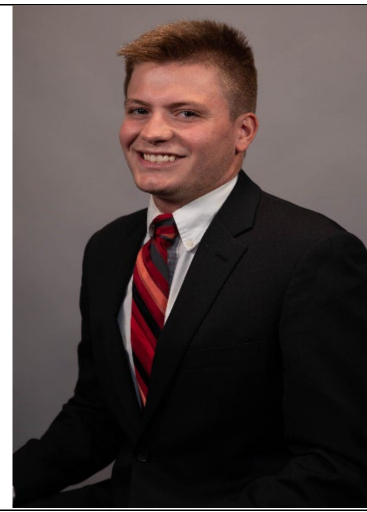
Abstract: Exposure to microgravity during spaceflight generates adaptations in the vestibular, sensorimotor, and cardiovascular systems. Post-flight these adaptations manifest as deficits in spatial orientation (e.g.: tilt-translation illusions), in sensorimotor coordination (e.g.: walking, balance), and in cardiovascular function (e.g.: orthostatic hypotension). Issues impacting mission success typically arise from sensory discrepancies between visual and vestibular afferent signals, often referred to as spatial disorientation. However, the impact of spatial disorientation on motor control behaviors is less well understood since the majority of motor control tests are conducted under stationary conditions. This study focuses on motor control of human-in-machine systems, for which motor control outputs directly impact the motion and orientation of the human/machine.

Participants were placed in a motion simulator controlled by a standard joystick. A custom VR simulation generated the vehicle environment, which was displayed on a VR headset. Participants were presented tilt tasks visually and instructed to manipulate the joystick to achieve a matching tilt angle for their vehicle. Motor control performance for the vehicle orientation task was assessed for no motion (static), matched motion, and over- or under-exaggerated motion (vestibular mismatch). The motion simulator provided either matched or mismatched motion to simulate motor control performance under normal conditions or conditions of sensory discrepancy. These conditions were then repeated under hypoxia. The overall goal is to inform pre-flight training approaches, improve human-machine interfaces, and standardize post-flight assessment procedures, resulting in fewer negative outcomes associated with compromised motor control due to sensory discrepancies.

Publications: None yet.

4	Jim Jordan

Ryan P. Leahy



Master’s 1, Mechanical Engineering
Advisor(s): Dr. Mo Samimy & Dr. Nathan Webb

Active Control of Flow and Acoustics in Supersonic Twin Jets

Biography: Ryan Leahy is currently a first-year master’s student pursuing a degree in Mechanical Engineering at The Ohio State University. In May 2021, Ryan graduated *magna cum laude* from Ohio State with a bachelor’s degree in Mechanical Engineering and a minor in Spanish. In addition to participating in the Formula and Baja SAE clubs as an undergraduate, Ryan obtained professional engineering internships in both the manufacturing and power industry. Working as a research assistant at the Gas Dynamics and Turbulence Laboratory at Ohio State has enabled Ryan to cultivate a new passion for aeroacoustics. Outside of his studies, Ryan serves as a delegate for the Mechanical and Aerospace Engineering Department in the Council of Student Graduates at Ohio State and enjoys playing the guitar.

Abstract: As the design requirements for future tactical aircraft become increasingly complex, future exhaust systems of these aircraft must adapt to the operational requirements that include thrust vectoring, thrust reversing, lower drag allowances, as well as greater control for mixing and entrainment. Rectangular twin jets offer a way to fulfill these requirements in the integration of aerodynamic and propulsion in the future tactical aircraft (Dusa et al. 1983, Weigand et al. 2018). In addition, due to the nature of closely spaced supersonic twin jets, the formation of feedback loops, coupling and screech, have the potential to increase the unsteady near field pressure fluctuations while also having the effect of elevated far field noise (Shaw 1990, Panickar 2004). The increased near field pressure fluctuations can induce structural damage to nearby components of the aircraft, while the elevated far field noise is detrimental for personnel working closely with supersonic jets (Walker 1990).

Localized arc filament plasma actuators (LAFPAs) have been developed at The Ohio State’s Gas Dynamics & Turbulence Laboratory and have previously been successfully used for flow control in several high speed and high Reynolds number shear layers (Samimy et al. 2018, Esfahani et al. 2021). These actuators have been implemented on supersonic rectangular twin jets and have demonstrated to harness the jets’ natural flow physics for controlling the screech and coupling of twin jets (Webb et al. 2022). This project investigates the control authority of the LAFPAs by viewing the effects of excitation frequency and patterns that can alter the screech and coupling modes, change the screech frequency, and suppress screech and coupling over different flow regimes. The results obtained today are very promising.

Publications:

1. N. Webb, A. Esfahani, R. Leahy, and M. Samimy, “Active Control of Rectangular Supersonic Twin Jets using Perturbations: Effects and Mechanism,” *AIAA SciTech Forum 2022*

8	Warren Davidson

Cleveland State University

Jacob Martin

Master's 1, Chemical Engineering
Advisor(s): Dr. Jessica Bickel

Self-Organization of Organic Molecules on Surfaces

Biography: Jacob attended Norwalk High School where he underwent a 4-year engineering program, Project Lead The Way, which sparked his initial interest in both research and engineering. He is a Master's student in the 4+1 accelerated Master's Program in Chemical Engineering at Cleveland State University (CSU). Jacob graduated summa cum laude with a B.S. in Chemical Engineering in May 2021. Jacob has worked as an undergraduate and graduate research assistant under Dr. Jessica Bickel since Spring of 2019, beginning with experimental research and transitioned to computational work at the beginning of the pandemic. During his undergraduate degree, Jacob participated in the Research Experience for Undergraduates at CSU, funded by the National Science Foundation. He has presented both experimental and computational research at local and national conferences.

Abstract: Organic semiconductors have advantages over their inorganic counterparts due to their eco-friendliness, cheap producibility, and applications in flexible electronics. However, organic semiconductors tend to have a lower conductivity than their inorganic counterparts. One possible method to increase the conductivity of organic semiconductors is self-assembly driven by a surface reconstruction that is a repeating topography across the surface of a substrate.

This work examines pentacene, an organic semiconductor, on a very simple surface of graphite or graphene both experimentally and computationally. Experimentally we see limited evidence of a lowest energy orientation for pentacene that is thermally evaporated onto highly ordered pyrolytic graphite (HOPG). This agrees with computational DFT calculations that show, despite an AB stacking structure being the lowest energy orientation, this is a very shallow minima. Several orientations of pentacene shifted laterally across the surface and rotated at each position have a similar final energy.

Publications: None yet.

13	Tim Ryan

Jacob C. O'Donnell

Master's 2, Mechanical Engineering
Advisor(s): Dr. Brian Trease

Multimodal Environmental Sensing via Application of Heterogeneous Swarm Robotics

Biography: Jacob O'Donnell was a graduate student at the University of Toledo where he pursued a Master of Science in Mechanical Engineering, graduating in 2021. At the University of Toledo, he was a member of the Mechanism, Mobility, and Multifunctional Design Laboratory under Dr. Brian Trease. He received his Bachelor's in Mechanical Engineering from Wright State University in 2019. He has interned at APT Manufacturing Solutions and Applied Optimization. During his time at APT Manufacturing Solutions, he was able to work around semi-autonomous systems and robotic arms for manufacturing application scaling from small arms for simple tasks to large arms for pallet stacking. During his undergraduate senior capstone, he was able to work on improving a consumer robotic arm, exposing him to design iteration and control development of a simple robotic system. These experiences provided a pathway to future work with robot systems.

Abstract: Harmful algal blooms (HABs) can be devastating to their local environment by affecting water supplies and wildlife. HAB's are often observed and measured using satellite imagery and water samples. To help prevent damage to the environment, an autonomous swarm of unmanned aerial vehicles (UAVs) and unmanned surface vehicles (USVs) can be used for locating and monitoring the harmful algae. In this study, a swarm of multiple cost-effective USVs, along with an UAV, will be developed to survey an area for HABs. Cost-effective USVs allow for a larger swarm and improving surface coverage area. To accompany the USVs, a UAV uses image processing to identify potential HABs locations, generating target areas relayed to the surface USVs for further investigation. The system functions on a centralized swarm approach with real time data transmission from the quadcopter to a designator that distributes the USV's as the quadcopter scans the area. The models are created with ROS (open-source robot control system) and Gazebo (open-source robot simulation package) to allow for simulation of controls as implemented on the actual robots. The simulations provide a test chamber for all control code that can be implemented on physical boats to be tested in the field for both ideal and realist effectiveness of this heterogeneous swarm environmental sensing method

Publications:

Ansary, J., O'Donnell, J., Fyza, N. and Trease, B., 2020, August. Swarms of Aquatic Unmanned Surface Vehicles (USV), a Review From Simulation to Field Implementation. In *International Design Engineering Technical Conferences and Computers and Information in Engineering Conference* (Vol. 83914, p. V002T02A029). American Society of Mechanical Engineers.

9	Marcy Kaptur

UNIVERSITY OF Cincinnati

Lynn Pickering

Genetic Fuzzy Systems: Application to the Homicidal Chauffeur Differential Game

2nd Year PhD. Candidate, Aerospace Engineering & Engineering Mechanics
Advisor(s): Dr. Kelly Cohen

Biography: Lynn Pickering is in her second year as a PhD candidate at the University of Cincinnati, after graduating with a Bachelors of Science in Aerospace Engineering and minor in German Studies (Summa Cum Laude and Distinguished University Honors Scholar). Without trust in AI, only so much can be achieved, and so she is passionate about Fuzzy Logic as an artificial intelligence method that provides the transparency and explainability to truly advance AI. Explainability in AI is essential to AI built to work in partnerships with Humans, as well as ensure that the AI is being accurate. To this end, she is working on applying Explainable AI methods to the Homicidal Chauffeur Differential Game. To further promote explainable fuzzy systems, she is on the organizing board of the Explainable Fuzzy AI student competition.

Abstract: A fuzzy system is trained by a Genetic Algorithm(GA) to find the optimal control path of the evader relative to the pursuer in the differential game the Homicidal Chauffeur. The optimal control solution is implemented and used to generate a data set of paths in the solution space that the GA uses to train the fuzzy system. The GA, fuzzy logic system and optimal control solution have been summarized. An average error for each path point of all the paths 0.0861 for the training data set and 0.0852 for the testing data set. Error is defined here as the sum of the error in the x and y coordinates. Initial results are given for the investigation of noise effect on the training and trained system.

Publications: Pickering, L., and Cohen, K., "Explainable AI - Genetic Fuzzy Systems - A Use Case", 2021 NAFIPS Annual Conference, June 7-9, 2021, Purdue University, IN. To also appear as book chapter in Springer publication titled 'Explainable AI and Other Applications of Fuzzy Technique's Editors: Julia Rayz, Victor Raskin, Scott Dick, and Vladik Kreinovich.

Pickering, L., and Cohen, K., "Genetic Fuzzy based Tetris Player", 2020 NAFIPS Annual Conference, August 20-22, 2020 - Redmond, Washington, USA.

Pickering, L., Viana Perez, J., Li, X., Chhabra, A., Patel, D., and Cohen, K., "Identifying New Inputs in COVID - 19 AI Case Predictions", Proceedings of 7th International Conference on Soft Computing and Machine Intelligence (ISCMI 2020), November 14-15, 2020, Stockholm, Sweden, pp. 192-196.

Chhabra, A., Patel, D., Viana Perez, J., Pickering, L., Li, X, and Cohen, K., "Understanding the Effects of Human Factors on the Spread of COVID-19 using a Neural Network", Proceedings of 7th International Conference on Soft Computing and Machine Intelligence (ISCMI 2020), November 14-15, 2020, Stockholm, Sweden, pp. 121-125.

2	Brad Wenstrup

MIAMI UNIVERSITY

William Lucas Rickman

Master's 1, Mechanical Engineering
Advisor(s): Dr. Edgar Caraballo

An Improved Method for Turbulent Flow Simulation Validation Using Surrogate Markov Models

Biography: William Rickman is a first-year master's student enrolled in Miami University's BS/MS program, pursuing both of his degrees concurrently in Mechanical Engineering. Over the past four years that he's spent at Miami, he's had the opportunity to work on a variety of different projects, such as the design and manufacture of an adjustable angle solar panel rig for Engineers Without Borders and the design of a test duct for Miami's Engineering Research Annex. He has also had the opportunity to work on several group-oriented design projects; including AIAA's Design, Build, Fly! Competition; gathering a small group within Miami's AIAA chapter focused on the thrust vectoring of solid rocket motors; and APOP's annual JETCAT design project, the latter of which is serving as his senior design project. Additionally, over the past three years, William has worked with the Director of Instructional Laboratories in Miami's Physics Department to help fulfil the manufacturing and design needs of their research groups. Outside of the University setting, He has worked with Tark Inc., a Dayton based engineering firm that designs cooling pumps for use within CT scanners, and with AFWERX, participating in their Agility Prime Digital Engineering Internship. He has a deep passion for music, a love of nature, and a sincere interest in mathematics.

Abstract: The ability to quickly and efficiently model turbulent flows has been sought after for as long as computational fluid dynamics (CFD) has existed. Even today, in the age of supercomputers, the most accurate simulations can take weeks to run in the optimal case, leaving data-driven design iteration a lengthy process and precise active flow control out of reach. In the past decades, new, flow-dependent methods of modeling highly turbulent systems have been developed. These data-derived models, referred to as Reduced-Order-Models (ROMs), offer a comparatively cheap and fast alternative to the more computationally expensive CFD solvers, sacrificing generality rather than accuracy. The mathematical methods used in developing these models often offer several distinct models as potential solutions, and validation is required to select the best representative. The validity of these models is often tested using statistical and flow-dependent procedures; both tending to be costly and subjective. Subjective in that different researchers have different standards and metrics for comparing the models to their source data, and costly in that these rarely automated procedures take time to complete.

Until the development of Chabot's thesis [1], the work this project is expanding upon, there was a distinct lack of a data-driven, objective validation procedure for ROMs. This thesis provided the framework for such a procedure, which was applied to ROMs generated using Proper Orthogonal Decomposition (POD). The flow within these models was clustered into different states using a Gaussian mixture model, and a surrogate Markov model was constructed to compare the experimental and modeled data sets to determine their usefulness and rank their "goodness". This project seeks to expand the scope of this procedure to other ROM methods, such as Dynamics Mode Decomposition (DMD). Within the current framework there is a certain level of ambiguity associated with the process of determining error states, which this project aims to redefine in a more logical manner.

[1] Chabot, John (2015). *Validating steady turbulent flow simulations using surrogate Markov models*. [Master's thesis, Miami University]

Publications: None yet.

5	Robert Latta

Joshua W. Stanley

Master's 1, Mechanical Engineering
Advisor(s): Dr. Anju Gupta

Controls System of Metal Oxidation Warming Reaction for Lunar Applications

Biography: Joshua Stanley is currently a first-year Master's student studying Mechanical Engineering at The University of Toledo. He graduated from The University of Toledo with his Bachelor's of Science in Mechanical Engineering in May of 2021, achieving the recognition of summa cum laude. During his undergraduate studies, he completed three co-ops in the automotive and appliance industries and worked as a teaching assistant, leading the lab portion of the Measurements course. He is a member of the Robotics Automation and Design Lab under Dr. Adam Schroeder, where he is working on developing robots of unique form factors and experimenting with new forms of locomotion. Aside from academics, Josh's hobbies include rock climbing, 3D printing, and playing guitar.

Abstract: Up to this point, the duration of lunar missions has been limited to a single lunar day (approximately 14 days on earth). Because of the oppressively low temperatures reached during the lunar night (reaching -200°C for 14 earth days), computer systems on board of lunar landers and rovers cannot survive the night. The current solution proposed to extend the working duration of lunar missions is to incorporate a heating system to keep critical components at a reasonable temperature throughout the lunar night so that they may boot up and remain operational the next day. As with all systems meant for aerospace applications, the mass and volume needs to be as minimal as possible because of the substantial investment required to send it to space. The system proposed for this function and currently being developed is a Metal Oxidation Warming System (MOWS). By combining the reactants of a highly exothermic reaction, a large amount of heat can be generated for a relatively small quantity of reactants (providing a system with a much higher specific energy than any battery systems with our current technology).

For this to perform autonomously, a control system needs to be created to dictate the rate of combination of the reactants based on the thermal mass of the payload, heat lost to the environment, and energy demanded throughout the lunar night. In the pursuit of the development of this control system, a program simulating the thermal needs of this system as well as other parameters was created to test different control board components and architectures in order to determine how effectively they keep the temperature on target and how little power they consume.

Publications: None yet

9	Marcy Kaptur

WRIGHT STATE UNIVERSITY

James G. Wnek

Master's 2, Mechanical Engineering
Advisor(s): Dr. Mitch Wolff

Multi-fidelity Analysis of Predictive Capability for Hypersonic Conceptual Design

Biography: James "Jamie" Wnek received his B.S. in Mechanical Engineering at Wright State University in 2021 and is currently pursuing an M.S. in Mechanical Engineering at the same university. He began taking graduate coursework as an undergraduate as part of Wright State University's combined B.S/M.S degree program. In Spring Semester 2021, Jamie began doing research under Dr. Wolff and in collaboration with GoHypersonic Inc., working with hypersonic conceptual design tools for an honors thesis. He is continuing his work with conceptual design tools for his master's thesis. Outside of engineering, Jamie enjoys drawing and creative writing.

Abstract: The conceptual design process requires going through numerous design iterations. The many iterations needed to explore a design space preclude the use of time-consuming RANS CFD for all but a few combinations Mach number, angle of attack, and angle of sideslip. This research focuses on identifying the level of fidelity needed to adequately predict the aerothermodynamic characteristics of hypersonic vehicles. Three different tools with differing levels of fidelity – CBAERO, Cart3D, and Kestrel – were used to analyze the Generic Hypersonic Vehicle (GHV) at design conditions. The data gathered in this research can aid engineers in choosing an appropriate level of fidelity for different design goals.

The preliminary results showed a large difference in the unstart threshold predicted by inviscid and viscous CFD, $21°$ vs $11.75°$ for $M = 5.85$. Despite that difference, the low and medium fidelity methods, CBAERO and Cart3D, can adequately predict C_L, C_D across the entire range, however the differences were magnified substantially when calculating L/D. The medium fidelity method was also capable of predicting C_M and mass capture below the unstart threshold. The high-fidelity method, Kestrel, was only necessary to predict the unstart threshold and mass capture after unstarting. Further research is still being conducted on aerodynamic heating estimates.

Publications:

Wnek, J. (2021). *Preliminary and Conceptual Design Methodology Comparison for Hypersonic Vehicles.* Wright State University, Department of Mechanical and Materials Engineering. Wright State University.

8	Warren Davidson

Scholars

CASE
CASE WESTERN RESERVE UNIVERSITY

Madeline Barto

Junior, Mechanical and Aerospace Engineering
Advisor(s): Chirag Kharangate

Surface Enhancements and Their Effects on Critical Heat Flux and Heat Transfer

Biography: Madeline is a junior studying mechanical and aerospace engineering with a minor in mathematics at Case Western Reserve University. She has been fascinated by science and mathematics since a young age and decided to pursue those interests in college. During her time at Case Western, Madeline has become the president of the Case Rocket Team, assisted as a teaching assistant, and conducted research in the Two Phase Flow and Thermal Management Lab. Over the summers, she has had internships at Bell Flight and Raytheon. After graduating next year, she hopes to enter the aerospace industry full time as an engineer.

Abstract: Many new technologies, including those involved in spacecraft, have a need for a more efficient and more compact thermal management systems. Two-phase cooling systems can help meet these requirements in comparison to traditional single-phase counterparts. Additionally, surface enhancements made to the boiling surface can further improve boiling performance and heat transfer coefficients. Using the pool boiling facility in the Two Phase Flow and Thermal Management lab, various types of surface enhancements can be examined. The aim of this research is to explore the effects of different surface enhancements applied to a copper surface. Data will be collected that allows for the critical heat flux and heat transfer coefficients to be calculated and compared against each other. Additionally, images taken of the fluid while boiling will provide insight into how the surface enhancements impact the onset of critical heat flux.

Publications: None yet.

11	Marcia Fudge

Joseph Beckett

Senior, Mechanical Engineering
Advisor(s): Dr. Robert Lowe

Optimization and Validation of a Stereo Digital Image Correlation System for Large Deformation Soft Materials Testing

Biography: Joseph Beckett is a senior undergraduate student and 2021 Goldwater Scholar pursuing a degree in mechanical engineering at the University of Dayton. In the spring of 2020, Joseph joined the Behavior of Advanced Materials and Structures lab and began working on his honors thesis research on digital image correlation of soft materials. In the spring of 2021, he started working on a collaborative research project (with the University of Dayton Research Institute and the Air Force Research Laboratory) focused on the mechanics of a novel self-healing photocurable elastomer. Joseph was accepted into the Berry Summer Thesis Institute during Summer 2021, a cohorted undergraduate research experience for Honors students at the University of Dayton. Previously, Joseph worked as an intern at the Department of Energy's Portsmouth Gaseous Diffusion Plant in Pike County, Ohio. Outside of classes, Joseph is an is the vice president of the "It Flies" competition team and a member of Pi Tau Sigma. After graduation, Joseph intends to pursue a Ph.D. in mechanical engineering, specializing in mechanics of soft materials.

Abstract: Stereo digital image correlation (DIC) is an optical measurement technique capable of producing full-field strain and displacement maps by tracking a high-contrast pattern applied to a deforming object. These rich measurement capabilities make DIC a compelling research tool for material characterization efforts involving coupon-level specimens undergoing complex, three-dimensional modes of deformation. Soft materials, which typically exhibit large strains at fracture, present several major challenges to DIC measurements including pattern breakdown at large strains, saturated image regions from glare, and large fields of view. This research implements several cost-effective strategies to improve soft material DIC measurements by increasing DIC image quality and optimizing DIC analysis parameters. It also provides relevant proof-of-concept DIC analyses of emerging soft materials and highlights applications that would benefit from experimental validation facilitated by large-deformation DIC measurements.

