

NASA / OHIO SPACE GRANT CONSORTIUM

2023-2024

SCHOLAR / FELLOW STUDENT JOURNAL

***Students Representing Ohio
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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, 1,537 undergraduate scholarships and 297 graduate fellowships have been awarded.

The Consortium is additionally supported by matching funds provided by the 24 member universities/community colleges and the Ohio Aerospace Institute (OAI).

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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- 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
- Ohio University
- The University of Toledo
- Wilberforce University
- Wright State University
- Youngstown State University

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Just click on any name, and it will link you to the page immediately!

TABLE OF CONTENTS

	<u>Page(s)</u>
Description of Fellowship and Scholarship Program	2
Membership	3
Ohio Congressional Map	4
Table of Contents	5-7

<u>Fellows</u>	<u>University</u>	<u>Page</u>
Duke, Kyle C.	Youngstown State University	9
Gilligan, Rebecca N.	University of Cincinnati	10
Murray, Justin M.	Ohio University	11
Porterfield, Andrew J.	University of Dayton	12
Siino, Michael A.	Miami University	13
Sipahioglu, John A.	Kent State University	14
Taylor, Julia A.	Kent State University	15
Wolf, Mark J.	The Ohio State University	16
Wong, Mitchell CH.	The Ohio State University	17

<u>Scholars</u>	<u>College/University</u>	<u>Page</u>
Admane, Sanskurti.	The Ohio State University	19
Baker, Douglas S.	Wright State University	20
Ballentine, Rachael A.	Wright State University	21
Bower, Lauren D.	University of Dayton	22
Brautigam, Grant I.	Ohio Northern University	23
Brockway, Megan A.	Miami University	24
Brodke, Marek D.	University of Cincinnati	25
Burton, Bryant R.D.	Wright State University	26
Buttrey, McKenzi E.	Cleveland State University	27
Cartwright, Ethan C.	The Ohio State University	28
Chaffey, Andreas D.	Cedarville University	29
Couch, Kennedy L.	Marietta College	30
Dando, Natalie M.	Youngstown State University	31
DeBruin, Simon A.	Miami University	32

<u>Scholars</u>	<u>College/University</u>	<u>Page</u>
Dippolito, Ryan P.	The University of Akron.....	33
Dotson, Alex	Central State University	34
Dunlap, Julia M.	Baldwin Wallace University.....	35
Eifert, Grant T.	University of Dayton.....	36
Fraser, Duncan M.	Marietta University.....	37
Gentilin, Angelina R.	Baldwin Wallace University.....	38
Gersey, Julia M.	Baldwin Wallace University.....	39
Ghanem, Aimee	Case Western Reserve University.....	40
Gilger, James C.....	University of Cincinnati	41
Harris, Ian M.....	The Ohio State University	42
Hensley, Elyse D.	Ohio University.....	43
Hyland, Emily R.	Cleveland State University	44
James, Cynthia M.	Baldwin Wallace University.....	45
Keller, Tara R.	Cedarville University	46
Lawal, Saraju A.	Central State University	47
Leslie, Abigail M.	Case Western Reserve University.....	48
Lyons, James J.	The University of Akron.....	49
Maller, Sydney R.	Youngstown State University.....	50
Marino, Anthony J.	Ohio University.....	51
Matar, Sophia N.....	Kent State University	52
Mathew, Anne M.	Ohio University.....	53
Miller, Ethan R.	Marietta College.....	54
Moore, Madisyn B.	Cleveland State University	55
Nash, Jean C.	University of Dayton.....	56
Nestor, Lee J.	The University of Akron.....	57
Neville, Joel P.	Marietta College.....	58
Patel, Jinit	The Ohio State University	59
Phelps, Brady M.....	Ohio University.....	60
Phillips, Maxwell A.	Ohio Northern University	61
Posey, Alex R.	Marietta College.....	62
Preusser, Kyle A.	Youngstown State University.....	63
Sanders, Andrew R.	Youngstown State University.....	64