Publications: 1. R. Lowe, J. Beckett, et al. (2021). Soft Piezoelectric Composites: Synthesis, Electro-Elastic Property Characterization, and Non-Linear Constitutive Modeling. In Proceedings of the ASME 2021 International Mechanical Engineering Congress and Exhibition.
2. J. Beckett (2021). Overcoming the Challenges of Digital Image Correlation Measurements for Soft Materials at Large Deformations: A Review. In Proceedings of 2021 Berry Summer Thesis Institute.
3. J. Beckett and R. Lowe (2021). Toward DLP 3D-Printed Soft Robots: A Stereo DIC Investigation of the Mechanics of Ultra-Stretchable Self-healing UV-Curable Photopolymers. In 2020-2021 NASA/Ohio Space Grant Consortium Annual Student Research Symposium Proceedings XXIX.

2	Brad Wenstrup

Isabella Bidart Ferrer

Senior, Aeronautical/Astronautical Engineering
Advisor(s): Dr. Matthew McCrink

Gust Response Evaluation for Small Unmanned Aerial Systems

Biography: Isabella is originally from Havana, Cuba and moved to United States when she was 19 years old. She then attended a Community College in Kentucky, where she completed her Associates in Science and worked as a Math and Science tutor. There she discovered her passion for the aerospace field and decided to transfer to the Ohio State University to pursue a BS degree in Aeronautical and Astronautical Engineering. She has worked as an undergraduate teaching assistant for the Mechanical and Aerospace department and as a research assistant at the Aerospace Research Center in the UAV lab. She is currently the president of the Aerospace Honorary Sigma Gamma Tau at OSU and has recently accepted a full-time position at Boeing working as an Instrumentation Flight Test Engineer in St. Louis, Missouri.

Abstract: This research project aims to ensure the safe use of small unmanned aerial systems (sUAS), often referred to as drones, for commercial applications such as infrastructure monitoring, agricultural missions, and small-package deliveries in unpredictable gusty environment. Gust tolerance is one of the most important technical challenges for sUAS because of its relatively light weight and low-altitude operations where severe turbulence often exists, which is caused by terrain, trees, buildings and so on. However, there are no standards provided by the UAS traffic management system (UTM) on the sUAS performance evaluation of the gust tolerance. In this research, multirotor UAS will be designed to evaluate the wake responses to controlled gusts by simulating maximum velocities, and velocity gradients that are expected in wake encounters in both a controlled indoor and an outdoor environment. This will help in the analysis and quantitative evaluations of the severity of the gust response for a representative sUAS.

Publications: None yet.

3	Joyce Beatty

Tyler Blackey

Academic Level: Senior, Mechanical Engineering
Advisor(s): Dr. Hazel Marie

Lunabotics Rover Auger System

Biography: Tyler is a Senior Mechanical Engineering student at Youngstown State University with a minor in Mathematics. His interest of robotics stems from a curiosity of automation and its applications in the engineering world. This passion for robotics led him to pursue a spot in the YSU robotics club, specifically on the NASA Lunabotics competition team working on the auger and dumping system. Tyler has plans to enter the robotics industry and contribute to the growing technologies within the sector. He then has hopes to continue his education in Mechanical engineering with a focus on robotics and control.

Abstract: The Youngstown State University Robotics Team will be competing in the 2022 NASA Lunabotics Competition with the task of designing, building, and programming a rover that must traverse a simulated lunar surface as autonomously as possible to mine icy regolith (gravel). This rover must meet specified design constraints, including an initial volume of 1.1m long, 0.6m wide, and 0.6m tall, and a maximum mass of 80kg. The rover must also be capable of avoiding or crossing boulders and craters traversing terrain simulating the lunar surface. The purpose of this proposed project will be to design the rover a new collection system that efficiently collects samples and deposits the desired material as required by the competition. This technology can be used on future rovers to quickly collect desired samples in these environments.

Throughout the semester, Tyler has Identified all the requirements for a collection system for a lunar rover competing in this event, including design constraints and necessary objectives. Then, research will be conducted on current collection system designs on rovers and other devices to gather ideas that may or may not have been used before on rovers. After comparing all potential options, one will be designed and optimized using 3D CAD and engineering software. During this process, the design will also be created with manufacturability, reliability, and maintenance in mind to make it a feasible option for this competition.

Publications: None yet.

13	Tim Ryan

Marietta College

Alec Bollinger

Junior Studying Petroleum and Environmental Engineering
Advisor(s): Dr Guam

Observing Earth's Past Climate using Rock and Ice Core Data

Biography: Alec Bollinger was born and raised on a small family farm outside Sycamore, Ohio. He is currently a junior attending Marietta College to obtain a dual degree in petroleum and environmental engineering. At Marietta College, Alec participates in variety of clubs and activities. As the founder and president of the Future Energy Producers of America, Alec is leading an energy analysis of Marietta College. He also serves as the treasure of AADE, the vice president of AAPG, the treasure of geology club, and is a member of SPE. He also is a member of Alpha Sigma Phi and Sigma Gamma Epsilon. Alec works as an engineering tutor and mentor for other students in his major. Outside of school, Alec works around the farm and has participated in paleontological digs and surveys in southern Utah. During the past two summers, Alec has worked as an engineering intern for Cemenco Service and Hess Corporation respectively. He plans to work again for Hess Corporation next summer as an engineering intern and for the Ohio State Airable Research Lab next winter. In his free time, Alec is an avid outdoorsman who enjoys arrowhead collecting, hiking, and cooking.

Abstract: The concern for climate change is one of the leading issues in our world today. The consistent rise in Earth's average annual temperature over the past couple of decades has many people fearing for our future. This slow rise in temperatures has been linked to prolonged droughts, melting glaciers, and extreme weather, among other things. Many believe that the major cause of this climate shift is due to human influence. While this is no doubt concerning, Earth's climate has always been going through extended periods of warming and cooling, well before humans ever existed. Historic changes in Earths temperatures stem from a variety of natural causes. Major events such as volcanic eruptions or meteorite impacts cause swift fluctuations in earth's climate, while other events such as the evolution of life take much longer to impact Earth's climate. This study will analyze natural climate shifts that occurred throughout the mid to late Cenozoic Era to try and better understand our current climate change. Data preserved in deep sea sediments and ice cores will be analyzed to interpret the conditions of these past environments.

Publications: None yet.

4	Jim Jordan

Anthony Bothe

Senior, Mechanical Engineer
Advisor(s): Dr. Jed Marquart

Design and Analysis of Annular Aerospike Nozzle using CFD

Biography: Anthony Bothe is Mechanical Engineering student at Ohio Northern University, and is set to graduate in May 2022. He never dabbled in the field of engineering and mathematics until taking Calculus I in high school and realizing that he had a very strong, natural understanding of mathematical concepts. His entire family consists of engineers of almost every field which influenced his decision to become an engineer as well. During his first year of college, he joined up with the ONU AIAA organization which participates in the annual SAE Aero Design East competition. Since then, he has loved every moment of it and has been heavily involved with the team and the knowledge transfer which is supposed to take place annually. Anthony has discovered that he particularly enjoys aerospace science and controls engineering.

Abstract: A brief introduction to the Lockheed Martin X-33 project and Rocketdyne's XRS-2200 project is presented as well as key advantages of aerospike nozzles over conventional bell nozzles. This article details the design, preliminary analysis, and evaluation of an annular aerospike plug nozzle using the simple approximate method for plug contour design... Plug nozzle contours were developed and computational fluid dynamics analyses performed. Conclusions are drawn from the data which promote understanding of the concepts of aerospike propulsion as well as present new ideas for aerospike research**.**

Publications: None yet.

16	Anthony Gonzalez

Patrick Brandt

Senior, Aerospace Engineering
Advisor: Dr. Jeffrey Peter Bons

Dynamic Response of Swept Wing Aerodynamics to Active Flow Control through Vortex Generating Jets

Biography: Patrick Brandt was born in Toledo, Ohio and grew up in Fulton County. After taking lessons learning to pilot a Cessna 172 from Fulton County airport, he developed a strong interest in flight and the field of aerospace. He is currently studying aerospace engineering at the Ohio State University. He is an undergraduate senior and has been accepted to continue his education in a graduate program starting in Autumn 2022. At OSU, he is involved with the Buckeye Vertical project team, the Evans Scholars Foundation, and Sigma Gamma Tau aerospace honorary.

Abstract: Active flow control (AFC) is implemented on a 30° swept wing through a streamwise row of vortex generating jets in order to investigate the time response of fluid dynamics to state changes in AFC blowing. The wing uses a NACA 64_3-618 laminar flow airfoil with a taper ratio of 1. The AFC technique has been proven to cause an increase in the wing's maximum lift coefficient and delay the onset of unstable pitching moments caused by swept-wing three-dimensional stall. Potential benefits for advanced flight vehicles implementing AFC technology include shortened take-off distances and improved turning performance.

The introduction of AFC will cause a time-varying reaction in the global forces and moments acting on the wing, and these transient conditions will have significant implications for flight controllability. Because many of the benefits of AFC are observed in flight mission profile sections such as landing and takeoff, the ability to operate AFC with safety and control is crucial for practical feasibility. The present study will seek to investigate the time-varying effects of AFC actuation on the global forces and moments acting on a swept wing. The dynamic responses of aerodynamic loadings on the wing are measured for the transient states when AFC blowing is toggled on and off. Data acquisition for this study includes load cell force and moment measurements and hot film anemometer flow velocity measurements. The parameters for variation in the research are the wing angle of attack and the AFC momentum coefficient. Dynamic datasets are collected for fixed angle of attack.

Publications: None yet.

5	Robert Latta

BW BALDWIN WALLACE UNIVERSITY

Elizabeth Bryson

Academic Level, Major: Senior, Biology Major
Advisor(s): Jacqueline Morris, Ph.D.

A *cyp1b1* Deletion Mediates Primary Open-Angle Glaucoma Through Malformations in Schlemm's Canal and The Trabecular Meshwork

Biography: Elizabeth is a Senior at Baldwin Wallace University currently residing in Willoughby Hills, Ohio. Her passion for science from a young age influenced her decision to pursue an undergraduate degree in biology and a career in clinical research. After graduating from Baldwin Wallace, Elizabeth plans to attend a post-baccalaureate program before pursuing a Ph.D. in regenerative medicine.

Abstract: Primary open-angle glaucoma is the second leading cause of blindness and the most common type of glaucoma in adults over forty years of age, affecting one in every 10,000 people. The autosomal dominant form of the disease, juvenile open-angle glaucoma, affects one in 50,000 people from three to thirty-five years of age (Chak et. al 2014). While the mechanism of the disease is not fully understood, *cyp1b1* is thought to play an integral role in the development of Schlemm's canal and the Trabecular meshwork in the eye due to its' expression in pericytes, endothelial cells, and astrocytes (Falero-Perez et. al 2019). Each of these cells has a different role in the formation of the two important parts of the drainage system of the eye. The study I am conducting aims to use the CRISPR/Cas9 system to create a targeted deletion of *cyp1b1* to better understand the effects of a complete gene deletion on the development of primary open-angle glaucoma. Three Danio rerio specific oligonucleotides were created to target the cyp1b1 gene located on exon one of chromosome thirteen. The oligonucleotides were PCR amplified and purified before undergoing in vitro transcription. Completed gene transcripts were confirmed via electrophoresis. Danio rerio one-cell stage embryos were then injected with Cas9 protein and the four cyp1b1 specific gRNAs. DNA isolated from injected embryos is currently being used to confirm mutagenesis.

Publications: None yet.

14	David Joyce

WRIGHT STATE UNIVERSITY

Zachary Carner

Senior, Mechanical Engineering
Advisor: Dr. Mitch Wolff

In-Situ Flow Meter Calibration

Biography: Zachary Carner is a senior at Wright State University who is majoring in Mechanical Engineering and minoring in Mathematics. From a young age, Zach has enjoyed math and the process of designing new systems and tinkering with existing ones to make them work more efficiently. Zach grew up in Tipp City, Ohio, and graduated as Salutatorian from Tippecanoe High School. Zach is a Choose Ohio First Scholar and frequent member of the Dean's List. Zach is also a member of Tau Beta Pi Engineering Honor Society, Golden Key International Honor Society, and The National Honor Society of Leadership and Success. Zach currently works as an intern for AFRL at Wright Patterson Air Force Base in the Power and Thermal Directorate. Upon graduation, Zach plans to continue his education, earning a master's degree in Mechanical Engineering from Wright State.

Abstract: The inability to calibrate flow meters in-situ for an experiment is inefficient for researchers. Flow meters are used to measure the rate of flow of a fluid through a pipe. The flow rate is often used to draw meaningful conclusions about the fluid being used for the experiment. The current method of calibrating flow meters involves sending them to an outside company to be calibrated. The primary issue with this practice is that it does not allow the flow meters to be calibrated in the situational context in which they are being used. To accomplish this, a cart will be constructed to accurately measure the weight of water entering a drum over a set time period. Sensor calibration and interfacing will then be conducted to increase the accuracy of the system. Finally, an uncertainty analysis will be conducted to determine the accuracy of the apparatus. As a result, the flow meters will be calibrated at the same time as the temperature probes in the exact situational context in which the flow meters will be operating. Additionally, this will prove to be more efficient for researchers because they will no longer have to send the flow meters to outside companies for calibration.

Publications: None yet.

8	Warren Davidson

Wilberforce University

Zackry Cephas

Senior, Computer Engineering
Advisor(s): Deok Hee Nam, Ph. D.

Smart Flying Sensor Robots For Exploring Mars' Terrain and Activity Detection

Biography: Allow me to begin from the start from when I was little, I play with Legos it shows me an engineer inside that thing are assembled it didn't make any difference what the designing field is all things fit. Together like bones fit in a body this grant would be something if past finished. Legos and Sci fi is something, that make you a visionary its assistance what make things outlandish into conceivable like telephones, game consoles, PCs, and space x rockets/unique NASA rockets anything is possible and that what makes me a visionary and a science fiction nerd who is somebody who have the thoughts. To go past regardless of whether they are senseless awards is a dazzling technique to spread the quality preparing among the normal individual. There are various understudies who merit this better than me.

Abstract: Recognition of investigating blemishes' territory with discernment ability for dynamic states of climate is altogether significant since it requires a higher and more adaptable robotization and effectively versatile capacity to conform to the inexorably quicker self-governing and collective discovery to adjust to differing and states of the climate. In the event that the flying self-governing robots can know about the space explorer's position and expectation at the blemishes, a common workspace between conveyed robots and different space travelers may build the availability and space travelers' security issues. This undertaking presents a review on flying robot sensor identification of dynamic and flighty of mathematical territory at the blemishes and the space travelers' location and activity acknowledgment in the blemishes' surroundings. An outline of various brilliant sensors and discernment procedures for flying robot sensors is introduced. Different sorts of mechanical frameworks normally utilized like fixed-base controllers, community flying robots, portable flying robots and versatile flying controllers.

Publications: None yet.

10	Michael Turner

Boyd W. Colbrunn

Senior, Biological Physics and Premedical Studies
Advisor(s): Karthik Vishwanath

Development of a Probe for Diffuse Reflectance Spectroscopy with Variable Source-Detector Separation

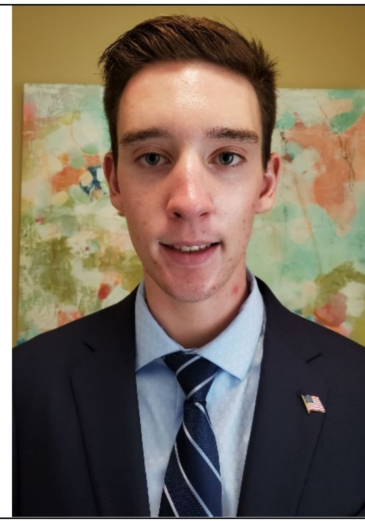
Biography: Boyd Colbrunn is a senior at Miami University majoring in Biological Physics and Premedical Studies, with a minor in Disability Studies. He grew up near Cleveland and first took an interest in engineering as a part of his high school robotics team. There, he developed an interest in programming and engineering to add to his passion for medicine. In college, these two were combined through pursuits in coursework, research, and other extracurriculars. He served as vice president of Delta Epsilon Mu, a co-ed pre-health fraternity, and also participated in intramural broomball and the rock climbing club. After graduation, he plans to attend medical school with hopes to pursue a career in space medicine.

Abstract: Diffuse reflectance spectroscopy (DRS) is an optical technique to interrogate a medium non-destructively using light. Information about the color of light backscattered from the medium is related to the optical absorption and scattering of the material, which in turn indicate its make-up and composition. DRS systems use fiber optic channels to couple a light source to the medium and to capture reflected light to the detector. The distance between the source and the detector fibers is called the source-detector separation and controls the depth of light penetration in the medium. A larger source-detector separation provides for deeper penetration, though the larger the source-detector separation the lower the signal measured. DRS fiber probes used usually have a fixed source-detector separation. When measurements need to be taken at different source-detector separation distances, probes are often built with several channels, each needing individual detectors. Although the method works, it does not allow one to dynamically vary source-detector separation and the cost of a system scales with the number of channels used. The goal of this project is to develop a fiber-based DRS system with a single detector and source that are coupled to a 3D printed variable-source-detector separation fiber optic positioner.

Publications: None yet.

16	Anthony Gonzalez

Jacob Connolly



Senior, Bioengineering
Advisor(s): Dr. David Kennedy

Paraoxonase Regulation of Vascular Dementia

Biography: Jacob is a Senior at the University of Toledo majoring in Bioengineering with a minor in Professional Sales. He is also a member of the University of Toledo's Honors College and a recipient of the Choose Ohio First For Engineering Entrepreneurship (COFFEE) Scholarship. After completing his undergraduate degree, Jacob plans to continue his education to receive both an M.D. and a Ph.D. In his free time, Jacob serves as the Student Advisor for the University of Toledo's chapter of the Biomedical Engineering Society (BMES). Furthermore, he is actively involved in the development of a university chapter of the Bioengineering honors society, Alpha Eta Mu Beta (AEMB), as a founding member and first Vice President. Jacob currently works in the lab of Dr. David Kennedy researching the effects of the paraoxonase family of enzymes on cognitive function.

Abstract: Chronic Kidney Disease (CKD) has been shown to be a possible risk factor for cognitive impairment. We hypothesize that the absence of Paraoxonase-1 (PON-1) and Paraoxonase-3 (PON-3) will lead to decreased cognitive ability in the Dahl-S model of CKD. In the absence of these antioxidant enzymes, we expect the animal models to exhibit increased Barnes Maze times (i.e. increased latency time). We also expect that oxidative stress, inflammation, and vascular fibrosis will be increased in the PON-1 and PON-3 knockout brains versus the control Dahl-S rats. We also anticipate a decrease in hippocampus size, providing histological evidence of cognitive decline. Furthermore, we anticipate that the PON-1 and PON-3 knockout brains will exhibit increased levels of genes associated with Alzheimer's disease and vascular dementia. Our research into these models hope to show how the paraoxonase enzymes regulate cognitive decline in the background of CKD.

Publications:

Khalaf FK, Mohammed CJ, Dube P, Connolly J, Kleinhenz A, Malhotra D, Fedorova OV, Haller ST, Kennedy DJ. Paraoxonase-1 regulation of Na/K-ATPase alpha-1 Src signaling in Chronic Kidney Disease. FASEB J. 2020; 34 (S1):1 https://doi.org/10.1096/fasebj.2020.34.s1.06643

Lad A, Kleinhenz AL, Breidenbach JD, Khalaf FK, Dube P, Su RC, Zhang S, Hunyadi J, Hinds T, Baliu-Rodriguez D, Isailovic D, Connolly J, Khatib-Shahidi B, Malhotra D, Haller ST, Kennedy DJ. Antioxidant Therapy Significantly Attenuates Hepatotoxicity Following Low Dose Exposure to Microcystin-LR in a Murine Model of Diet-induced Non-alcoholic Fatty Liver Disease. J Investig Med 2020;68:1121

Mohammed CJ, Khalaf FK, Dube P, Reid TJ, Connolly J, Khatib-Shahidi B, Kleinhenz AL, Haller ST, Kennedy DJ. Targeted Disruption Of Paraoxonase 3 In A Dahl Salt-sensitive Rat Model of Chronic Kidney Disease Increases Renal Cortical Pro-inflammatory Eicosanoids. Circulation. 2020;142:A16835

Chrysan J. Mohammed, Jacob Connolly, Pamela S. Brewster, Tyler Reid, Prabhatchandra Dube, Christopher J. Cooper, Lance D. Dworkin, Deepak Malhotra, Steven T. Haller, David J. Kennedy. Circulating PON Lactonase Activity Predicts Major Adverse Cardiac Events in Subjects With Atherosclerotic Renal Artery Disease. *Circulation. 2021;XXX:A13819 (Awarded Poster Presentation at "Expanding the Role of Cardiac Biomarkers" AHA Scientific Sessions 2021, Boston, MA).*

5	Robert Latta

WRIGHT STATE UNIVERSITY

Sabrina D'Alesandro

Junior, Material Science Engineering
Advisor(s): Henry Young

Microhardness and Fractography of Alloy 718 Additively Manufactured Samples

Biography: Sabrina D'Alesandro is a junior Material Science Student at Wright State University. During her time at Wright State, she has found a passion for research while working both at Wright State and through the SOCHE program at Wright-Patterson Air Force Base. She has also served as the President of Engineers Without Border, the Commuter Student Association and the Dean's Student Advisory Board. Currently, she is finishing her college career as the Vice President of the Wright State student body. She hopes to continue making additional opportunities for engineering students at her college and in her local community. In the research realm, she hopes to continue making impacts in the understanding of data collection such as in-situ monitoring techniques.

Abstract: Additive Manufacturing (AM) is a layer-by-layer process in which samples are built in an iterative style. AM has many benefits including low cost, quick prototyping, and low energy consumption that makes it a competitive choice for manufacturers compared to other more traditional methods. Due to the variability in thermal energy within the material during manufacturing, it produces microstructure within the material which effects it differently from other manufacturing processes. The thermal history of the material can drastically affect the structure which in turn will affect the material's performance in a created part. However, high-level analysis can be done to better understand how to avoid potential detrimental effects. Using alloy 718, the microstructure of a sample that was created using AM, will be observed by conducting image collection using SEM. Additional data will then be collected using microhardness and fractography, such as feature detection, to understand how microstructure is related to fatigue. This data will be used to gain insight into the mitigation against detrimental effects from the AM process to increase its effectiveness in industry.

Publications: None yet.

10	Michael Turner

THE UNIVERSITY OF TOLEDO

Kevin H. Decato

Senior, Chemical Engineering
Advisor(s): Dr. Glenn Lipscomb

Development of a UV-C Photoreactor

Biography: I am a senior at the University of Toledo pursuing a Bachelor's Degree in Chemical Engineering with a minor in Green Chemistry. From a young age, I have enjoyed solving complex problems, and as I got older, I developed a passion for math and chemistry. Combining all of these elements led me down my current path. I am currently serving as President in The University of Toledo's AICHE (American Institute of Chemical Engineers) chapter. I began research during Fall of 2019 under Dr. Glenn Lipscomb to branch out and make a positive impact on the world.

Abstract: Access to clean drinking water is one of the world's largest problems of our generation. As global populations increase, an estimated 884 million people lack access to safe drinking water. While of course there are a variety of water treatment methods that exist today, the struggle has always been finding a method that consistently works in developing parts of the world. These areas often lack access to the requirements of these alternative methods, as well as the capital to purchase and maintain them. A UV-C photoreactor used to inactivate bacteria and viruses constructed using LED bulbs addresses many of these issues.

A traditional UV-C reactor utilizes a fluorescent bulb that emits a wavelength of UV-C radiation at 254 nm. This wavelength of UV-C light inactivates the bacteria and viruses by catalyzing a reaction between amino acids that fuses their DNA together, preventing reproduction and thus preventing illness. The optimal range for this process to occur is between 250-280 nm and varies between microorganisms. While the fluorescent bulb has worked to date, there are many improvements to be made around the design, especially with the development of LED lights that mimic the same UV-C output as fluorescent bulbs. LED chips offer a more robust 40-50% power efficiency compared to the 20-30% of the fluorescent tube. In areas where the power supply is lacking or given at a variable rate, the highest efficiency possible would be desired. A study also showed that when a sample is exposed to the same total fluence dose, a high intensity/low residence time reactor (LED chips) is better at inactivating bacteria than a low intensity/high residence time reactor (Fluorescent tube.) The main challenge of using LED chips is the radiation output isn't uniform like the fluorescent tube but consists of multiple point light sources along a channel. Although point light sources have higher intensities and are better from a raw inactivation standpoint, they present the challenge of making sure the entire sample is exposed to an equal amount of light. LED chips also last 10 years compared to 1 year of a fluorescent bulb, along with removing the complication of disposing fluorescent bulbs and the mercury within them. Due to COVID-19 and a variety of factors, increased research into sanitization using UV-C light should have a positive effect on the price as demand and supply increase. The increased efficiency, longevity, and lack of maintenance makes the LED bulbs the superior choice for a UV-C reactor.

Publications: None yet.

9	Marcy Kaptur

UNIVERSITY OF Cincinnati

Amanda Devillier

Senior, Mechanical Engineering
Advisor(s): Dr. Daniel R. Cuppoletti

An Investigation of Rotor Scaling on Acoustics Metrics

Biography: I am a 5th year Mechanical Engineering student at the University of Cincinnati and will graduate in Spring of 2022. I am an Air Force kid and spent a lot of my childhood going to air shows as well as traveling across the U.S. and abroad. For as long as I can remember I have loved cars, planes, drones, basically anything that moves, and so that along with my aptitude for math and problem-solving, made Mechanical Engineering a clear choice.
Outside of academics, I spend time working on my Nissan 350z as well as building racing drones. I have been lucky enough to co-op with Air Force Research Laboratories, Gulfstream Aerospace, and University of Dayton Research Institute.

Abstract: Urban Air Mobility (UAM) is a topic of increasing interest as urban roadways get more and more congested. In overpopulated areas, such as Los Angeles, residents on average spend a cumulative seven weeks a year commuting to and from work. Additional heavy infrastructure, such as roads and bridges, would help alleviate traffic, but at a higher cost than the infrastructure needed for Vertical Takeoff and Landing (VTOL) vehicles. The tops of buildings, parking garages, existing helipads, and open areas nearby population centers can be converted to VTOL hubs.
The noise created by rotors used for distributed electric propulsion on Urban Air Mobility presents a unique challenge that must be accounted for in the preliminary design of such vehicles. Currently, many predictive tools use helicopter rotor data which does not accurately model noise physics at lower rotor tip speeds, characteristic of smaller rotor diameters. The objectives of this research were to capture acoustic trends on rotors of various scales in the lab and to explore scaling the acoustics data up to 5x of the measured size to explore how the acoustic energy distribution may impact noise metrics. The accuracy of scaling rotor data up will also be explored in this work. The ability to accurately scale subscale rotor acoustics data will allow engineers gain a better understanding of the noise of their vehicle in preliminary design stages prior to testing full scale rotors. The methodology developed here will be useful for tailoring acoustic energy distributions by selecting the rotor size and number of rotors to minimize noise metrics.

Publications: None yet.

10	Mike Turner

Natalie Douglass

Senior, Mechanical Engineering
Advisor(s): Dr. Rydge Mulford

Parametric Optimization of a Radiative Fin for Maximum Heat Transfer

Biography: Natalie Douglass is a senior undergraduate studying Mechanical Engineering at The University of Dayton. In the Spring of 2020, Natalie joined Dr. Rydge Mulford's DaTA Lab to study advanced concepts of heat transfer. Throughout her undergraduate experience, Natalie interned at Lockheed Martin Space, learning all about the production of satellites. She has a strong desire to impact the space field with new technologies to improve radiative heat transfer for space vessels. Natalie is an active member of Pi Tau Sigma mechanical engineering honors society, the Society of Physics Students (SPS). Outside of school, she can be found rock climbing, hiking, and reading. After graduation, Natalie intends to pursue graduate studies in mechanical engineering, specializing in advanced heat transfer concepts.

Abstract: Small spacecraft in orbit experience a wide fluctuation of temperature depending on the amount of solar irradiation they encounter. To reject excess heat when they are warmed by the sun, the spacecraft have radiators. However, these steady-state radiators continue to remove heat when the spacecraft is in the shade, causing the spacecraft temperature to drop to unsafe levels. This is problematic for the electronics aboard, so the spacecraft then turns on electronic heaters. These heaters take up a lot of space and energy aboard a small spacecraft. This study proposes nature-inspired, dynamic radiators that vary the emitting surface area to respond to the variations of heat inputs.

The main work of this project involves optimizing the shape of a radiative fin for maximum heat transfer properties with a Python model. Since this work is partially inspired by the cooling properties of flower petals, the fin shapes will be varied to mimic different petal shapes, ranging from a square-planar fin to a triangular-planar fin. This study also includes a SolidWorks model to examine differing thickness profiles and actuation angles on the effects of heat transfer and temperature in a radiative wing. From analysis, results confirm a tapered, triangular thickness profile of the fin has optimal heat rate. A tapered thickness fin has a 38.8% increase in heat rate than a uniform thickness fin with the same planar geometry. Then, optimization on the planar geometry shows a rectangular fin has a 6.8% heat transfer increase as compared to a triangular fin with the same thickness profile and volume. Following these results, a novel design for a dynamic spacecraft radiator was studied with annular geometry and varied thickness profiles. It was found that turndown ratios of 3.33 are capable with this novel system. Finally, it was found that fins with tapered thickness profiles have the highest efficiency and turndown ratio.

Publications: N. Debortolli, N. Douglass, D. Warburton, J. Price, J. Cannon, B. Iverson, R. Mulford, "A Novel Dynamic Spacecraft Radiator Design With Annular Geometry and Varied Thickness Profiles for Cubesat Applications" ASME 2022 Heat Transfer Summer Conference

10	Michael Turner

Kevin Du

Senior, Applied Mathematics
Advisor(s): Professor Lei Zhu

Artificial Neural Network for Modeling Hypothetical Policy Effects on COVID-19 Infection Rates

Biography: Kevin Du is a senior majoring in Applied Mathematics and minoring in Computer Science at Case Western Reserve University. His academic interests include artificial intelligence, renewable energy sources, and sustainability and sustainable practices. He concurrently works part time as an intern at Sandia National Laboratory as a Renewable Hydrogen Technology Development Intern in its Hydrogen and Material Science Department. His primary responsibilities in this position include functional and statistical analysis of research data and coding of parsing tools for a database. Outside of academics, Kevin participates in and helps lead in a number of extracurricular groups. Sophomore year, he was a founding member of CWRU iGEM, a bioengineering research team, was the primary author of the founding constitution, and served as treasurer after founding. He also served in leadership for Taiwanese American Student Association (TASA); as Activities Chair, he was responsible for all administrative duties necessary to plan and execute events such ensuring safety protocol is followed, planning reservations, and communicating with relevant administration. In his free time, Kevin enjoys reading, taking online classes, cooking, and music.

Abstract: The applicability and application of artificial intelligence networks has exploded in the past few years. Similarly, the onset of COVID-19 has completely reshaped society. The goal of this project is to create and test an artificial intelligence that models COVID-19 infection rates in different regions of the United States, for the purpose of (1) gaining a better understanding of how the virus spreads on a macro scale and (2) gaining a better understanding of what are the shortcomings and biases produced when attempting high level analysis with artificial intelligence. The expectation is the project results will help aid in future applications of artificial intelligence, especially with the purpose of prediction of a pandemic spread.

For the sake of depth of understanding, this project chooses to focus on the applications and development of Artificial Neural Networks to model infection rates. While different types of neural networks have been researched to some success in modeling the spread of the pandemic, ANNs are found to be comparably successful to other models with a much shorter training period. This project will base its ANN architecture off of the architecture described in "Neural network powered COVID-19 spread forecasting model" by Michal Wieczorek, et al. (2020), and attempt to improve its accuracy for the regions in the United States by integrating policy data sources in addition to the JHU infection data source utilized in the paper. The hypothesis is the resulting neural network will be able to be used as a hypothetical model for the effect of policies on infection rates; we would be able to model the infection rates in Ohio if the lockdown was extended, if restaurants were allowed to open a month earlier, etc.

Publications: None yet.

14	David Joyce

Trevor Dundore

Senior, Aerospace Engineering
Advisor: Dr. Igor Adamovich

Plasma Assisted Combustion of Hydrocarbon Fuels in Extreme Fuel Lean Conditions for the Study of Combustion Kinetics and Intermediate Chemical Reactions

Biography: Trevor Dundore grew up in Gurnee, Illinois, a northern suburb of Chicago, where he attended Warren Township Highschool. During his time in high school, he excelled in math and science courses along with developing an interest in engineering. While in high school, Trevor was a part of the school's baseball team, math team, and academic team.

Now, Trevor is currently a senior at The Ohio State University where he studies aerospace engineering. During his undergraduate experience, Trevor completed the Dunn Sport and Wellness Scholars Program and currently serves as a mentor for underclassmen within the program. In addition, he serves as the vice president of Sigma Gamma Tau, the aerospace honorary society at The Ohio State University. He will be graduating in May and has accepted a full-time position as a Mechanical Engineering with Raytheon Missiles and Defense.

Abstract: There is limited knowledge on the kinetics of radicals and intermediate species formed during combustion of hydrocarbon fuels. Understanding these phenomena can lead to better performance of jet engines and supersonic combustors. In addition, the techniques enacted to study these phenomena are leading to the development of efficient plasma-assisted combustion methods. Plasma-assisted combustion methods do not require large or hazardous facilities to study combustion. To study the kinetics of radicals and intermediate species formed during combustion of hydrocarbon fuels at extreme "fuel-lean" conditions, a wind tunnel will be coupled with a heated flow reactor. In the reactor, which will serve as the plenum of a supersonic wind tunnel, the fuel-air flow diluted in argon will be heated by passing through a thermal energy storage system (a chamber filled with ceramic beads and placed in a furnace), and then expanded through a converging-diverging nozzle into a supersonic test section. Between the thermal storage and the nozzle, there will be an electric discharge section, which will generate atoms and radicals not present in the fuel-air mixture. This needs to be done since most atoms and radicals, unlike stable molecules, are chemically reactive even below ignition temperature. Finally, the heated and plasma-processed reacting flow will expand through the nozzle into the supersonic test section. The rapid supersonic expansion will "freeze" the chemical reactions in the flow, such that the reaction products can be analyzed using laser diagnostics. The aforementioned system will preheat and excite a fuel oxidizer mixture in a plasma flow reactor. The plenum will operate with a pressure up to one bar and a temperature range of 300 Kelvin to 900 Kelvin. The tunnel will operate between Mach 4 and Mach 5 giving the system a run time of between 10 and 20 seconds. The following species will be measured using cavity ring down spectroscopy: fuel (CH_4, C_2H_4), reaction intermediates (HO_2, CH_3O_2, $C_2H_5O_2$), products (H_2O).

Publications: None yet.

3	Joyce Beatty

MIAMI UNIVERSITY

Miranda L. Eaton

Junior, Mechanical Engineering
Advisor(s): Dr. Jeong-Hoi Koo

Characterization of Skin-Like Elastomers for Improving Accuracy of Radial Pulse Pressure Measurements

Biography: Miranda Eaton is a junior Mechanical Engineering student at Miami University. She was first introduced to engineering at a STEM summer camp in seventh grade. From then, her passion for engineering and problem solving developed through high school where she enjoyed her math and science classes. At Miami University, Miranda has served as Local Outreach Chair for Engineers Without Borders, a tutor in math and physics, and an undergraduate research assistant in the Mechanical and Manufacturing Engineering department. In addition to her academics, Miranda enjoys reading, playing piano and guitar, and spending time with her family. She plans to pursue a master's degree in Mechanical Engineering where she will further her research in blood pressure measurements.

Abstract: Accurate measurements of blood pressure, a major indicator of multiple health risks, and its continuous monitoring are extremely important for personal health care. Invasive methods, which are unpractical for daily use, are the most accurate way to measure blood pressure (BP). Thus, there is a growing need for more accurate and convenient non-invasive measurement wearables that allow the users to monitor their BP continuously. Current wearables (such as smart watches) are still immature, and its performance has not been validated at the level for clinical use. In order to improve the sensor technology embedded in wearables for accurate BP measurements, the "skin effect" must be considered. The skin is located between the sensor in the wearables and the blood vessel. It can act as a physical filter, affecting the sensor measurements. Since using human subjects to study the effect of skin stiffness is resource intensive and costly, this project proposes to use artificial skin samples to study the effect of skin on BP. The primary goals of this study are to fabricate skin samples based on silicones that can represent a range of human skin properties, perform characterization testing of the samples using a Dynamic Mechanical Analyzer (DMA), and evaluate how skin samples affect the pulse measurements. The characterization testing results show that the modulus of the samples can represent a range of human skin. The findings of this project are anticipated to pave the way to develop mathematical models (transfer functions) that can relate the actual pulse pressure in arteries and the measured pulse data with respect to a range of skin properties as well as the development of non-invasive radial pulse monitoring systems. Developing a transfer function would improve the accuracy of wearable devices for continuous BP monitoring, thus providing a practical alternative to invasive BP measuring.

Publications: None yet.

5	Robert Latta

Cleveland State University

Rebecca L. Ellis

Senior, Chemical Engineering
Advisor(s): Dr. Jorge Gatica

Waste to Energy: Catalytic Gasification of Household Recyclables

Biography: Rebecca Ellis is a senior pursuing a Bachelor's degree in Chemical Engineering at Cleveland State University. She is a first-generation college student and grew up in Lagrange, Ohio. She is a member of Tau Beta Pi and Phi Theta Kappa. After graduation she has plans to further her education with a Master's program. The experience with her undergraduate research has led to an interest working in the energy industry to formulate more environmentally friendly processes.

Abstract: Waste buildup is quickly becoming a serious global problem, one that negatively impacts quality of life and damages ecosystems. While a variety of methods of reducing waste exist, their environmental impact is rapidly becoming an issue. Thus, developing waste management methods that do not further harm the environment is a necessary next step in pollution control and sustainability. Via the process of gasification, recyclable plastics can be converted (gasified) into syngas, which in turn can be converted into fuel. The low-temperature catalytic gasification of Polyethylene Terephthalate (PET) is the focus of this project. Research was centered on comparison of thermal properties of PET recovered from household recyclables and laboratory-grade PET. Thermal analysis completed in a research-grade Differential Scanning Calorimeter (DSC) yielded heat of formation values of 24.99 J/g and 27.33 J/g for pure PET and household-recovered PET, respectively. Mixing patterns of a multi-phase reacting media in a laboratory-scale stirred tank reactor were predicted using a finite-element method (FEM) based computational fluid dynamics (CFD) platform. The results suggested satisfactory mixing within the reactor and flow patterns were recovered to study simultaneous mass transport and reaction phenomena in a particulate (catalyst and polymeric particles in a fluid media) system.

Publications: None yet.

7	Bob Gibbs

Marietta College

Emily Etheridge

Junior, Planetary Science
Advisor(s): Dr. Andrew W. Beck

Biography: Emily Etheridge is a student studying planetary science at Marietta College from Burrillville, RI with a minor in GIS/GPS mapping and a certificate in leadership. This past summer, she assisted Dr. Andrew Beck on the Martian Moons eXploration Mission (MMX). Here, she organized and analyzed data to aid future modeling of the composition of the martian moon, Phobos, for the Mars-moon Exploration with GAmma rays and NEutrons (MEGANE). In this upcoming summer, she will be participating in the LPI Summer Internship Program, working with Drs. Drs. Brendan Anzures and Cyrena Goodrich of the LPI and Frances McCubbin of NASA. They will be investigating thermal evolution of an enstatite chondrite parent body.

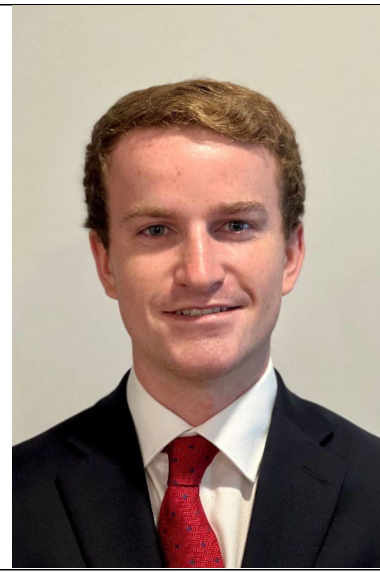
Abstract: The purpose of the Martian Moons eXploration mission is to determine the origin of Phobos. The work that was completed this summer is with the gamma-ray and neutron spectrometer (MEGANE). The methods used to construct the bulk geochemical dataset in this project was taken from the work completed in Beck et al. (2015) and altered to fit this project. Beck et al. (2015) was centered on understanding neutron flux on the asteroid 4 Vesta but was easily altered to study Phobos and Deimos. We first constructed a bulk chemistry database of the two potential compositions of Phobos, volatile-rich carbonaceous chondrites and martian meteorites, using data found in studies conducted to find the bulk chemistries of various martian meteorite. This was split into shergottites, nakhlites, and chassignites martian meteorites. Once completed, we then calculated thermal neutron absorption and other neutron parameters using methods described in Prettyman et al. (2013) and Peplowski and Lawrence (2013). Those results will be synthesized and used to aid in geologic interpretation of the Phobos surface from MEGANE data.

Publications: None yet.

6	Bill Johnson

MIAMI UNIVERSITY

Gregory S. Fetter



Senior, Mechanical Engineering
Advisor(s): Dr. Muhammad Jahan

Post Processing of Additively Manufactured Metallic Parts

Biography: Gregory Fetter is currently a senior attending Miami University majoring in Mechanical Engineering. He was born and raised in New Jersey where he took an interest in engineering while in High School when he took a course on marine engineering at Stevens Institute of Technology. Prior to starting his research, he was a member of the Miami University club rowing team where he was on the varsity team for 3 semesters and received the Club Sports Rookie of the Year Award. He started his role in undergraduate research during the 2021 Spring semester and assisted in the completion of a review paper on new bandsaw blade designs for M.K. Morse. In his free time, Greg enjoys playing intramural ice hockey and softball. He would like to pursue a career in designing and manufacturing motor yachts after graduation.

Abstract: Additive manufacturing has played a pivotal role in innovating manufacturing methods, specifically in the aerospace industry. The ability to 3D print parts reduces the amount of material waste and can decrease manufacturing time. The objective of this research is to examine how the different infill characteristics, including the number of roof and floor layers, fill pattern, and number of wall layers, effects the dimensional accuracy, surface finish, and number of cracks and surface defects present. The Markforged Metal X printer, washer, and sinter will be used to manufacture 26 test parts. Using ASTM standards for testing, the 3D printed parts will undergo compression, tensile, and bending testing. Markforged utilizes Eiger software to transfer parts made in CAD to the Metal X printer and allows for the customization of various part properties including the infill characteristics. Eiger software provides recommended infill characteristics that consider the manufacturing time with respect to the number of roof and floor layers and the surface finish with respect the number of wall layers. These recommendations were the basis of the infill characteristics chosen for the test parts. Heat treatment is currently one of the best ways to post process 3D printed metallic parts and Markforged only has data on 17-4 PH stainless steel and H13 Tool Steel. The data collected by Markforged on the material properties that resulted from varies heat treatment temperatures and times will be considered when conducting heat treatment on future test parts. This research is important because given the complexity of the parts required in the aerospace industry, a more accurate relation between the mechanical properties of the parts and the infill characteristics is necessary to optimize efficiency.

Publications: None yet.

8	Warren Davidson

CASE
CASE WESTERN RESERVE UNIVERSITY

Grace N. Floring

Senior, Mechanical and Aerospace Engineering
Advisor(s): Brian Maxwell, Ph.D.

On the Role of Transverse Waves in the Re-Establishment of an Attenuated Detonation

Biography: Grace Floring is currently a 5th year student at Case Western Reserve University majoring in Mechanical and Aerospace Engineering. She is enrolled in the BS/MS program, where in Spring of 2022 she will also receive her Master's degree in Aerospace Engineering. Grace has always had a love for science and was excited to continue pursuing her passion once entering college. She has been involved with CWRU's chapter of Society of Women Engineers (SWE) since her freshmen year, and is currently serving as chapter President, with this being her fourth year on the executive board. During her time at CWRU she was also involved in Greek Life, was an Orientation Leader, and a TA for multiple courses. She has had professional experience in the industry during her internship at Parker Hannifin and her co-op at Nottingham Spirk. She joined the Computational Fluid Dynamics and Supersonic Combustion (CFDSC) Research Laboratory in January 2020 and has enjoyed getting research experience from her involvement. After graduation, Grace is excited to start her career with Northrop Grumman as a Space Systems Engineer in the Payload and Ground Systems Division.

Abstract: In certain scenarios, detonations can quench (or die out) and subsequently re-initiate back into a detonation wave. This is not desirable in situations where an explosion is meant to be prevented, such as in the chemical and mining industries. This situation also relates to the deflagration-to-detonation transition (DDT), since detonation re-initiation is equivalent to the final stages of DDT. The ability to accurately predict and model detonation re-initiation is important in understanding the DDT phenomenon and being able to prevent accidental explosions. In the past, numerical models with simple chemistry have not been able to accurately model detonation re-initiation. In experiments, it has been noted that a key feature of detonation re-initiation is a transverse detonation wave, which has not been captured numerically with a simple chemistry model before. The purpose of this study is to address this problem by using a thermally perfect 4-step global reaction mechanism with temperature dependent properties.

A 4-step model is still considered a simple chemistry model, so it has the benefits of being computationally inexpensive and has the ability to model at laboratory scales. It also has better chemistry than the more common 1- or 2-step models. A full chemistry model is computationally expensive and can only perform at small scales, which is not useful in real world applications. In order to capture detonation re-initiation, the domain is set up with an obstacle of a half-cylinder, which in experiments performed by Bhattacharjee in 2013 demonstrated the critical regime, or where detonations quench and re-initiate. After encountering the obstacle, the detonation front expands, and the shock wave decouples from the reaction zone, before a localized explosion at the bottom of the channel causes re-initiation. Currently, the 4-step model has shown promising results in comparison to experimental data, as the transverse wave and the critical regime can be clearly observed.

Publications: Floring, G. N. (2021, March). *Initiation of Super-Detonations Following a Porous Medium Using a Global 4-Step Combustion Model*. OSGC. http://osgc.org/wp-content/uploads/2021/09/2-Proceedings-PDF.pdf

12	Troy Balderson

NORTHERN

Olivia F. Galigher

Junior, Mechanical Engineering and Applied Mathematics
Advisor(s): Jed E. Marquart, Ph.D., P.E.

Rocket Propulsion Systems – The Past and The Future

Biography: Olivia Galigher is a junior pursuing a Bachelor's Degree in Mechanical Engineering with a concentration in aerospace and a second major in Applied Mathematics. She is originally from Bolivar, Ohio and was drawn to Ohio Northern University for an engineering education with a small school feel and big-time opportunities. During her time at Ohio Northern, Olivia has served as a representative of the College of Engineering on ONU's Student Senate, served as a representative on the Joint Engineering Council, and is currently serving as the Student Branch Chair and President of Ohio Northern's chapter of AIAA. She is also a member of the Varsity Women's Golf Team. Olivia enjoys spending her free time outdoors on the golf course, the lake in the summer, and the ski slopes in the winter. Upon graduation in May of 2023, Olivia plans to pursue a career in the aerospace industry and is considering attending graduate school to earn a Master's Degree in Aerospace Engineering.

Abstract: Rockets are a crucial component of space exploration and without their propulsion system, they'd never leave the ground. The goal of this research is to understand how rocket engines work and how technology in this field has advanced beginning in the thirteenth century until present day. Understanding what has and hasn't worked in the past, will provide pertinent information to allow for predictions of what to expect in the future.

There are plenty of different types of engines, but for rockets, two main types are used: solid-propellant and liquid-propellant. A comparison of the two engines, with both advantages and disadvantages addressed, will create a deeper understanding of this technology, and allow for engineers to make the best possible choice to meet the needs of each rocket they design, build, and test.

Publications: None yet.

7	Bob Gibbs

Peter Glaubitz

Academic Senior, Aerospace Engineering
Advisor(s): Ephraim Gutmark

Aft Imaging of Hollow Rotating Detonation Engines

Biography: Peter Glaubitz is currently a Senior at the University of Cincinnati in the Aerospace Engineering program. Growing up he frequently visited the National Museum of the US Air Force in Dayton, Ohio where he developed an interest in aircraft. He came to the University of Cincinnati to study Aerospace Engineering, and for the co-op program. Through the co-op program, he was able to explore aerospace research and education. This experience sparked his desire to pursue a graduate degree to do further academic research. His future career plans include become a college level educator.

Abstract: A rotating detonation engine (RDE) is a type of specialized combustor that harnesses a continuous detonation wave which rotates around the wall of the combustion chamber. Rotating detonation engines offer the potential for significant gains in efficiency over conventional combustors. Additionally, the continuous nature of the detonation in the engine eliminates many of the issues inherent in using similar systems such as pulse detonation engines. With the rise of supercomputers and advanced CFD which allows for the practical use of simulation of these flows, the necessity for experimental verification of these simulations is high. This project aims to analyze the angle of the detonation wave front to provide some experimental verification for centerbodiless RDE (CDRE) simulations. The aft of a CRDE was imaged with a high speed camera. The resulting high speed footage was then processed using an automated processing algorithm to measure the wave angle throughout the test.

Publications: None yet.

12	Troy Balderson

Devin R. Grant

Senior, Manufacturing Engineering
Advisor(s): Dr. Augustus Morris

High Altitude Ballooning with Raspberry Pi and Slow Scan TV for Ozone Detection

Biography: Devin Grant is from Columbus, Ohio, home to the Buckeyes, but is currently a senior, honors Manufacturing Engineering student at Central State University with a minor in business administration. Her interest in continuous improvement, fabrication, along with math drove her to pursue her degree. Once obtained, Devin has plans to obtain her engineering license and work alongside likeminded individuals to contribute to a greener Earth and revolutionize Mars.

Abstract: High altitude ballooning is the process of launching a balloon into the atmosphere to observe a set condition, environment, or objective which is predetermined by the launcher/s. These balloons are filled with gas, usually hydrogen or helium, with an attached payload that consists of the necessary equipment that is programmed or controlled to monitor the set conditions. There are a handful of high-altitude ballooning missions focused on Earth's stratospheric ozone layer. These missions are completed on large scales, widely using super-pressurized balloons because they achieve high altitudes to reach the high concentration level of ozone which is located 22 miles above earth's surface. These types of missions can be expensive and take months for preparation. The purpose of this research is to utilize Pico balloons for such stratospheric missions. Pico balloons are small, roughly 3 feet in diameter, and can carry small payloads which can weigh up to 60 grams for various missions that are noteworthy for their flight duration and circumnavigation. By utilizing a Pico balloon that will fly above jet stream into the highest concentration level of the ozone to monitor the state of the stratospheric ozone, questions such as "what is the variation in ozone concentration overtime? Is there a time where the ozone concentration is higher/lower? How can this global issue be solved on a smaller scale rather than NASA missions" will be answered.

Publications: None yet.

3	Joyce Beatty

Amy Gravenstein

Senior, Chemical and Biomolecular Engineering
Advisor(s): Dr. Edward Evans

Characterization and Modeling of Hydrogen Fuel Cells for Thermal Management

Biography: Amy Gravenstein was raised in Akron, Ohio and attended Our Lady of the Elms high school where she was first introduced to engineering. She is passionate about renewable energy and the development of clean technology. She is in her senior year at the University of Akron where she is pursuing a degree in Chemical and Biomolecular Engineering with a focus in biotechnology. At the University of Akron, Amy began working with Dr. Lu-Kwang Ju where she performed soy hull fermentations that yield a valuable enzyme mixture used in fatty acid production. She then worked at The Goodyear Tire and Rubber Company performing research on retread plies and non-pneumatic tires for both the aircraft and global metrology teams. Amy has spent the last two year working with LTA Research and Exploration, an aerospace R&D company, where she is performing hydrogen fuel cell research. This area of research closely aligns with her passion to contribute towards the development of sustainable energy. Amy is currently applying to master's programs in energy systems engineering to broaden her knowledge of this field.

Abstract: The focus of this project is to develop and model the performance of a hydrogen fuel cell system in order to develop a lower weight thermal management system. The nature of hydrogen causes it to have higher safety risks despite being a cost-effective fuel source. Characterization of the fuel cell includes modeling and predicting hydrogen and air consumption, water production, power production, and efficiency. Thermal management modeling takes these fuel cell characteristics, predicts cooling requirements for efficient fuel cell operations, and allows for creative solutions to cool the fuel cell and lower the weight of the balance of plant. Two MATLAB models were created, one for predicting fuel cell performance characteristics and a second for determining heat produced for hypothetical fuel cell operations. Together, these models can be used to compare performances of hydrogen fuel cells on the market and compare effectiveness for desired applications. For each system, heat integration was performed to reduce the mass associated with the balance of plant. Further advancements should include experimental verification. This research is vital in advancing the application of fuel cell technology for energy in transportation.

Publications: None yet.

13	Tim Ryan

Jude Hagerman

Senior, Environmental Science
Advisor(s): Dr. Annette Trierweiler, Dr. Carrie Davis Todd

Evaluation of the Hydrological Effectiveness of Rain Gardens on Baldwin Wallace's Northern Parking Lots

Biography: Jude Hagerman, born and raised in Cincinnati, Ohio, attended St. Xavier High School before venturing off to Cleveland to earn a degree in Environmental Science from Baldwin Wallace University. Jude discovered his initial passion for the sciences young, with desires to understand the world and how it works; Jude's time in the Boy Scouts of America lent to his passion for the environment and the outdoors, and in the future hopes to work to bring harmony between industrialism and environmentalism. A specific interest in hydrology developed from his time spent with Dr. Carrie Davis Todd, and the following project is the culmination of that interest. Jude began working with both of his mentors/advisors over the summer of 2021, with his initial plans of research being delayed from 2020 due to the global pandemic. The Ohio Space Grant Consortium has given Jude the opportunity to continue his education and furthermore, continue his research through his senior year. Jude is currently on track to commission into the US Army as an Environmental Sciences Officer after graduation in the Spring of 2022 and hopes to continue his education and learning throughout his career.

Abstract: Rain gardens are an excellent solution to the increased runoff caused by the overabundance of impermeable surfaces in modern landscapes. Rain gardens increase the residence time for runoff to reach natural waterways, helping to combat local flood events. They have been successfully implemented across the country, gaining popularity as an efficient way for the control of runoff, and removal of pollutants picked up as rainwater runs off roads, parking lots, and sidewalks. This study aims to assess how efficiently the Baldwin Wallace rain gardens are performing their designated hydrologic role by assessing the soil properties, hydrologic properties, plant life, and water quality of the two gardens present on BW's north campus. While we found the construction of both rain gardens effective in their structure and design, containing well drained soils and hydrophytic vegetation, the true issue was the surrounding lot topography. Our survey of overall topography found the surrounding lots directed flow away from the garden inlets, with most of the flow entering the storm drains. This shows a disconnect between the sectors of design and construction; The garden itself can function, yet the surrounding landscape is not allowing it to do so at design capacity. We are currently analyzing the nutrient levels of the soil and water to determine the health and remediation capabilities of the soil.

Publications: None yet.

1	Steve Chabot

Daniel R. Heitmeyer

Senior, Aerospace Engineering
Advisor(s): Dr. Kelly Cohen

Fuzzy Logic Roundabout Manager for Autonomous Vehicle

Biography: Daniel is currently a Senior at the University of Cincinnati pursuing his Bachelor's degree in Aerospace Engineering. He has completed a total of four co-op rotations at the UAV MASTER Lab at the University working on Collaborative Multi-UAV systems. Under the guidance of Dr. Kelly Cohen, Daniel has taken a passion to Fuzzy logic and genetic algorithms for aerospace applications. He has worked on various UAS projects including custom ground station software and flight controls. After obtaining his degree, he hopes to continue researching UAVs and Fuzzy Logic to obtain a master's degree at the University of Cincinnati.

Abstract: This paper introduces the usage of a fuzzy logic based decision making for control of Autonomous Vehicles (AVs) at a simulated roundabout scenario. A four input two output fuzzy logic controller was developed for control of the vehicle's merging decision and acceleration. The introduction of AVs to roundabouts has shown improvements in overall traffic, number of major collisions, and fuel or energy consumption. The controller was developed within software in the loop testing using the SUMO simulator. Such a controller can provide the AVs with near optimal decision making to minimize traffic congestion and collisions while providing a level of explainability via the fuzzy logic rule base. The fuzzy logic based system is trained with reinforcement learning using a genetic algorithm optimization approach. The results show that a trained fuzzy system can strategically interact with other vehicles at a roundabout to improve overall traffic performance at the cost of increased emissions and fuel consumption. Future works includes continuous traffic simulations, introduction of other AVs, run time assurance for collision prevention, and strategic communication between vehicles.

Publications: None yet.

15	Steve Stivers

Sarah Herbruck

Senior, Mechanical Engineering
Advisor(s): Mark Sidebottom

Investigation of Surface Finish and Applied Force on the Tribological Performance of Graphite-Filled Polyimides

Biography: Sarah Herbruck is currently a senior at Miami University studying Mechanical Engineering with a minor in Computer Science. Sarah is a member of Theta Tau, a professional engineering fraternity. She also holds a position in Miami's chapter of the American Society of Mechanical Engineers. Outside of academic clubs, Sarah enjoys rock climbing in the red river gorge and photography. After graduation this spring, Sarah will join Swagelok's career development program in Cleveland.

Abstract: Typically, polymers are limited in sliding applications due to their limited tribological performance at higher temperatures. These higher temperatures often occur during conditions of high friction coefficients, high contact pressure and/or sliding velocities. When considering both the pressure and velocity induced on materials, the tribological heat flux is defined as the PV limit (P*V), which has units of W/m2 . When the PV limit is reached, polymers often fail in tribological systems due to excessive wear, friction, or deformation. To extend the life and scope of polymers, we can aim to increase the PV limit. Graphite powders have been used for many decades as solid lubricants and can be combined with other materials, like plastics, to be applied in situations where such pieces are subject to severe dynamic conditions such as bushings or sealing rings. These Graphite-filled polyimides reduce friction coefficients and decrease the wear of the materials. The goal of this research is to further understand the tribological behavior of these graphite-filled polyimides. The ultimate context of this research is for bushings, but due to the fundamental test condition of a flat-on-flat experiment, the results can be applied to other applications as well. Through evaluation of the tribological performance of graphite-filled polyimides under different pressures and surface roughness, a more detailed picture of the true scope, efficiency, and application of such materials can be gathered. These results will be compared with benchtop testing of bushing under similar load, velocity, and temperature conditions to determine if the fundamental tests simulate the application sufficiently. This can lead to further investigation on such materials as an efficient alternative to traditional lubricants and their effect on efficiency in application.

Publications: Herbruck, S. C. (2021). Advanced Polymeric Materials for Aerospace Applications. *Ohio Space Grant Consortium 2020–2021 Annual Research Symposium Proceedings*, 148–149. http://osgc.org/wp-content/uploads/2021/09/2-Proceedings-PDF.pdf

14	David Joyce

Timothy Hudak

Senior, Chemical Engineering
Advisor: Dr. Lu-Kwang Ju

Solid-State Fermentation of Scopulariopsis brevicaulis

Biography: Tim is a senior chemical engineering student at The University of Akron, also pursuing a minor in chemistry and mathematics. Joining the organization in the fall of 2019, Tim has recently become The University of Akron's Tau Beta Pi chapter treasurer. In fall of 2018, Tim began working with Dr. Lu-Kwang Ju and a graduate student on self-healing biomaterials. Starting in spring 2020, Tim worked three co-op rotations at Schaeffler Group USA, in the advanced materials lab. Here, his two main projects involved finding an electrically insulative and wear resistant coating to prevent electrically induced bearing damage and nano-coatings to improve Li-ion battery cycle life and performance. Currently, Tim is again working in Dr. Ju's lab focusing on a solid-state fermentation process. After graduation he hopes to attend graduate school with a focus on renewable energy technologies.

Abstract: Scopulariopsis brevicaulis potentially has applications in self-healing biomaterials used in manmade structures. These applications require significant amounts of spore produced by the micro fungus. Solid state fermentation (SSF) is an effective way of upcycling materials that are often disposed of as food waste, for example soy hull. Because materials necessary for SSF are waste, this growing method can also serve as a low-cost alternative to submerged fermentation cultivation methods. Sporulation can be induced by exposing the fungi to harsh growing conditions, however the interplay between fungal growth and the sporulating process is critical to maximize spore production. Earlier studies within the Ju group examining the effects of soy-hull size, pH, sodium content, moisture and shaking, temperature, and external supports to improve oxygenation indicate that increased oxygen concentration is a dominating factor in spore production. A serious drawback of traditional SFF is fermentations often require shallow beds due to oxygen transfer limitations at large bed depths, subsequently hampering sporulation. It may be possible to overcome limited bed depth by using column shaped fermenters supplied with humidified air. Bench-top scale fermenter set-ups which reduce the effects of oxygen limitation are being designed and tested. While column fermenters may allow for commercial fermentation scale-ups, several key challenges presented in the packed column beds include; available surface area constraints due to compression of the fermentation substrate, and moisture content within the column.

Publications: None yet.

13	Tim Ryan

Allayah Hughes

Senior, Computer Engineering
Advisor(s): Deok Hee Nam, Ph. D.

Wearable body smart wireless sensor networks through implanted communication system

Biography: I get excited knowing that I have many options for my career to be successful. Majoring in computer science, as an African American woman, there are many doors I can go through to succeed. The fact that my major is Computer Science, I know this internship would be a great opportunity for me. As a junior, my eyes are open to a variety of options on what I want to do in my future. One major goal I have always wanted to accomplish is to show different software improvements for different companies or even the government. While I am showing these software developments to these different companies, I am still looking forward to traveling around the world and educate myself on learning the ins and outs of a computer. Not only will I be intrigued by the software, but I will be communicating with others and influencing inspiring minds. While I am still educating myself, I do not want to limit my possibilities on the variety of jobs. I can't say that I have tunnel vision for a specific goal, but I am very optimistic about anything that is placed in front of me. A computer engineer has always made me curious and a great way for me to expand my mind to many different things that I can potentially be great at. I would love to see where my software development takes me because I know my future will be bright.

Abstract: Wearable body smart wireless sensor networks are revolutionizing the involvement of both doctors and patients in the modern healthcare system by extending the capabilities of physiological monitoring devices. The rapid advancement in ultra-low-power RF (radio frequency) technology enables invasive and non-invasive devices to communicate with a remote station. The purpose of this project is to provide an overview of current developments and future direction of research on wearable and implantable body area network systems for continuous monitoring of astronauts at the mars. This study shows the important role of body sensor networks in astronauts' activities and health conditions at the mars by In-body and On-body communication networks with a special focus on the methodologies of wireless communication between implanted medical devices with external monitoring equipment and recent technological growth in both areas.

Publications: None yet.

3	Joyce Beatty

Michael J. Johnson

Junior, Physics
Advisor(s): Dr. Jay Mathews

Collecting Photoluminescent Data on GeSn Alloys

Biography: Michael Johnson is a Junior studying Physics at the University of Dayton. After growing up in rural Alaska, he made it his goal to dedicate his career to fighting climate change. In the summer of 2020, he began research under Dr. Jay Mathews where he studied the optical properties of germanium tin alloys with the goal of making photonic devices. Michael has also worked in under the Princeton Plasma Physics Lab (PPPL) Plasma and Fusion Undergraduate Research Opportunities (PFURO) program, where he studied plasma physics in application to fusion devices at the University of Wisconsin – Madison. After graduation, Michael intends to pursue graduate studies in plasma physics.

Abstract: Germanium tin alloys are an attractive material system because of their lattice compatibility with silicon and their optical properties in the infrared range. These properties give GeSn alloys potential to be integrated on silicon boards, which can be used for low cost, high-efficiency photonic devices like photodetectors, LEDS, and infrared lasers that operate in the infrared range. Collecting absorption data on GeSn alloys plays a crucial role on the development of silicon integrated optical devices. The absorption of GeSn alloys is affected by temperature, strain, and Sn concentration. The effects that these have can dramatically affect absorption and emission properties.

Publications: None yet.

10	Michael Turner

Karli Katterle

Senior, Mechanical Engineering
Advisor(s): Jed E. Marquart, Ph.D., P.E.

Propulsion Systems for Future Hypersonic Flight

Biography: Karli Katterle is a senior Mechanical Engineering major at Ohio Northern University. She grew up in Ohio in the Cleveland area. During her time at Ohio Northern University, she has had the opportunity to be a student coordinator for the engineering mentorship program. She has also been a member of Ohio Northern's Women's swim team and has been captain for both the 2020-21 and 2021-22 seasons. This past summer Karli participated in a Research Experience for Undergraduates (REU) at the University of Central Florida where she focused on the relationship between the damping of a flat plate and applied mechanical loads. After graduation, she plans to continue her education and pursue a graduate degree in Aerospace engineering.

Abstract: The next step for commercial flight is hypersonic flight, traveling through the atmosphere at speeds greater than Mach 5. The propulsion system used in hypersonic flight will be similar to that seen in a rocket, however, different challenges will need to be met. Current challenges that are being seen in hypersonic flight include reducing shockwaves and disturbances. To determine what is being done currently, the NASA supersonic aircraft initiative will be examined. This research is intended to summarize the current challenges in hypersonic flight, potential solutions, and what is currently being done.

Publications: None yet.

16	Anthony Gonzalez

Conrad Kent

Senior, Aerospace Engineering
Advisor(s): Catharine L. R. McGhan, Ph.D.

An Affordable Way to Simulate Space Robots in Virtual Reality

Biography: Conrad Kent is a Senior in Aerospace Engineering at the University of Cincinnati with a Minor in Mathematics. He has been interested in space since he was young and came to college with the intention of working on space robots and probes. Conrad has worked with Engineers Without Borders and travelled to Tanzania to implement a set of mobile latrine units. He has done work with structural analysis and VR simulation on his co-ops. Conrad hopes to continue working with simulation and space robotics in graduate school.

Abstract: This project developed a method that allows robots to be displayed and controlled in virtual reality (VR) using ROS+Gazebo, a robot simulation platform, OpenVR API, and consumer grade, affordable hardware. This project leveraged prior work by UC's AS4SR lab to get ROS+Gazebo to work with Vrui and OpenCV for an older single-display headset on a single desktop system running Ubuntu Linux, and ongoing work to expand this to using OpenVR and newer dual-display VR headsets. The project then focused on making an example scenario which simulates the user working alongside robots in VR. The user is able to give robots waypoints to travel, control them directly, and pass equipment back and forth to them.

The developed package can be easily adapted to other robot simulations in ROS by other research or educational organizations, as it largely consists of free and open source code (OpenVR, ROS+Gazebo, and Ubuntu Linux). It can also be used to perform human factors testing or other space robotics research, for the cost of a commercial VR headset and a single VR-capable desktop computer. The package for this new project is called openvr_headset_ros.

Publications: None yet.

15	Mike Carey

Zion Klinger

Senior, Computer Science
Advisor(s): Chad Mourning

Using an Evolutionary Algorithm with L-Systems as the Genome to Generate Possible Martian Tree Structures

Biography: A senior majoring in computer science at Ohio University, Zion is interested in modeling chaotic systems where simple rules can produce highly emergent behaviors. Their past projects include a boids flocking simulation using octrees, a galaxy generator that utilized B-H trees and orbital physics, and a database that makes housing records publicly searchable. Outside of programming, Zion enjoys building mechanical keyboards and flying stunt kites.

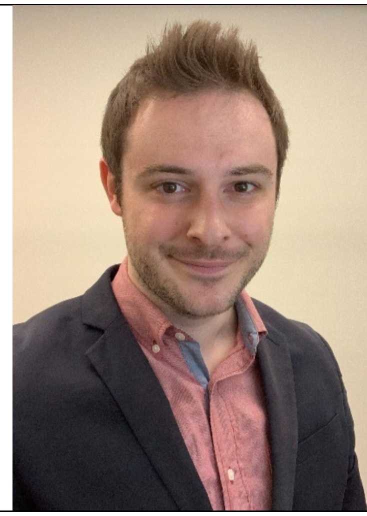
Abstract: This evolutionary algorithm utilizes an L-System grammar as its genome and takes environmental factors such as light and gravitational effects on the growth of woody trees into account to generate plausible tree species that could evolve from Earth plants in a terraformed Martian environment. This algorithm repeatedly generates trees using a set of L-System Genomes and then rates them on the amount of net "energy" they have for producing seed. This is calculated as a difference between the amount of light energy that the tree is able to collect with its leaves and the energy cost of growing. Trees that are more reproductively successful will make up a larger portion of the subsequent generation. Each generation will also introduce random mutations to the L-System Genomes, and apply a small reproductive penalty to genomes that have remained dominant for multiple generations. These will add variation to the gene pool and prevent a "cheap" and "safe" genome from dominating for more than a few generations respectively.

Publications: None yet.

15	Steve Stivers

Cleveland State University

Tanner L. Larson



Senior, Chemical Engineering
Advisor(s): Geyou Ao, Ph.D.

Thermally Conductive and Lightweight Composite Materials Designed with Hexagonal Boron Nitride Nanosheets

Biography: Raised in Cleveland, Tanner Larson is currently an Undergraduate student who is also enrolled in the 4+1 accelerated Master's Program in Chemical Engineering at the Washkewicz College of Engineering, Cleveland State University (CSU). Tanner has worked as an undergraduate research assistant in the Bio-Nano Materials lab at CSU since 2019 under the guidance of Dr. Geyou Ao. Tanner has also participated in the I-Corps@Ohio program in 2020 as an entrepreneurial lead of the team to evaluate critical market and commercialization associated with a specific technology developed in the BioNano Materials lab. He is also a member of the Tau Sigma National Honor Society, the Tau Beta Pi Engineering Honors Society, and the American Institute of Chemical Engineers (AIChE). After graduation, he plans to pursue a career in chemical engineering with a focus on energy storage and heat management systems. Outside of schoolwork and research, Tanner plays men's club volleyball for CSU and serves as president of Cleveland State's Zeta Upsilon Chapter of Tau Sigma.

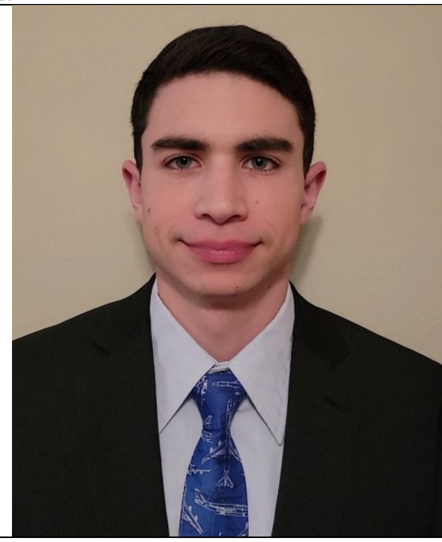
Abstract: Hexagonal boron nitride (hBN) nanosheets are lightweight (density ≈ 2.12 g/cm^3), twodimensional nanostructures that are mechanically robust and have superior thermal and chemical stabilities. These properties are desirable for many applications, such as developing advanced composite materials for equipment protection and efficient heat management. Particularly, the high thermal conductivity of hBN nanosheets (i.e., 360-600 W/mK), which is similar to that of copper (ca. 390 W/mK), coupled with its electrical insulating property is unique for developing certain thermal management applications that require thermally conductive and electrically insulating materials. To be able to utilize the superior properties of hBN nanosheets, high quality dispersions within a wide range of solvents are necessary. In this work, we will develop methods to produce hBN dispersions with improved quality and yield in various solvents, such as water, alcohol, and dimethyl sulfoxide, through ultrasonication with the assistance of varying dispersing agents such as DNA, natural polysaccharides (e.g., pectin), and synthetic glycopolymers. Liquid dispersions of hBN will enable us to produce solid assemblies of films and polymer composites utilizing industrially viable liquid phase processing techniques. hBN dispersions will be characterized by UV-vis absorption spectroscopy and Tyndall effect that demonstrates distinct light scattering by suspended colloids. Solid hBN assemblies will be characterized by scanning electron microscopy and mechanical testing. This project will lead to the design and manufacturing of strong and thermally conductive films and composite materials, which can be potentially utilized in high temperature and hazardous environment as well.

Publications: Khoury, J.; Vitale, J.; Larson, T; Ao, G. Boron nitride nanotubes enhance mechanical properties of fibers from nanotube/polyvinyl alcohol dispersions. Nanoscale Advances, 4, pp. 77-86, 2022

11	Marcia Fudge

UNIVERSITY OF Cincinnati

Sebastian Lemieux



Senior, Aerospace Engineering
Advisor(s): Dr. Kelly Cohen

Quadcopter Stability Varying Arm Dihedral and Motor Twist

Biography: Sebastian Lemieux is a 4th year Aerospace Engineering student at the University of Cincinnati. Sebastian was well traveled as a military child having gone through multiple high schools where he gained an interest in engineering through the PLTW program. He also began flying RC quadcopters and airplanes as a hobby, which allowed him to intertwin his passion with engineering through UAV research. At UC Sebastian spends his time in AFROTC to gain a commission in the USAF upon graduation, gaining flight hours and developing leadership skills. Through UC, Sebastian has had cooperative education experiences at companies like Barnes Aerospace and Altec. More recently he assisted in undergraduate research at UAV Master Labs working on unmanned systems under Dr. Cohen. Sebastian's work at the lab has included obtaining his Part 107 unmanned civil license, flight testing small unmanned aerial vehicles, and work on large scale multirotor and fixed wing platforms under 55 lbs.

Abstract: The goal of this project is to evaluate the effects that arm angle and motor twist have on the flight stability of a multirotor. Many commercially available Unmanned Aerial Systems (UASs) incorporate some amount of angle on their motor arms to improve dynamic stability in varying flight conditions. To improve the stability and yaw authority of a conventional quadcopter, this research seeks to make discrete changes in motor position by varying motor twist and motor arm angle relative to the main quadcopter body. This will change the thrust vector of each motor relative to the quadcopter body to allow for greater control authority in roll, pitch, and especially yaw. The small UAS used in this research will utilize a custom designed aluminum arm mount that allows for 5-degree angle changes to the angle of the platform's tube arms. Both the angle of the motor arms on the quadcopter and twist of the motors on each arm will be changed in a design of experiments to evaluate the combined effects on stability and controllability. First, Ardupilot's autotune is used in each configuration to obtain an optimal tune of the flight controller. Next, autonomous evaluation flights are flown to gather stability data in as consistent flight conditions as possible. Gyro data, accelerometer data, and desired versus actual rates are then compared from each flight log and used to quantify both the stability and the level of controllability of the UAS. The results of this research may hopefully provide insight to the effects of these changes on a quadcopter's motor position and be implemented to create a UAS with more robust stability.

Publications: None yet.

10	Michael Turner

Daniel Lipec

Senior, Computer Science
Advisor(s): Dr. Chad Mourning

A Three-Dimensional Virtual Depiction of the Errors of the Major Global Navigation Satellite System Constellations

Biography: Daniel Lipec is a senior at Ohio University, majoring in Computer Science with a minor in Mathematics. He grew up in Mentor, OH where he developed an early interest in computing. In high school, he began to explore this interest by taking web development and computer science classes which ultimately solidified his decision to pursue higher education in the field of Computer Science. After graduation, Daniel hopes to pursue a master's degree in Computer Science before working in the medical sector.

Abstract: Global Navigation Satellite Systems (GNSS) are vital in the modern world. The most common GNSS constellation is the Global Positioning System, or GPS that is used commonly in the United States. However, many other constellations exist, this project will focus on GPS, Galileo (European Union), GLONASS (Russia), and BeiDou (China). Most phones in the US use multiple constellations to determine a more accurate position, but no constellation is 100% percent accurate, nor are constellations created equal.

The goal of this project is to help visualize the scale of the errors of the positions received from each of these four constellations. Data will be gathered from a set of GNSS receivers located at the Ohio University Avionics Engineering Center which record position data from each constellation every second. This data will then be visualized in three-dimensions, so it is easier to understand how far off the received position from the constellation is from the true position of the receiver.

This tool will not only be able to show live data, but also archived data since the beginning of the receiver's data collection. This is especially useful to identify and see how anomalies such as solar flares affect our GNSS constellations, as well as which constellations handle these anomalies with less disruption.

Publications: None yet.

14	David Joyce

Alexandra P. Mangel

Senior, Aerospace Engineering
Advisor(s): Dr. Mrinal Kumar

Trustworthy Analysis of Recent Debris Cloud Conjunction Events Using an Adaptive Monte Carlo Forecasting Platform

Biography: Alex is a senior at the Ohio State University, pursuing a degree in Aerospace Engineering, with plans to graduate in the spring. Her research interests are in flight vehicle control and autonomy, as well as the intersection between robotics and astronautics. She intends to pursue a PhD in the same field, utilizing mathematics and dynamical modeling to guide spacecraft to interact with their environment. Her previous work has investigated the optimization of small unmanned aerial vehicles, and her current work uses the adaptive Monte Carlo algorithm to monitor potential close-approach events in geosynchronous orbit to determine risk of collision. Outside of research work, Alex is the president of Ohio State's Amateur Student Radio Organization, which broadcasts online daily and hosts numerous events for the Columbus music scene.

Abstract: Every untracked, inactive, or unfamiliar object in Earth's orbit poses a risk to satellites and rockets that wish to safely navigate through space. Objects of this nature, known as "space debris", will remain in orbit without deliberate intervention. The purpose of this project is to perform a highly accurate retrospective analysis of a certain outstanding close-approach event (also known as a conjunction event) that occurred in the geostationary belt. It is expected that the successful completion of this work will result in a trustworthy prognostics tool that can help minimize, or even eliminate, such risk in the future. Events related to candidate resident space objects were considered, and the 2016 Briz-M rocket body explosion was chosen as the particular event of interest. By appropriately modeling the motion of such candidates through astrodynamics analysis and adjusting the initial conditions to reflect sensor precision, a recently developed Adaptive Monte Carlo method, a MATLAB-based forecasting platform, can be employed to propagate a particle cloud representing the object's orbit over time. The completion of this project will validate the methods used, while simultaneously reducing the risks of collision and damage in similar events in the future.

Publications: VanFossen A., Mangel A., Kumar, M., "Efficacy of Parallelization in Adaptive Monte Carlo for Forecasting in GEO", AIAA Sci-Tech Forum, 2022, 3-7 January.

11	Marcia Fudge

Jacob G. Mansell

Junior, Neuroscience
Advisor(s): Dr. Clare Mathes, Ph.D.

Correlations between Alcohol Preference and Hormone Profiles after Roux-en-Y Gastric Bypass Surgery in a Female Rat Model.

Biography: Jacob Mansell is a junior at Baldwin Wallace University pursuing a bachelor's degree in neuroscience. Jacob is currently following the pre-med track required to apply to medical school. After suffering from an unexpected life event, it influenced him to study neuroscience and pursue medicine. During high school, he underwent urgent brain surgery that resulted in the absence of most of his senior year. During this scary time, his medical team mentored and motivated him to pursue the ever-changing field of neuroscience. Growing up, he always wanted to go into a profession where he could directly impact society. After persevering through such a terrifying surgery, he wants to inspire children that medicine is never out of reach, no matter what conditions they develop or are born with, just as his Neurosurgery team had done for him. In addition to research at Baldwin Wallace University, Jacob worked on the front lines during the Covid-19 pandemic as a phlebotomist and a member of the hospital's emergency response teams. This strengthened his passion and reinforced a strong work ethic to achieve his goals in pursuing a rewarding career in pediatric neurosurgery.

Abstract: Bariatric surgery is a weight-loss procedure with proven effectiveness reserved for obese individuals and/or individuals who have obesity-related co-morbidities. Even though women are more prone to obesity and related co-morbidities than men and 80% of bariatric surgery patients are female, there is a paucity of research featuring female models. Thus, the surgery's effects on the behavior and physiology of female organisms are much less understood. Therefore, the purpose of this study is to explore the effects of Roux-en-Y gastric bypass (RYGB) surgery on reproductive cyclicity (experiment 1), ethanol preference (experiment 2), and ghrelin levels (experiment 3) in a female rat model. Experiment 1 aims to assess if a high-fat and -sugar diet induces irregular estrous cycles akin to some symptoms of polycystic ovarian syndrome and if RYGB surgery would alleviate this. Experiment 2 seeks to assess how RYGB surgery alters the preference between water and low concentrations of ethanol. Lastly, experiment 3 will conduct a hormonal analysis to identify ghrelin levels after RYGB surgery and how this correlates with ethanol preference.

We induced weight gain and disturbances in glucose metabolism by feeding female rats a high-sugar, high-fat cafeteria diet; however, the diet did not induce insulin resistance or persistent estrous. We continued with the RYGB and sham operations, and we found, as expected, that RYGB surgery in female rats decreases body weight and restores glucose metabolism. Further, the cycles of female rats given RYGB did not differ from those given a sham operation. We have completed the postsurgical assessment of ethanol preference, and those data are currently being analyzed. We euthanized and took blood from the rats and will run the plasma using enzyme-linked immunoassay (ELISA) to measure the active (acylated) ghrelin levels. In addition, we plan to assess Leap2, which is a recently isolated endogenous ligand of the ghrelin receptor that has the opposing effect. After determining differences in levels between surgical groups, we will correlate the hormone levels to degrees of alcohol preference exhibited in the prior study aspect. These measures and analyses will be performed in conjunction with collaborators at The Johns Hopkins University School of Medicine who have expertise in these techniques.

Publications:

- MIDBRAINS: Midwest Regional Neuroscience Conference 2021
- Baldwin Wallace University's Computing Engineering Mathematics Science showcase 2021

7	Bob Gibbs

David Marshall

Senior, Mechanical Engineering
Advisor(s): Dr. Mo Samimy, Dr. Nathan Webb

Experimental Determination of Convective Velocity through Wavenumber Analysis

Biography: David Marshall is a senior mechanical engineering major at the Ohio State University. David grew up in Duxbury, Massachusetts and didn't have much exposure to math or science during his time in school. It wasn't until freshman year of college that David discovered the field of engineering. Math and science had been his weakest subjects up to that point in his life, but David wanted to turn his weakness into strengths and decided to pursue a degree in mechanical engineering as he knew that it would provide the best opportunity to garner skills and ultimately mastery in those areas with the hope that one day he would become a well-respected engineer. David joined the Gas Dynamics and Turbulence at Ohio State's Aerospace Research Center in August of 2020 after taking an interest in research and fluid mechanics from courses he took. After graduation David plans to pursue a master's degree to continue to gain mastery of his discipline.

Abstract: Advanced tactical aircrafts are increasingly using non-axisymmetric, often rectangular, twin supersonic jets due to many advantages they provide over axisymmetric designs such as minimizing drag (since aft bodies are typically non-axisymmetric) and reductions in weight. However, one disadvantage of twinjet configurations is that they can lead to significant increases in near-field pressure fluctuations that can potentially result in structural fatigue and failure. As such, the over-arching purpose of our research is to better understand the physics behind these pressure fluctuations and establish active flow control over the twin supersonic jets using localized arc-filament plasma actuators (LAFPAs) to perturb the flow in such a way as to mitigate these fluctuations. One step in establishing active flow control is to construct an analytical model that predicts certain parameters which will be used to both model the system’s response given certain inputs and provide better understanding of the flow physics. An important parameter that we need to find to corroborate our model’s predictive accuracy is the screech frequency. Given that the flows are supersonic and shocks are present (meaning the nozzles are not ideally expanded and have sharp throats) there will also be the presence of jet screech which are caused when the large scale structures (LSS) shed from the jet nozzle interact with the shock cells, thus forming feedback waves which trigger the formation of more structures. The focus of this study is to empirically determine the convective velocity of the LSS since convective velocity is an important parameter of the model used to predict the system's response to particular control conditions. To empirically determine convective velocity, we generated St-k plots from experimental schlieren images of the flow at Mach numbers ranging from 1.25 to 1.90. This study resulted in the empirical determination of the convective velocities from all tested Mach number cases.

Publications: None yet.

3	Joyce Beatty

WILBERFORCE UNIVERSITY

Derek McGee

Senior, Electrical Engineering
Advisor(s): Jennifer Williams, Ph. D.

Engineering Perovskite Solar Cells

Biography: I am currently a senior Electrical Engineering major at Wilberforce University with a Bachelor of Science degree. My journey to become an engineer was inspired by my passion for working with automobiles and electronics. After I graduate, I plan to work for a major electrical company such as Lincoln Electric or a major laboratory research facility like NASA. This is for the first 10 years, or until I can initiate my own business that utilizes my intricate engineering background.

Abstract: Thin-film perovskite photovoltaic (PV) devices have the potential to reduce the cost of space ready PV cells 100 fold. To date perovskite solar cells (PSC) have reached power conversion efficiencies (PCE) exceeding 25%, while newer tandem perovskite devices have PCEs that surpass commercially available silicon photovoltaic devices, currently at 26%.1 Furthermore, inexpensive perovskite liquid precursor inks, paired with simplified deposition techniques and flexible substrates illuminate the potential for full automation and in-space fabrication of solar materials. Several challenges remain before commercial use. Herein, fabrication methods used to develop PSCs are evaluated to determine the process of perovskite degradation. Six different commonly used perovskite substrates coated with popular perovskite precursor ink, MAPI (methyl ammonium lead iodide), were produced and degraded via extreme temperature and e-beam irradiation experiments. It is hypothesized that e-beam excitation via Scanning Electron Microscopy (SEM) can be used to simulate 60Co gamma irradiation.2 Analysis of MAPI thin films pre and post irradiation will be essential to unveil the mechanism of degradation of PSCs.

Publications: None yet.

11	Marcia Fudge

Austin L. McKibben

Senior, Computer Science
Advisor(s): Dr. Sabrina Ugazio

Bobcat-1 CubeSat Operations

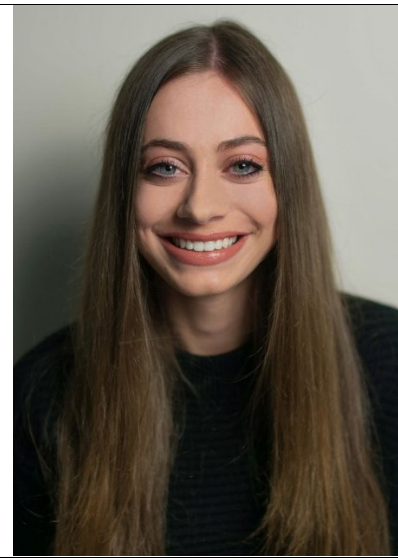
Biography: Austin McKibben is currently an undergraduate at Ohio University majoring in computer science with a minor in business administration. During his freshman year, he was hired at the Avionics Research Center at Ohio University and has worked there for three years. During those years, he has participated in many avionics projects, mostly relating to the application of GNSS receivers in infrastructure monitoring. He has also been involved in the operation of Ohio University's CubeSat, Bobcat-1. In the future, he hopes to continue his education in aerospace and expand his research opportunities.

Abstract: Bobcat-1 is the Ohio University CubeSat developed at the Avionics Engineering center and launched and deployed in October and November 2020, respectively. Its core mission was to test the feasibility of using Low Earth Orbit (LEO) satellite to accurately measure the time offsets between Global Navigation Satellite Systems (GNSS) in the Space Serial Volume (SSV). Bobcat-1 is still in operation and must be managed until the CubeSat is no longer operational. The CubeSat has surpassed its life expectancy and the opportunity for more and possibly better data has presented itself. The more data that is available from Bobcat-1, the better the timing offset estimation accuracy will be.

Publications: None yet.

6	Bill Johnson

Victoria Messuri



Junior, Biochemistry and Chemical Engineering
Advisor(s): Dr. Byung-Wook Park

Electrochemically Regulated Smart Wound Dressing For Controlled Drug Delivery

Biography: Victoria is currently a third-year undergraduate student at Youngstown State University dual majoring in Biochemistry and Chemical Engineering. She hopes to continue her academic studies in biochemical or biomedical engineering and pursue a career in the pharmaceutical research field with a focus on cancer treatment. Victoria is involved in several organizations and clubs at YSU, including the Honors College, Chem-E-Car, The American Institute of Chemical Engineers, Tau Beta Pi, Phi Kappa Phi, and Pi Mu Epsilon. In high school, she was a member of the golf team and played alto saxophone in marching and concert band. Additionally, Victoria is active in her community with volunteer work and enjoys traveling and exercise.

Abstract: The skin represents the largest organ of the human body and acts as a barrier to microbial threats. Conventional wound dressings deliver drugs based on passive diffusion, which is relatively easy to incorporate into the dressings. However, the main drawback of passive methods may be a lag time in drug release incurred with negative influences on rapid onset drugs. To develop a new treatment that would be more efficient and effective, we are designing a smart wound dressing that is responsive to a stimulus. Controlling the release of therapeutics can minimize side effects and enhance the efficiency to treat the wound sites. The smart wound dressing is a transdermal patch device capable of loading therapeutics and allowing for their controlled release. Hydrogel is integrated into the smart wound dressing. Polyelectrolyte complexes (PECs) are a hydrogel formed when a pair of opposite charged polyelectrolytes are mixed in an aqueous solution, which is a good candidate for a smart wound dressing due to its flexibility, biocompatibility, and ability to have a high-water content. We have currently used different ratios of alginate to chitosan polyelectrolytes for our control experiment and have tested its passive diffusion of the model drug FITC-dextran on agarose gel: referred to as phantom skin. Ferrocene (Fc)-containing macromolecules have attracted considerable attention in controlled drug delivery, due to the reversible redox conversion such as neutral/cationic conditions. In this project, the ferrocene will be used to modulate the PEC hydrogel stability as redox-responsive units. The electrochemically regulated smart wound dressing, developed by incorporating Fc-containing PEC hydrogel, will be integrated in a portable/personal device, which will be potentially applied for future astronauts who may need a wound treatment during their missions.

Publications: None yet.

6	Bill Johnson

Brooke N. Meyer

Junior, Mechanical Engineering
Advisor(s): Jed E. Marquart, Ph.D., P.E.

Improvements in Airbreathing Propulsion Systems

Biography: I am currently a Junior at Ohio Northern University and will graduate in May of 2023 with a B.S. in Mechanical Engineering. I am originally from Ottawa, Ohio. My hobbies include hanging out with friends and family, kayaking, four-wheeling, and doing anything outdoors. So far at Ohio Northern, I have served as treasurer and logistics manager for the AIAA competition team and am a member of the SAE Baja team. I also had the opportunity to travel to Florida with the Aero team and compete with our RC airplane at the 2020 SAE Aero Design East Competition. After graduation, I plan on starting my career and entering the workforce.

Abstract: The goal of this research is to analyze airbreathing propulsion and look at different methods to improve airbreathing propulsion for future vehicles. Airbreathing propulsion is commonly used in jet engines where air enters at the front and is pushed out of the back of the engine to create thrust. The air that enters the engine is compressed by a fan, combined with fuel, and combusted. This is then pushed out of the back of the engine as a high-speed exhaust creating thrust. Possible improvements of this method involve efficiency, noise, cost, emissions, and performance.

Publications: None yet.

5	Robert Latta

Tyler Motzko

Junior, Mechanical Engineering
Advisor(s): Dr. Mitch Wolff

Frost Deposition on Flat Plates

Biography: Tyler Motzko is currently studying Mechanical Engineering at Wright State University. Tyler plans to continue his education and pursue a Master's Degree in Mechanical Engineering. Tyler grew up in the small town of West Liberty, Ohio. Love for engineering was cultivated from a young age and grew as Tyler participated in Science Olympiad in middle school and high school. Tyler would like to pursue a career involving the design of mechanical components.

Abstract: The icing phenomenon is commonly experienced in heat exchangers and the wings of an airplane. In both cases, icing is a negative phenomenon; therefore, icing must be understood so that it can be compensated for or prevented. A key part of this is understanding how the frost layer grows on a surface, the density of the frost layer, and the thermal conductivity of the frost layer. Expressions for these are presented in several papers found throughout literature. Having these expressions in an easy-to-use program, like MATLAB, would be extremely beneficial. This MATLAB program could be used to predict frost deposition. The program inputs can be changed depending on the experiment parameters. This allows for more accurate predictions which can be used in various design considerations, like heat exchangers or airplane wings, where the predictions may be useful.

Publications: None yet.

4	Jim Jordan

CEDARVILLE UNIVERSITY

Stuart Nowery

Junior, Mechanical Engineering
Advisor(s): Dr. Thomas Ward

Development of Static Test Stand for Nasa Student Launch Team

Biography: Stuart Nowery grew up in Lebanon, Ohio where he attended and graduated from Lebanon High School summa cum laude. Stuart achieved the rank of Eagle Scout in his local scout troop. Growing up, he always had a knack for all things mechanical. He enjoyed building small drones and an electric skateboard. As this passion grew, Stuart delved into gaining experience in the world of additive manufacturing. Stuart now attends Cedarville University and is pursuing a degree in Mechanical Engineering. At college, Stuart joined Cedarville University's NASA Student Launch Team where he is designing the rocket test stand and aiding the team in 3-D modeling among other things. In his free time, he designs, manufactures, and sells 3D-printed parts to help pay for his education. Stuart is now a student member of the ASME Society. Stuart is currently applying to internships to gain even more hands-on experience. After graduation (May 2023), Stuart plans to work in the space exploration or automotive industries.

Abstract: The goal of the static test stand development is to create an inexpensive yet incredibly safe, versatile, and strong structure for testing both the required sub-scale and full-scale rockets being created for Cedarville University's NASA Student Launch Team. Tasked with meeting many criteria specified by NASA, the team's goal is to create a sub-scale rocket for testing purposes and a full-scale rocket capable of reaching altitudes between 4000 and 6000 feet. Using student-designed control systems, the full-scale rocket will reach a predicted apogee altitude. Additionally, the rocket must be able to track its own position to allow the team to identify the rocket on a grid at competition without the use of a global positioning satellite system.

The ability to create a rocket capable of meeting NASA's performance requirements results in and a long list of variables that must be known. This is where a static test stand proves to be useful, allowing the team to perform several tests and reduce the number of unknown factors. One among many of these factors is the provided manufacturer data for the thrust curves of the desired rocket engines. Knowing the experimental thrust versus time curve for comparison to manufacturer data will allow for more precise predictions of altitude and corrections by the active control systems onboard the rocket. The stand is chiefly designed and manufactured by Stuart to be compact with a low part count and capable of securing both the sub-scale and full-scale rockets.

Publications: None yet.

1	Steve Chabot

Natalie S. Richards

Senior, Mechanical Engineering
Advisor(s): Dr. K.T. Tan

Design of Single Lap Adhesive Joints Using Machine Learning Approaches

Biography: Natalie Richards is a Senior at The University of Akron from Louisville, Ohio. In high school she found her interest and passion for math and science. While at The University of Akron, she participated in the Co-op Education Program spending two semesters working for Swagelok in areas of product engineering and research as well as one semester at Goodyear working in design and testing. She was on the Akronauts (student rocket design team) for two years and is currently the CEPS Head Tutor, President of Engineering Student Council and a member of Tau Beta Pi. She has accepted a full time position at Goodyear at the Akron Test Facility where she looks forward to starting her career testing tires for aerospace applications including commercial planes, fighter jets, and NASA rover tires.

Abstract: Adhesively bonded joints have high structural efficiency and are used to join composites in advanced aerospace structures. These joints are becoming increasingly popular in the aerospace field due to the fact they are lightweight and able to distribute a load over a much wider area than mechanical joints. One of the most common types of adhesively bonded joints is the single lap joint because they offer a range of advantages including time and cost savings, better damping coefficients, higher strength, etc. The relationships between the variables that make up this adhesive joint are complex and non-linear, bringing difficulties in predicting the damage. The goal of this project is to create an Artificial Neural Network using Python as the language with a Keras interface and Tensorflow backend to accurately predict the failure load of the joint and optimize its design using any input data. This will also allow for a further understanding of the relationships between the parameters.

Publications: None yet.

7	Bob Gibbs

Anthony Romeo

Senior, Chemical Engineering
Advisor(s): Dr. Byung-Wook Park and Dr.Cortes

Wearable Hydrogel-Based Biosensor Fabricated by Laser Direct Writing for Detection of Cortisol

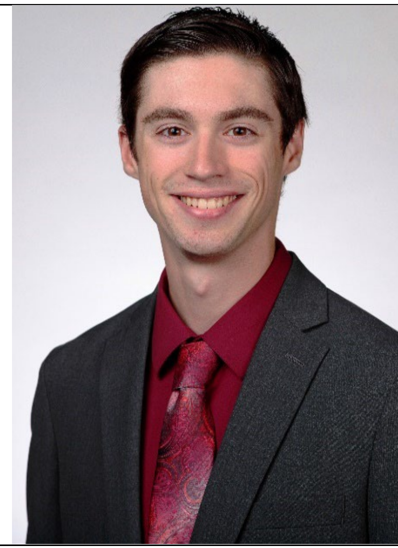
Biography: Anthony is a graduating senior of Youngstown State University with a Chemical Engineering major and a minor in Chemistry and Mathematics. He was born in Struthers, Ohio. Anthony has been very passionate in and a part of many research projects as an undergraduate and has presented his works in the AIChE national conference in Boston, Wright Patterson Air Force base, Kent State University, Cleveland State University, Cuyahoga Community College and Youngstown State University. Additionally, Anthony is a member of Alpha Phi Delta Fraternity. He serves as Philanthropy chair and has coordinated thousands of hours of volunteerism throughout his community and was named Outstanding Fraternal Organization for Philanthropic Service by Youngstown Awards Program in 2019. One of his proudest moments was raising over $5,000 for children miracle network hospitals by creating virtual DJ livestreams and gaming with his chapter for the kids.

Abstract: Wearable sensors have attracted much attention thanks to their promising applications in personalized medicine through remote monitoring of physiological parameters. Cortisol is a biomarker for numerous diseases and is important for blood pressure regulation, glucose levels and metabolism. The current project is to create a flexible, wearable biosensor to detect cortisol in body fluid by skin contact with the sensor. A laser-assisted processing technique is used to produce laser-induced graphene (LIG) by direct laser writing with a carbon dioxide laser on carbon materials. For non-invasive extraction of biomarkers, a hydrogel layer is incorporated onto the electrode surface. An antigen-antibody interaction is fabricated to take place on the working electrode to detect cortisol via surface chemistry. Both cyclic voltammetry and electrochemical impedance spectroscopy are used to characterize the modified electrode and detection of cortisol. Specifically, the characterization will consist of detection limit, selectivity, sensitivity, response time, and linear range. Using 3D printed wristbands and wireless communication devices, it will be possible to monitor personnel in real-time during any sort of situations including long-term exposure to space environments, flight preparations, sleeping and take-off.

Publications: Singh, A. V., Romeo, A. (2021). Emerging technologies for in vitro inhalation toxicology. *Advanced Healthcare Materials*, *10*(18), 2100633.

13	Tim Ryan

Ryan R. Sauder



Senior, Mechanical Engineering
Advisor(s): Jed E. Marquart, Ph.D., P.E.

Exploration of Laser Induced Graphene Capacitors As a Possible Energy Storage Means

Biography: I am a senior at Ohio Northern University where I will graduate in May 2022 with a BSME, an applied math minor, and an aerospace concentration. I have always been interested in aerospace technologies ranging from materials to propulsion and colonization. Outside of the classroom I enjoy building things and learning new manufacturing techniques. From programming, to blacksmithing and machining, I have used my hands-on experience to solve engineering challenges in the most efficient way possible. At Ohio Northern University I have been a member of the Society of Automotive Engineers Baja team for all four years. Over the course of my time as a member of the team I have served as both the team's treasurer and president. The skills that I have learned throughout my time at ONU served me well during the summer of 2020 when I completed a summer internship at NASA Glenn measuring ion plumes to support ion engine materials research. After graduation this spring, I hope to start a career in the aerospace industry working to solve the new problems that face a society that is constantly innovating.

Abstract: Electricity has becoming an increasingly important aspect of modern space craft and satellites. There are two primary means that electricity is generated for these missions. First, a radioisotope thermoelectric generator (RTG) generates power for long periods of time using a radioactive heat source. Another common means is to use solar cells. These cells generate energy from the sun and store this power in batteries. For missions that are staying close to Earth, more traditional battery technology, such as Lithium Ion batteries are adequate. However, for long range mission such as traveling to Mars, or long time frame missions such a base on the moon, a more robust means of energy storage should be explored. This is because on these longer missions the batteries experience many charge/discharge cycles and degrade over time. To overcome this, the use of laser induced graphene to create a bank of energy storage capacitors will be explored.

Laser induced graphene is a process of exposing a polyamide film to low power laser light under normal atmospheric conditions. This causes the film to decompose into a layer of graphene. Using a computer controlled laser, the pattern that the graphene takes can be precisely controlled to create capacitors. These capacitors can then be chained together to increase the total energy stored and create a small electrical power storage system. To be functional, the time that this system holds a charge will be maximized. Since capacitors operate on the simple principle of stored electrical charges they are able to be cycled many times without any degradation in performance, and thus are optimal for the next generation of space travel.

Publications: None yet.

14	David Joyce

Abigail Schauer

Junior, Mechanical Engineering
Advisor(s): Dr. Jed Marquart

Investigation of Using Indirect Clues to Solve Accident Investigations

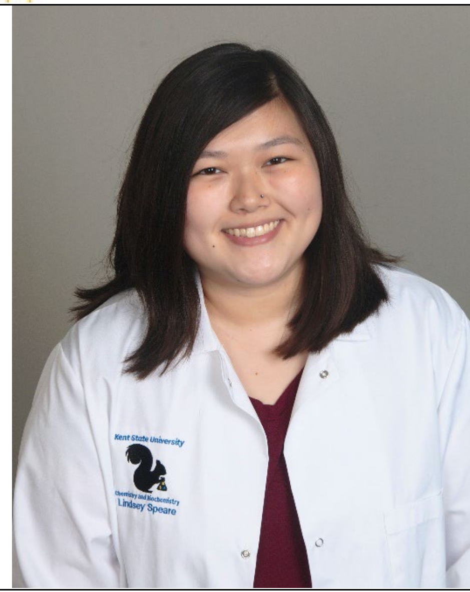
Biography: Abigail Schauer is a Junior at Ohio Northern University studying Mechanical Engineering with a concentration in Aerospace. She is a design lead for ONU's American Institute of Aeronautics and Astronautics (AIAA) chapter that designs remote control planes for competition. She is also a coordinator for the peer mentoring program, a member of the President's club, and on the varsity swim team. She has always been interested in the safety of engineered products and hopes to use her degree to improve the safety of flight.

Abstract: Air travel is heavily integrated into the modern world with continued trust in safety and reliability as a vital component of the system. When accidents happen, the cause must be quickly and accurately assessed and addressed. With many components contributing to an incident, authorities and industry must be able to decipher wreckage on the ground, evaluate human factors and the physical environment to determine the root cause, or causes. This paper will focus on the methods used in this process such as analyzing the final position of motors, reviewing the Flight Data Recorder (FDR), and rebuilding the scene.

Publications: None yet.

10	Michael Turner

Lindsey A. Speare



Senior, Chemistry
Advisor(s): Dr. Michael Tubergen

Investigating CO_2 Capture Complexes Using Microwave Spectroscopy

Biography: I am currently a senior at Kent State University, majoring in Chemistry with a minor in Physics. I was born in Suwon, South Korea and was adopted to the United States when I was six months old. I grew up in Stow, Ohio, where I attended Stow Munroe Falls High School. In my senior year of high school, I was accepted into the college credit plus program at Kent State, which is where I found my love for chemistry. In 2019, I declared my major in chemistry and I got accepted into Kent's Research Experience for Undergraduates program. It was a rewarding experience, which piqued my interest in research. Receiving the OSGC scholarship in addition to that is truly phenomenal. I am thankful to be able to gain more experience and to contribute to environmental research, which is a goal of mine. After graduation, I will be pursuing my PhD in chemistry. I hope to focus on environmental or astrochemical research.

Abstract: Carbon dioxide is a greenhouse gas that is produced in many biological and anthropogenic processes. This type of emission contributes to global warming and at high concentrations it can be harmful. One way to reduce these emissions is to trap CO_2 with amine containing molecules ($R\text{-}NH_2$), however, the mechanism behind this complex remains unresolved. It is suspected that a strong base, like 2-aminoethanol or KOH, can absorb carbon dioxide by forming a zwitterion. This stabilizes the complex enough until another base in solution can deprotonate it, capturing the molecule. In this investigation, a jet-cooled Fourier transform microwave spectrometer will be utilized to study the capture of CO_2 in the gas phase. This will determine the structure of the complex and assist in providing a detailed mechanism. Before carrying out experiments, high level quantum chemical and *ab initio* calculations have been performed to obtain the rotational constants, centrifugal distortion constants, and nuclear quadrupole coupling constants of all possible amine-CO_2 complexes.

Publications: None yet.

14	David Joyce

Aubrey Strong

Junior, Molecular Biology
Advisor(s): Dr. Kaleb Pauley

microRNA Differential Expression in Glioblastoma

Biography: Aubrey Strong is a Junior Molecular Biology student at Cedarville University and will graduate in May 2023 with her Bachelor's in Science, as well as a minor in Spanish. She is from Westfield, Indiana and developed a love of science in high school through participation in Project Lead The Way's biomedical science program. During her four years at Cedarville University, Aubrey has worked as an EMT, participated in a mentorship group and choir, and volunteered as a tutor, soccer coach, and Spanish interpreter. Upon graduation, Aubrey plans to pursue a PhD degree in neuroscience or cancer with hopes to continue research and teach at the collegiate level.

Abstract: Glioblastoma is an aggressive type of brain cancer, leaving patients with an average life expectancy of 15 months from the time of diagnosis. MicroRNAs are small, non-coding segments of genetic material that play a role in gene expression, and influence the development and progression of many diseases, including cancer. Understanding the relationship between microRNA expression and Glioblastoma could lead to the development of miRNA targeted therapies or better diagnostic methods to improve patient outcomes.

To look at this relationship of microRNA expression in Glioblastoma, a series of procedures were followed to measure the concentration of microRNAs in a sample of RNA from the U87 GBM cell line. qRT-PCR is a tool used to amplify a desired sample of DNA and measure the concentration of the genetic material. In this experiment, RNA isolation and qRT-PCR protocols were used to extract RNA from Glioblastoma cells and measure the cycle numbers of experimental microRNAs (miR-145 and miR-449). A standard curve was developed using miR-146a that compared the known concentrations of the miRNA samples to the cycle numbers. The equation [$f(x)=13.1-1.54\ln x$] formed by the standard curve was used to calculate the concentrations of miR-145 and miR-449 based on the experimental cycle numbers. In this experiment, the U6 control had a concentration of 5.0×10^{-2}nM. The average concentration for miR-145 was 7.2×10^{-5}nM, and the average concentration for miR-449 was 2.6×10^{-5}nM. MiR-145 was found at a higher concentration than miR-449 in the GBM cell line that was used for this study. Further research on the concentration of the microRNA concentrations in healthy astrocyte cells would provide a comparison to draw conclusions about the expression of these microRNAs and their effect on cancer.

Publications: None yet.

10	Michael Turner

CEDARVILLE UNIVERSITY

Andrew T. Swift

Junior, Geology
Advisor(s): Dr. John Whitmore

Megafloods on Mars: Geomorphology and Terrestrial Comparison of Marte Vallis

Biography: Born in Cincinnati, Ohio but later moved to Overland Park, Kansas, Andrew Swift is a junior geology major at Cedarville University. Since he was very young, he has always been fascinated with space and exploration with his sights set on Mars. In middle school, he was introduced to geology and has loved it ever since. He has participated and counseled in Kansas Cosmosphere summer camps as well as taken aircraft piloting lessons in between his studies focusing on planetary geology such as the moon and Mars. He loves doing many outdoor activities such as hiking, backpacking, camping, fishing, and especially field geology. An FAA-licensed commercial UAS pilot, he loves using drones for both commercial and academic use as well as a hobby. He has been awarded with performance awards in math and science in high school and the Honors program at Cedarville University as well as other performance-based scholarships. After graduation in 2023, Andrew hopes to attend graduate school continuing to study geology while serving part-time in the military as a pilot and work for either a federal or state geological survey using the field skills he has learned to contribute practical knowledge and service to his community and country.

Abstract: Marte Vallis is a largely understudied region in the Amazonis Planitia on Mars. The few studies on it so far have identified it to be an outflow channel carved by a catastrophic release of water from underground aquifers. The valley is around 600 miles long and some channels at least 230 feet deep. The petrologic composition of this area is mostly volcanic rocks and displays the first columnar jointing ever discovered on the Mars. This study will investigate what available digital resources there are from NASA, USGS, and other organizations and persons studying the geology of Mars to collect a history of the region and how the landscape has changed over Mars' long history. The geomorphology of Marte Vallis and its geological structures can be compared to certain areas on Earth that have experienced similar megafloods such as the Channeled Scablands in Washington, USA and hold crucial information that can help geologists and planetary scientists understand both Martian and Earth history. Suggestions for geological field studies and the locating of potential water sources will be discussed for future sustained living and manned exploration on the Red Planet.

Publications: Swift, Andrew T. "Geology and Mapping of Apollo Lunar Landing Sites." (2021) *Cedarville University Research and Scholarship Symposium 2021*.

10	Michael Turner

The University of Akron

Jakub Sychla

Junior, Aerospace Systems Engineering
Advisor(s): Kwek-Tze Tan

Additive Manufacturing of Light-Weight High-Strength Carbon Fiber Composites

Biography: Jakub Sychla is currently an undergraduate student studying Aerospace Systems Engineering at the University of Akron. He joined Dr. Tan's research group in January 2021. He is from Cleveland Ohio and found his passion for aviation from science fiction movies and wanting to progress humanity into that direction. While at the University of Akron, Jakub participated in the Co-op program working for Bowden Manufacturing as a manufacturing intern, and Delta Airlines as a propulsion intern in the test cell facility. Jakub is also very involved with the Akron Rocket Design Team where he is currently Structures System Manager, managing the vehicle design, flight dynamics, and manufacturing sub teams.

Abstract: Additive manufacturing of carbon fiber reinforced polymers (CFRP) provides the ability for rapid prototyping of complex shapes and geometries that traditional manufacturing methods of CFRP could not achieve. In recent years, there has been significant development and advancement in commercially available composite 3D printers that use fused filament fabrication (FFF) technique to fabricate CFRP. This paper aims to investigate the effect of printing parameters on the flexural performance of 3D printed CFRP using the Design of Experiment (DoE) analysis. CFRP specimens were fabricated using a MarkForged Mark II 3D printer, with several configurations being set up, each of which printed three specimens. The configurations were set to push the extreme limits of the controlled aspects for the rectangular fill pattern that was used, including fill density, roof and floor layers, and wall layers. Each sample consisted of twenty-four layers, and inner layers with continuous carbon fiber remained consistently angled at [0/90°] orientation. Results from flexural bend test (load, deflection, and flexural strength, showed that the roof/floor layers had the largest impact on the flexural strength. The configurations with less roof/floor layers were able to take on a larger load, due to the presence of more carbon fibers in the internal layers. However, those that had more roof/floor layers were able to withstand less load and found to be observably ductile, due to the reduction in the number of internal layers with continuous carbon fibers. Using DoE analysis, contour plot can be generated to predict flexural strength of various printing parameters. Flexural damages were further characterized using X-ray micro-computed tomography to correlate with strength values.

Publications: J. Sychla, C. Zhang, KT. Tan "Analysis of Printing Parameters in 3D Printed Carbon Fiber Composites Using Design of Experiments" 36^{th} ASC 2021

11	Marcia Fudge

Marcus Terry

Junior, Geology, Petroleum Engineering
Advisor(s): Dr. Andrew Beck

Constraining Olivine Abundance in Diogenite Meteorites

Biography: Marcus Terry grew up in the small farming town of McCutchenville, Ohio, in a farming and mining family. This upbringing steered Marcus towards his current pursuit of dual degrees in Geology and Petroleum Engineering at Marietta College, wherein he is completing his third year. During this time at Marietta College, Marcus has become involved in many organizations at varying leadership levels, including: the Society of Petroleum Engineers (SPE), the American Association of Drilling Engineers (AADE), the American Association of Petroleum Geologists (AAPG), the Geology Club, the Energy Business Alliance, and the Future Energy Producers of America (FEPA). In addition to club activities, Marcus has also been an acting Resident Assistant for two years, as well as a mentor and tutor for incoming students. Outside the school year, Marcus has participated in geologic and paleontological digs in Southern Utah and interned for Chevron the previous two summers in Houston, Texas and Bakersfield, California. He will again be completing an internship with Chevron in the Gulf of Mexico for the summer of 2022.

Abstract: Diogenite meteorites are ultramafic cumulate rocks, mainly composed of the mineral orthopyroxene, from the asteroid 4Vesta (Beck and McSween 2010). A subgroup of diogenites contains higher abundances of the mineral olivine, and the petrogenesis of this subgroup is debated, partially due to the uncertainty of the exact abundance of olivine (Beck et al. 2013, Mandler and Elkins-Tanton 2013). In this study, we will attempt to ascertain a more accurate olivine abundance in diogenites by determining abundance in multiple thin sections per meteorite. This data will be collected via thin section point counting on a petrographic microscope, and meteorite thin sections will be supplied by the NASA Antarctic Meteorite Program.

Publications: None yet.

5	Robert Latta

Kevin Tomlin

Senior, Materials Science and Engineering
Advisor(s): Dr. Henry Young

Investigation of $AgNO_3$ Sintering Aid for Nanosilver Particles

Biography: My name is Kevin, and I am currently a senior at Wright State University studying Materials Science and Engineering. I have been working as a student research assistant through SOCHE at WPAFB since June 2019. I work primarily with adhesives and composites; fabrication and testing composite laminates and adhesively bonded specimens to ASTM and industry standards. As a research assistant I have been able to refine my skills in CAD and professional machine drawings, as well as use of material extrusion additive manufacturing.

Abstract: Nanosilver particles are a potential bonding agent in electronics and die attach applications, where elevated temperatures are present. In this work, nanosilver particles were synthesized at Wright State University via reduction of silver acetate by ascorbic acid in a polyacrylic acid solution. The purpose of this experiment is to determine the effects of an $AgNO_3$ sintering aid added to the nanosilver powder in different weight% (0.0, 2.5, 5.0, 7.5, 10, 20). Mixtures of silver nanoparticles and AgNO3 were consolidated at 5 MPa of pressure for 20 minutes at 300°C. The density, microhardness, and microstructure were then evaluated. It is hypothesized that addition of the $AgNO_3$ will provide high-diffusivity pathways to enhance surface diffusion-based consolidation. The addition of $AgNO_3$ affects both the microstructure and its properties.

Publications: None yet.

8	Warren Davidson

KENT STATE UNIVERSITY

Naomi Wang

Academic Level, Major Senior, Computer Science
Advisor(s): Dr. Jong-hoon Kim

eXtended Reality based Telepresence Interface (XRTI) for xEMU in the AARON System

Biography: Naomi Wang is in her fourth year pursuing her Bachelor's Degree in Computer Science at Kent State University. Her interests are within the areas of robotics, human-robot interaction, and augmented reality. She is an undergraduate research assistant under Dr. Jong-hoon Kim in the Advanced Telerobotics Research lab, focusing on research incorporating augmented reality applications as assistive interfaces for human-robot interactions. She has plans to work in industry before returning to university for a graduate degree.

Abstract: As a part of the robot interface design aligning with the NASA Mission Directorate, this research aims to develop an eXtended Reality based Telepresence Interface (XRTI) for NASA's exploration extravehicular mobility unit (xEMU) in the AARON (Assistive Augmented Reality Operational and Navigation) System proposed by the ATR Flux team in NASA SUITS challenge 2020 and 2021. The XRTI system will allow an immersive hologram view of xEMU in the AARON System for telepresence operation and smart interactions between xEMU and astronauts. The extended immersive view will enhance the situational awareness and ease of operation for astronauts, as well as facilitate human-robot interaction. The interface will feature an intuitive design to surround the human supervisor within a virtual space and will be configurable to user preference for data monitoring, including both one-on-one and group interaction possibilities among members of a robot team. Currently, the XRTI system is focused on the implementation of a single column-shaped design in which the user experiences a wrap-around data display. The interface layout can be modified by the user with drag-and-drop functionality, which may further be expanded to include hand tracking interaction. The research expects outcomes of decreased cognitive workload for the robot supervisor, ease of data access and retrieval, and improved management of data in robot teams.

Publications:
N.Wang, J.Kim "eXtended Reality based Telepresence Interface for Multiple Robot Supervision", *The 13th International Conference on Intelligent Human Computer Interaction*, December 2021 {Accepted}

13	Tim Ryan

Joshua Ward

Senior, Mechanical Engineering
Advisor(s): Dr. Mitch Wolff

Optimization of a Scramjet Engine for Hypersonic Vehicle Design

Biography: Mr. Joshua Ward is currently enrolled at Wright State university in a dual degree program. Working towards a Bachelor's degree, with expected graduation this coming spring. After graduation I plan on continuing to graduate school to pursue a Master's degree. As a student I have participated in an internship at Wright Patterson Air Force Base performing materials research, prior to joining this project. I am currently the President of the Ohio Mu chapter of Tau Beta Pi, and look forward to continuing to grow this association.

Abstract: The design of hypersonic vehicles has been at the forefront of research since the use of the SR-71 back in the 1960's. The biggest issue facing this field today is the design of engines capable of producing enough thrust to maintain hypersonic speed. The computational fluid dynamics (CFD) used to calculate estimates for designs is rather expensive in some packages, and very computationally heavy. This leads to possible errors, and loss of appeal for some researchers. Prior to this project Dr. Ramana Grandhi of the Air Force Institute of Technology (AFIT) worked to develop a new form of CFD for scramjet engine design.

Using this code the goal is to optimize the design of a scramjet engine. Using component design, and CFD to calculate boundary conditions, temperatures, and pressures through the engine, and overall thrust is the function of this code. An optimization problem must be designed as to create the optimal design of the scramjet. To do this some variables must be designated, such as constraints, bounds, objectives, and initial conditions. The goal of this project is to create an optimization problem to design the ideal scramjet engine to use in the generic hypersonic vehicle (GHV) as designed by the Air Force.

Publications: None yet.

10	Michael Turner

WRIGHT STATE UNIVERSITY

Kaitlin Willi

Junior, Mechanical Engineering
Advisor(s): Dr. Ahsan Mian

Mechanical Characterization of Metallized 3D Printed Polymers

Biography: Kaitlin Willi is a Junior at Wright State University majoring in Mechanical Engineering with a minor in Communication Studies. During high school, she participated in the College Credit Plus program where she achieved her Associate of Science degree at Cuyahoga Community College. She is currently a member of Tau Beta Pi, Phi Theta Kappa, the Society of Women Engineers, and the Society of Mechanical Engineers. She has worked with small manufacturing firms to improve and streamline processes, lead non-profit projects, and help bridge the communication gap between white-collar and blue-collar workers. After graduation Kaitlin plans to work in a manufacturing setting where she can apply her mechanical and design skills.

Abstract: 3D printed polymers have various applications in spacecrafts, and military and personal UAVs. Copper-plated objects have been found to have low resistivity, high durability, a capability to protect the part against damage from UV light and moisture, and many other benefits. These benefits can be used on parts that will be exposed to the weather and the sun for long periods of time to reduce deterioration. In order to use the 3D printed polymer materials for space travel and UAVs, testing must be done on the effects of vibration and thermal loads on the metallization. As such, the effects of the metallization of 3D printed polymer parts under different loading conditions are investigated in this work. Testing will be done to find the influence of coating thickness, and thermal and vibration loads on tensile mechanical properties of the metallized samples. In addition, dielectric constant of printed samples will be measured by using 3D printed rectangular coupons having different coating thicknesses.

Publications: None yet.

16	Anthony Gonzalez

Marcus W. Wittlinger

Senior, Mechanical Engineering
Advisor(s): Dr. Wei Zhang

PIV Tests of Rooftop Vortices and Correlation with Peak Pressures Over a Low-Rise Building Model

Biography: Marcus Wittlinger is a senior undergraduate student pursuing his master's degree at Cleveland State University. Growing up, Marcus developed an interest in engineering while working on projects at home with his father. Upon the beginning of his university studies, Marcus immersed himself in the world of mechanical engineering, joining the on-campus Baja SAE team and completing three co-ops at a local automation company. Marcus is driven to improve the well-being of the public using his analytical and problem-solving skills, as evidenced by his honor's thesis. Upon the completion of his project, Marcus plans to begin his career and simultaneously complete his master's degree with the ultimate goal of making impactful changes through his work.

Abstract: Windstorms, such as hurricanes and tornadoes, and associated flooding account for the most economic loss and death in the United States among all other weather hazards. Among the structures that are exposed to these disasters, low-rise buildings (residential homes, industrial and commercial buildings) are the most vulnerable. Post-disaster surveys have evidenced that failure of roofs and roof coverings account for the majority of the initial damages of such low buildings. Roof failure is often initiated at windward roof edges and corners due to peak suctions induced by flow separation and vortex formation. Despite extensive research via full-scale field tests, wind tunnel experiments, and computational models, the nature of such vortices' formation and development near roof edges is not well understood. Thus, there is critical need to clarify the conditions, physical process, and flow mechanism that governs extreme local suctions occurring on the edges and corners of a roof.

This project will seek to correlate the rooftop vortex flow field and peak pressures utilizing synchronized flow field and pressure measurements. Experiments will be conducted on a 1:100 scaled Texas Tech University (TTU) WERFL building model in a wind tunnel. Unsteady vortices and roof surface pressures will be measured simultaneously using the Particle Image Velocimetry (PIV) technique and pressure scanning modules, respectively. This approach will allow new insight into rooftop vortex formation and the flow mechanism that govern peak pressure values. Furthermore, this paper intends to serve as a preliminary study to assess the capability and limitations of simultaneous flow field and pressure measurement planned in a larger flow facility, such as the Wall of Wind at Florida International University for hurricane-type wind conditions. The desired outcomes of this study are: (1) correlation between complex rooftop vortical flow structures and surface pressures and (2) a better understanding of simultaneous flow field and pressure measurement prior to conducting large-scale tests.

Publications: None yet.

16	Anthony Gonzalez

KENT STATE UNIVERSITY

Madison Wood

Senior, Geology
Advisor(s): Dr. David Singer

Lead (Pb) in Urban Soils

Biography: Madison is a senior at Kent State University studying Environmental Geology. Madison is very involved in both school and her community. She is president of two student organizations; Sigma Gamma Epsilon (Gamma Zeta Chapter) which is a nationally recognized honorary society of earth sciences and the Kent State Geological Society (KSGS). She is also a member of the National Society of Leadership and Success (NSLS) and a member of the American Association of Petroleum Geologists (AAPG) and is a Research Ambassador at Kent State where she works to educate students about how they can be involved in research within their major. Madison has been working in a Geology lab since her second semester of freshman year and plans to continue her education in Environmental Geology by pursuing a Masters degree at the University of Akron, upon completion of her Bachelors.

Abstract: Lead (Pb), a versatile metal, is commonly found in urban soils because of its wide range of industrial uses and its resistance to degradation. Pb has been used over the past few centuries, primarily in gasoline and paint in the 20th century, and can have long-lasting negative health effects following exposure, particularly for children. This caused the USEPA to set a standard of 400 parts per million for bare soils to limit human exposure. The risk of Pb exposure is based on its speciation (chemical form) in soils. This project aims to identify the speciation and total concentration of Pb in soils as a function of distance from a home and roadways to determine the relative contribution of paint- versus gasoline-derived Pb at a given home property, and as a function of depth in the soil. Soils were collected from three homes in Northeast, Ohio which were known to have been painted with Pb paint. Soil samples were collected from lateral transects at 1 m increments from the front of each house toward the street and from the back of the house, and from a soil core collected in 10 cm increments near the front foundation of each house. The soils will be analyzed by the following suite of methods: (1) X-ray fluorescence to determine the bulk concentration of Pb and other trace metals; (2) Scanning Electron Microscopy with Electron Dispersive Spectroscopy to identify the physical speciation of Pb-bearing phases; and (3) X-ray Diffraction to determine the bulk mineralogy of the soils. Preliminary XRF results show a concentration gradient at the front of a home; with high concentration near the home and a decrease in concentration near the road, and with high concentration near the surface and a decrease as depth increases. Results from this study will aid in refining potential reclamation needs across the wider urban area.

Publications: None yet.

13	Tim Ryan

Samuel Yoder

Senior, Aerospace Engineering
Advisor(s): Mo Samimy

Active Noise Control of Supersonic Rectangular Twinjets

Biography: Samuel Yoder is a senior undergraduate student pursuing a degree in Aerospace Engineering from The Ohio State University expecting to graduate in the spring of 2022 with an honors research distinction. In the spring of 2021, he joined advisor Dr. Samimy in Ohio State's Gas Dynamics & Turbulence Laboratory at the Aerospace Research Center. Outside of class, Samuel is a teaching assistant for Ohio State's Fundamental of Engineering Honors (FEH) course and has been in that position for three years now. He is also a member of the Ohio State chapter of the aerospace honorary society Sigma Gamma Tau. Previously, Samuel has interned at GE Aviation for two summers. Additionally, he has accepted a position in GE Aviation's Edison Engineering Development Program (EEDP) and after graduation will earn his Master's degree in Aerospace Engineering through the EEDP program.

Abstract: Rectangular twin jet engines used on tactical aircraft have several advantages compared to circular twin jet engines, namely, reducing an aircraft's weight and drag and improving its maneuverability. However, relatively little research has been done on the flow characteristics of rectangular twin jet engines. Coupling between the two jets due to their close proximity introduces rapid pressure fluctuations in the near field which, if not controlled, can cause high levels of sonic fatigue as well as intense radiated noise. This can damage critical components close to the nozzles over time and is a health concern for those nearby. This project will investigate the use of plasma actuators which interrupt the fundamental mechanism that causes jet noise to reduce the pressure fluctuations due to jet coupling, therein reducing sonic fatigue and jet noise. Specifically, this analysis will investigate the decoupling of both hydrodynamic and acoustic pressure to more fully understand the noise interaction in the jet near-field.

Publications: None yet.

5	Bob Latta

Community College

Mickela N. Harris

Freshman, Pre- Engineering Major
Advisor(s): Professor Abigail Yee

How AI is Leading the Perseverance Rover Ahead

Biography: Mickela was born and raised in Cincinnati, Ohio. After a brief career in the Air Force Reserves, she found her love for computers. She is pursuing an Associate in Pre- Engineering and a certificate in Leadership at Cincinnati State. After graduating, she will be pursuing a Bachelor's degree in Computer Science at the University of Cincinnati. Mickela has a strong background in the health field as Pharmacy Technician and as a Laboratory Assistant. She dreams of using her degree to combine the Medical Field with her passion for technology.

Abstract: Artificial Intelligence is the ability of a computer software or machine to learn or think and have become a critical part of this space mission from the very beginning to now. On February 18th 2021, the Rover Perseverance landed on Mars, specifically the Jezero Crater. Engineers nicknamed it "seven minutes of terror", as it takes exactly 7 minutes to find out how the landing went due to delays in retrieving data from mars to Earth. Thankfully due to AI from Terrain Relative Navigation System, the landing went smoothly. This technology included a camera that took images as the rover landed and used the images with the map provided to help Perseverance land safely. After the landing, the rover used AEGIs (Autonomous Exploration of Gathering Increased Science System), which is a software that uses AI to aim and control the chemistry camera. This project will analyze the AI systems that Rover Perseverance is currently using and how it impacts the mission at hand.

Publications: None yet.

1	Brad Wenstrup

Lorain County Community College

Kump, Michael	

Undergraduate, Universal Science
Advisor(s): Dr. Regan Silvestri

Finite Element Analysis of Surgical Implants For The Treatment of Scoliosis

Biography: I was born and raised in northeast Ohio. When I graduated high school I joined the US navy and served for several years in Japan. When I left the service I began my studies at lorain county community college.

Abstract: Scoliosis is a severe deviation of the spinal column that negatively affects the lives of those afflicted with the disorder. While there is no definitive cause for many instances of scoliosis there are however treatments that can restore proper function to the spine. Among these is the use of surgically implanted constructs to correct the curve of the spine. Using Abaqus a computer program for modeling how designs will perform under stress these constructs can be modeled and improved before using real world stress tests. Results are pending.

Publications: None yet.

4	Jim Jordan

Lorain County Community College

Sara Martin

Senior, Biology
Advisor(s): Dr. Regan Silvestri, PhD

Evaluation of Growing Rod Implants used in Pediatric Scoliosis Surgeries by Finite Element Analysis

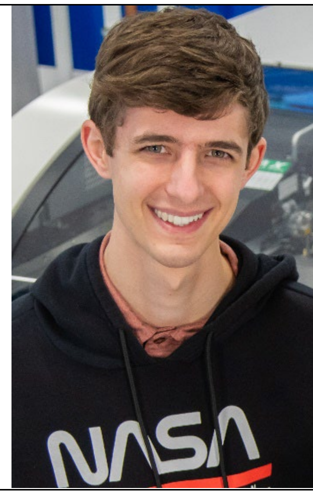
Biography: Sara is a student at Lorain County Community College finishing her Bachelors degree in Biology. She is currently working as a lab instructor for the Clinical Microbiology course at LCCC. This summer, Sara will begin studying at Cleveland Clinic's Medical Laboratory Science program to become certified to work as a medical laboratory technologist. In the past, her primary research focus was molecular biology in relation to HIV infectivity. She became involved in this biomedical research project after contacting Dr. Regan Silvestri about branching out with extra research opportunities, and is using her experience in the lab combined with her knowledge of anatomy to contribute to this project.

Abstract: Pediatric scoliosis is characterized by an abnormal lateral curve in the spine of young children. Lorain County Community College has partnered with the University of Toledo to evaluate orthopedic devices used in corrective surgeries for pediatric scoliosis. One class of orthopedic devices commonly used in corrective surgeries for pediatric scoliosis are growing rods, named as such because following implant they allow for growth through adolescence. Current designs of growing rod are being evaluated for performance by computer modeling. Computer modeling of the stresses in growing rods is being performed by Finite Element Analysis using the software suite Abaqus CAE. Modeling of the stresses in current growing rod designs pinpoints limitations in the current designs, with hopes of working toward design modifications for increased performance.

Publications: None yet.

4	Jim Jordan

Ryan M. Palmer



Sophomore, Micro Electromechanical Systems (MEMS)
Advisor(s): Johnny Vanderford

How the Collimation of Lighting Affects Productivity and Mood

Biography: Ryan Palmer is currently working towards a bachelor's degree in Micro Electromechanical Systems (MEMS) after earning his Associate degree in Applied Electronics. In the years leading up to attending college, he participated in the Brookside high school robotics program, where he worked with fellow student teammates to create many high-performance competition robots. Ryan entered college as a CCP student knowing what profession he wanted to pursue. He had spent 6 years self-educating himself on electronic assembly and design with the help of online forums, Youtube, and electronic project websites. With this prior knowledge, he has been able to better complete his college classes and work on many complex and fun projects. In 2019 Professor David Astorino, having been impressed with Ryan's performance in his class, gave him the opportunity to work as an assistant in the electronics lab at LCCC. He has since transferred to the MEMS department as a lab assistant. As Ryan learns more about electronics fabrication and design, he views this project as an amazing learning experience.

Abstract: In 2016, new LED lights were delivered to the International Space Station to replace the fluorescent lights previously in use. These new lights output different optic spectral density depending on the time of day to help astronauts with their sleep schedule and increase their alertness. While these lights can change the composition of the light they output, they deliver the light the same way most lights do. By putting the light behind a diffuser, it disperses the light at many different angles. Diffused light makes shadows look fuzzy and are more likely to change the size of the shadow as the object blocking the light changes its distance from the light source. This is different from how most natural light is perceived, since the light from the sun is almost perfectly collimated by the time it reaches the Earth creating "beams" of light rather than the soft defused light that most man-made light sources produce. This project will test if the collimation of light affects how the light is perceived and what effect it has on productivity and mood. Constructing a high-power light source that outputs high CRI (Color Rendering Index) light in a collimated beam, testing will be done on volunteers in a blind study. Half of the participants will be exposed to the collimated light source while the other half will be exposed to a defused light source, the composition of the light will remain constant for all tests. Exact testing methodology will be determined with the help of psychology staff at the college.

Publications:

1. Palmer, R. M. (2021, March). *Reduction of Voiding in Pb-Free Solder Joints on PCBs Processed in Varying Thermal Profiles of a Solder Reflow Oven*. NASA/ Ohio Space Grant Consortium. http://osgc.org/wp-content/uploads/2021/09/2-Proceedings-PDF.pdf

4	Jim Jordan

Columbus State Community College

Nahaniel A. Surgeon

Sophomore, Construction Management
Advisor(s): Dean M. Bortz

Manufacturability of Smaller Components with Modern Equipment

Biography: A little about me: I was born in Queens, New York in 2002. Both of my parents are Jamaican and Jamaica is where I spent my early childhood. Some time in 2008 we as a family moved to Athens, Ohio where I ended up skipping the second grade. We then moved again in 2011 to Pickerington, Ohio, and I spent most of my life there. I graduated from Pickerington High School North in 2019. After graduating I enrolled in the University of Toledo Civil Engineering Program, and after my first year I took a gap year to work and do some introspection. Now I am studying architecture at Columbus State, and ideally I will transfer to The University of Cincinnati after getting my associates. From there I aim to get my Bachelors and then Masters in Architectural Design. With a minor in environmental science.

Abstract: I hope to bring a basic awareness of wildlife fragmentation and provide an example of a way to reduce the disruption caused by fragmentation. While also understanding and keeping in mind that infrastructure is an integral part of societal function, and that means removing or reducing the highways is not a feasible option.
The method of reducing wildlife disruption I resonate with, is the construction of wildlife bypasses across certain points in the Ohio highway system. On a personal level I find the construction and architectural design of ecoducts and bypasses incredibly interesting. More specifically I enjoy Dutch architecture and The Netherlands has become very progressive in wildlife preservation. One of the major ways they accomplish this is by constructing ecoducts and wildlife bypasses across their major highways in multiple locations, and this inspired me to choose wildlife bypasses as the method I would promote.

Publications: None yet.

3	Joyce Beatty

Nicholas Valescu

Freshman, CIS Software Development
Advisor(s): Laurel Gibbs

Evaluation of Growing Rod Surgical Implants Used in the Treatment of Pediatric Scoliosis by Finite Element Analysis

Biography: My name is Nicholas Valescu, I was born in Florida but spent most of my life in Ohio. I'm a recent High School graduate getting into college for Software Development. I've always been fond of computers, part of the inspiration coming from my dad who was an accomplished software developer. I'm hoping to get into a good business after school that I can apply my skills to, while still being passionate.

Abstract: The Orthopedic Implant Design Project, supplemented and hosted by the University of Toledo, was designed to evaluate the mechanical properties of spinal implants and concept new models. The study was carried out using the provided software, ABAQUS, using a technique called Finite Element Analysis. 3D mockups of orthopedic implants were also provided by the university. Test environments are simulated to gather the properties of the constructs, which is then used to construct the new hypothetical model. Said model is currently being tested to see how it compares to the provided UT model, and if it can withhold a higher stress limit. These tests were all done via Finite Element Analysis within the ABAQUS software.

Publications: None yet.

9	Marcy Kaptur

Emily T. Williams

Junior, Micro Electromechanical Systems (MEMS)
Advisor(s): Johnny Vanderford

Manufacturability of Smaller Components with Modern Equipment

Biography: Em Williams is a third year Micro Electromechanical Systems major at Lorain County Community College. She is working as a Laboratory Technician for the MEMS department at the college as well as the Ohio Aerospace Institute's OSGC Program Assistant. Em is currently working on her second NASA OSGC research project and is preparing to give a presentation on her previous project on the topic of Solder Fume Inhalation at an upcoming Surface Mount Technology Association (SMTA) technical conference. She grew to love science and technology while a student in high school taking Project Lead The Way classes, and has enjoyed designing and building in various projects since. Em is a Student Leader of SMTA Ohio Valley Chapter, a member of Northeast Ohio's Society of Women Engineers, and the founder of Lorain County Community College's STEM club, µ-Steam, with her advisor Johnny Vanderford.

Abstract: As innovation and technology advances with increasing economic and social demands, the condition of miniaturization of surface mount devices (SMD) necessitates that technology and equipment used in assembly lines be both functional and satisfy takt time requirements. Although the 0603 and 0402 package sizes for SMD resistors and capacitors are most widely used in high volume production, as miniaturization moves forward, SMD components as small as 0201 and 01005 are being gradually implemented in industry. Using modern equipment that sufficiently meets or exceeds current industry standards in surface mount technology (SMT), a potential solution for manufacturing these components is using trial and error with different commercially available nozzle tips used in the pick & place machine and programming techniques. The manufacturability of the SMD components can be further verified when compared to test results published by the SMT equipment manufacturers. The goal of this project is to report on the overall manufacturability of picking & placing 0201 and 01005 SMD components using Panasonic NPM-W2 pick & place. The pick & place will be programmed with a test board that will be designed with a variety of pads that will be printed on with different apertures from a solder paste stencil made to be printed with T5 RoHS compliant Pb-free solder paste. After a board is pick & placed and reflowed, it will be electrically tested and visually inspected for defects using an Omron VT-S730 Automated Optical Inspection (AOI) system. A comparison of takt time vs number of manufacturing defects will be observed and reported.

Publications:

1. Williams, E. T. (2021, March). *A Study on Solder Fume Inhalation and the Long-Term Health Effects on Industry Workers*. NASA/ Ohio Space Grant Consortium. http://osgc.org/wp-content/uploads/2021/09/2-Proceedings-PDF.pdf

4	Jim Jordan

Education Scholars

CEDARVILLE UNIVERSITY

Alayna Ackley

Senior, AYA Life Science Education and BA Biology
Advisor(s): Dr. William Jones

Mars Ecosystem Proposal

Biography: I am a senior who will be going a 5th year, so next year I will be certified for grades 7-12 in Life Science Education as well as a double major in Biology. Having always been skilled in science and English, I knew I wanted to help other people develop their skills in one of these fields. In the future I hope to get a career teaching internationally, where I will be able to teach science while at the same time needing to teach English since my students will probably all be ESL learners. I am excited for this challenge and pouring into student's lives, going beyond just learning and to explain to them my reasons for the way I live my life. I am thankful to the Ohio Space Grant Consortium and Cedarville University for allowing me to explore science in the classroom and further develop my teaching skills.

Abstract: During the Ecology unit I will cover the standard 7.LS.2: In any particular biome, the number, growth, and survival of organisms and populations depend on biotic and abiotic factors. This standard will be covered with a project where student's goal is to work in teams to come up with a researched proposal for creating an ecosystem on Mars. Students will be given resources such as NASA articles on plans to create an ecosystem on Mars. They will determine for themselves if Mars is suitable for life by exploring it themselves 3-dimensionally with NASA's free online resource. Students will write a proposal for the organisms that they believe should be used to start an ecosystem on Mars based on what they learn about the planet.

Publications: None yet.

10	Michael Turner

NORTHERN

Joelena Brown

Junior, Mathematics Major with AYA Licensure
Advisor(s): Dr. Tena Roepke

How Fast is a Launch Vehicle?

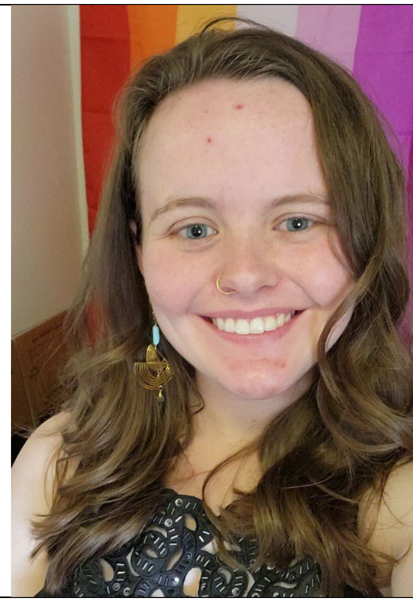
Biography: Joelena Brown is a junior mathematics major at Ohio Northern University studying to obtain her AYA Integrated Mathematics Licensure. Outside of her education courses, she gains experience working at the mathematics and statistics tutoring center and participating in the Robert Noyce Teacher Scholarship Program. Brown has been a resident assistant at ONU from 2020-22 and will serve as a senior resident assistant for the freshman dormitories in 2022-23. She enjoys spending her spare time working in the office of student affairs and delivering meals to students in quarantine. Brown will be studying abroad in 2022 to experience and learn about the culture, language, and religions of Japan. After graduating, she plans on teaching middle or high school mathematics in Ohio.

Abstract: Using activities from the Science Mission Directorate resource page, I was able to create a lesson plan for junior high students on analyzing and graphing functions. Students will learn about the rockets used to launch satellites into space and the speed at which they do so. Students will use data from the Atlas V 421 launch vehicle to calculate instantaneous speeds. They will use this information to make graphs and to make predictions. Students will then create and launch their own "rocket". They will perform multiple trials, collecting data on the time and distance travelled. Students will calculate the average speed of each trial and organize the data from their trials. The purpose of this lesson is to raise students' interest in NASA and space while covering Ohio's Learning Standards for mathematics.

Publications: None yet.

5	Robert Latta

Makenna R. Chappell



Sophomore, Engineering Education
Advisor(s): Dr. Todd France

Building A Miniature Solar Car Using the Engineering Design Process

Biography: Makenna Chappell is currently a sophomore at Ohio Northern University, originally from St. Louis, Missouri, and is majoring in Engineering Education with a minor in Mathematics. Along with being a student, she is involved in the American Society for Engineering Education (ASEE), Society of Women Engineers (SWE), and Teachers of Tomorrow (ToTs). Outside of student organizations, she is a student worker for the athletic department and is a specialized engineering tutor for the Writing Center on campus. She also serves as a Good News Bear for orientation sessions over the summer.

Makenna started taking engineering and STEM courses in the sixth grade and took them all throughout middle and high school. The engineering teachers she had for those classes helped her find a passion for engineering, and she decided she wanted to help young students find that same passion as well—thus the decision to pursue a career in Engineering Education. Makenna believes that taking engineering and STEM classes should be available in all school levels because they provide hands-on learning experiences, teach valuable teamwork skills, and help develop creative thinking.

Abstract: Students will create and design a miniature solar car using provided materials and the engineering design process. The students will be given a wide variety of materials with the main goal to create a car that fits the given criteria and constraints. Using the engineering design process, students are expected to brainstorm, sketch, and design the car and once they build a final product, it will be tested, revised, and tested again. Students will determine how mass, the type of light (natural or artificial), and the amount of light (shade or full exposure) affect the speed and position of the car. The students will work separately, but at the end they will race their cars to see which goes the furthest. The main goal of this activity is for students to gain understanding of solar power while utilizing all six steps of the engineering design process

Publications: None yet.

5	Robert Latta

Rachael Harbaugh

Junior, Mathematics Education
Advisor(s): Dr. Tena Roepke

Mathematics all over The Space

Biography: Rachael Harbaugh is an undergraduate student at Ohio Northern University where she studies Mathematics education. She is originally from Marion, Ohio. After graduation, she plans to teach at a school near her hometown. Rachael is involved in many ways on campus: Kappa Delta Pi Iotta Chapter (KDP) where she serves as the secretary, Teachers of Tomorrow (ToTs), Cheerleading where she serves as one of the captain's and a Mathematics tutor. Rachael has always had a very strong passion for Mathematics and teaching. She is so excited to share her passion with her students and show them all of the possibilities that it can lead them to.

Abstract: This lesson was made to take place in a high school mathematics classroom and is based on the Ohio's Learning Standards. The main idea is for students to be able to create a proportion in order to convert different measurements and weights from Earth to different planets in our solar system. Students will work on a packet that will guide them through the process of learning and applying this information. Here are some conversions they will be working with: miles to lightyears, the temperature of the sun in Celcius and Kelvins, their weight on Earth versus on the moon. This lesson is made to spark interest in the different kinds of mathematics that take place in our solar system.

I plan to take some time to dig into some history of NASA and some key mathematicians. One of my favorite movies is Hidden Figures. I will show a video/ clip from the movie for students to hopefully find motivation and excitement about mathematics.

Publications: None yet.

4	Jim Jordan

KENT STATE UNIVERSITY

Emily M. Hippich

Senior, Early Childhood Education
Advisor: Dr. Bridget Mulvey

Next Generation Scientists Exploring Green Energy

Biography: Emily Hippich is currently a senior at Kent State University. She has earned an Associate of Science degree and is pursuing a Bachelor's degree in Early Childhood Education with an expected December 2022 graduation. Emily is a member of Kent State's Honors College and is on the President's List. After graduation, she plans to be a substitute teacher in schools to help her get more classroom experience before looking for a full-time teaching position the following summer.

Abstract: This lesson is designed as a problem-based learning project and will be taught in a third-grade classroom. Students will become NASA research scientists tasked with designing and implementing a renewable energy resource into their community. This project will combine both science and social studies together, as students will have to conduct research on the community that they live in. Students will become specialists in one type of renewable energy, and then present their findings to the class. Students will be given new groups that have representatives from each type of renewable resource. In these groups, students will be discussing which renewable energy resource they want to design for their community. Students will be drawing a model of their energy resource that includes the location it will be placed in their community. Using their model, students will be able to build a replica of their energy resource to share with the class.

Publications: None yet.

7	Bob Gibbs

McKenna Marcus

Junior, Early Childhood Education
Advisor(s): Brandi Seither, Ed.D.

Ecology on Mars

Biography: McKenna Marcus is a junior at Baldwin Wallace University, majoring in Early Childhood Education. She comes from a long line of educators. McKenna has always been passionate about pursuing a career in Education. She currently works at a Head Start school. She has regularly volunteered at Cleveland Metropolitan Schools. McKenna has also volunteered at reading and STEM camps during the summer. After graduating, McKenna plans on getting her Master's in Education.

Abstract: For this project, students will be studying the environment on the planet Mars. Students will research Mars and its environment. Students will create their own Mars ecosystems with the information gained from their research. Students will develop ecosystems to see how they will interact with the environment on Mars; students will choose to create an ecosystem to see how plants or humans will survive on Mars. Students will receive materials that will allow them to create their own Mars ecosystems.

Students will learn about the difference between Mars and Earth's environments during their research. For example, the average temperature is-81 degrees Fahrenheit while the atmosphere is 96% carbon dioxide on Mars. Students will take this information and create ecosystems to see how they will interact with the environment on Mars. For example, one student may make an ecosystem for plants and discover how to survive Mars's environment, while another may choose to create an ecosystem for humans to see what they would need to live on Mars.

Publications: None yet.

16	Anthony Gonzalez

The University of Akron

Kayleigh Penton

Senior, Middle Level Education: Language Arts and Social Studies
Advisor(s): Dr. Gary Holliday

Students Advocating for Change at The Top

Biography: Kayleigh Penton grew up in Vermilion, Ohio. She is an undergraduate student at The University of Akron, currently student teaching in a Social Studies classroom, with plans to graduate in the spring. While at The University of Akron, Kayleigh was on the Women's Soccer Team, a LeBron James Family Foundation College of Education Student Ambassador, and an Urban Youth Mentor. She was a recipient of the Dr. Pepper Go Teach Scholarship and also worked with First Lego League students and Special Olympic athletes. Her various field experiences have allowed her to work with a wide variety of students and have given her opportunity to grow as an educator. Kayleigh has a passion for creating engaging cross-curricular lessons that help students thrive in a world beyond the classroom. After graduating she hopes to use what she has learned to facilitate a classroom community that motivates and guides students to achieve success.

Abstract: Cross curricular education provides students with the opportunity to utilize critical skills while making distinct connections amongst a wide variety of concepts. Students studying the U.S Constitution and the framework of our government will explore a representative democracy and the powers and responsibilities of Congress. This project urges students apply what they have learned about the government by examining the actions of our current legislators, with special attention to how they address some of NASA's most prominent challenges and missions: sustainability, climate change, STEM education, pollution, and technology. The tasks will combine inquiry and analysis, persuasive writing, and scientific research, in order to inspire students to advocate for a better future.

Students will compete in a "Fantasy Congress" competition with a drafted team of real U.S legislators that acquire points when they make significant contributions to Congress. They will report on their teams each week, monitoring congressional activity and exploring a wide variety of current issues. After several weeks, students will choose an issue that interests them and compose an email or letter to an Ohio representative. They will utilize NASA resources to gather additional information regarding their issue. In the letter, students will urge the representative to take action regarding their issue or commend them for the actions they have already taken. Then students will be encouraged to propose possible evidence-based solutions or suggestions that they have found in their research to combat the issues they address in their letters.

Publications: None yet.

9	Marcy Kaptur

CEDARVILLE UNIVERSITY

Isaiah Andrew Reinhard

Senior, Middle Childhood Education Math and Science
Advisor(s): Dr. Lori Ferguson

Liftoff on Mars

Biography: Andrew Reinhard grew up in Bellefontaine, Ohio. He knew he wanted to pursue a career in education and began attending Cedarville University to do so. Andrew is currently a senior at Cedarville and will graduate in the Spring of 2022. In addition to majoring in Middle Childhood Education, he is on the Cedarville Track and Field team, a volunteer youth leader at his local church, and a student worker in the Cedarville University Education Department. Andrew's passion to teach middle school students science has only grown during his time at Cedarville and he is excited to begin teaching. He is passionate to orchestrate student learning in a meaningful and exciting way.

Abstract: "Liftoff on Mars" is an educational project that creates an opportunity for students to learn about the concepts of gravitational force, lift, air vehicles, and how they can be applied to earth along with other planets. This project utilizes the mathematics concepts of learning and applying ratios and proportional relationships. Students will first be introduced to concepts of gravity, lift, air vehicles, and the recent milestones made on Mars with NASA's Mars Helicopter. They will then be tasked with discovering how much lift is required for a helicopter to fly off the ground on Mars. Students will be given needed information throughout their inquiry of how a helicopter gets off the ground on Earth to help guide them. Students will utilize the mathematics concepts and the information about gravitational pull found on the NASA website pertaining to the two different planets. Students will use this to discover how much lift is required to get the helicopter in the air on Mars. This lesson utilizes real-world information and situations to spark interest for students to learn scientific and mathematical concepts.

Publications: None yet.

4	Jim Jordan

Erica Schwartz

Senior, Early Childhood Education
Advisor(s): Dr. Brandi Seither

Gravity Mission

Biography: Erica Schwartz is a senior at Baldwin Wallace University studying Early Childhood Education with a 4th and 5th grade generalist endorsement. Erica grew up in Coshocton, Ohio and found a love for learning and teaching alongside children at a young age. She began her Early Childhood Studies during her senior year of high school and has followed it on into currently student teaching through her studies. Since Attending Baldwin Wallace, Erica has been involved in groups on campus such as the Baldwin Wallace Education Association and the Kappa Delta Pi Honors Society in Education. She has also enjoyed finding oportunities off campus coaching a youth volleyball team and joining Big Brothers Big Sisters Greater Cleveland. Erica has found her passion for teaching and guiding her students to love learning alongside her. She has found the importance in creating a classroom environment where students have the support they need to thrive.

Abstract: This lesson is based on Ohio's Learning Standards for elementary science. Students have been introduced to forces and motion. Students will be introduced to gravity and how it affects us here on Earth. At the time the Perseverance Rover had just had its first drive on mars. Students used Chromebooks to explore all the information NASA had to offer on the rover before a secret mission came in; The Perseverance Mission. NASA called on our class specifically to help. The rover has found a rare alien egg on Mars! The rover was to drop this egg into the Earth's atmosphere to succumb to the dangers that gravity may bring. We tested what might happen dropping a regular chicken egg in the classroom to see some daunting results. Then came the mission, to protect this egg found by the rover we must create our own devices for it to be dropped in using only a variety of found materials.

Students were to construct a sketch of the materials they would use keeping in mind the effect of gravity on Earth. Students must then purchase materials needed from the class store and stay on budget when creating and testing a prototype with a fake egg. Our student scientists rose to the occasion and the teams did not disappoint. After numerous prototypes and testing, the students were ready. After weeks of preparation, students went outside, dropped their egg device from the highest point to demonstrate which final egg protecting devices would be selected. After, the students will reflect on what they accomplished and how Gravity plays its role on Earth.

Publications: None yet.

7	Bob Gibbs