<u>Scholars</u>	<u>College/University</u>	<u>Page</u>
Schofield, Collin B.	Kent State University	65
Smith, Anastesia K.	Wilberforce University	66
Sultan, Elizabeth G.	Cedarville University	67
Suter, Aaron B.	Wright State University	68
Swiler, Victoria A.	Ohio University.....	69
Verhosek, Justin T.	Baldwin Wallace University.....	70
Wimer, Bailey D.	Kent State University	71
Yunker, Nikolas B.	University of Cincinnati	72
Zayac, Jennifer S.	Ohio Northern University	73

<u>Community College Scholars</u>	<u>Community College</u>	<u>Page</u>
Bogna, Olivia L.	Lorain County Community College	75
Douglas, Lia M.	Lorain County Community College	76
Hustic, Jilyan A.....	Lorain County Community College	77
Martin, John S.	Lorain County Community College	78
Williams, Emily T.	Lorain County Community College	79

<u>Education Scholars</u>	<u>College/University</u>	<u>Page</u>
Babcock, Ari J.	Cedarville University	81
Curry, Ruthie A.....	Baldwin Wallace University.....	82
Davis, Roemello A.	Baldwin Wallace University.....	83
Gill, Cora L.	University of Cincinnati	84
MacLochlan, Molly M.	Youngstown State University	85
Moner, Ryah M.	Baldwin Wallace University.....	86
Roche, Elizabeth S.....	Cleveland State University	87
Samblanet, Nate A.	Baldwin Wallace University.....	88
Turcotte, Grace A.....	Cedarville University	89

Fellows

Kyle Duke



Master's 2, Chemical Engineering
Advisor(s): Dr. Byung-Wook Park

Impedimetric determination of cortisol levels in sweat using gold nanoparticles functionalized laser induced graphene electrode on a wearable platform

Biography: Kyle Duke is a second year Master's student from Perry, Ohio studying Chemical Engineering at Youngstown State University. In 2022, Kyle Duke received his B.S. in Chemical engineering (Summa Cum Laude) from Youngstown State University. Kyle began his research in 2021 where he studied microbial fuel cells as a research assistant for Dr. Park. Kyle was first introduced to his current thesis topic his senior year at YSU which he found extraordinarily fascinating and led him to pursue his Master's degree. Kyle was first introduced to his current thesis topic his senior year at YSU which he found extraordinarily fascinating. With his newfound passion for research, he plans to pursue his PhD after graduation with a focus in biosensors.

Abstract: Cortisol is a stress hormone that regulates many bodily functions in the body such as metabolism, sleep/wake cycle, and blood pressure. An imbalance in cortisol levels are signs of diseases such as Addison's disease and Cushing's syndrome. Conventionally, cortisol levels are evaluated through blood, saliva, or urine samples. These samples are then sent to a lab which can be expensive and take days for results. To address the disadvantages of conventional cortisol testing, we are currently developing a wearable sweat based impedimetric cortisol biosensor with Bluetooth capabilities. A fully customized application is in development to pair with the device allowing for real time monitoring of cortisol levels, effectively reducing the cost and time associated with conventional methods.

In this study, a carbon dioxide laser was utilized to produce a flexible laser-induced graphene (LIG) on polyimide (PI) film for the detection of cortisol. First, gold nanoparticles (AuNPs) were formed to the sensors surface via electrodeposition, followed by Self-Assembled Monolayer (SAM) formation of MPA on the AuNPs via thiol chemistry. With the SAM in place the carboxylic acid (-COOH) groups of the MPA were activated to immobilize antibodies via EDC/NHS chemistry. After MPA activation, the LIG was incubated in an anti-cortisol antibody solution to immobilize on the surface. Lastly, to avoid unwanted signals during detection, the LIG was incubated in a solution containing the blocking agent bovine serum albumin (BSA). Surface characterization of the LIG was performed at each step of modification by cyclic voltammetry (CV) and Electrochemical impedance spectroscopy (EIS) in a phosphate buffered saline (PBS) solution containing a 5 mM $\text{Fe}(\text{CN})_6^{3-/4-}$ (1:1) redox couple. Further characterization of the modified LIG electrode was achieved through scanning electron microscopy (SEM), surfaced-enhanced Raman spectroscopy (SERS), and X-ray diffraction (XRD). The detection experiment using EIS was carried out in increasing concentrations of cortisol (0.1 pM-100 nM) in PBS. A decrease in impedance (Z_{Mod}) and increase in the electric double layer capacitance was found after an increase in cortisol concentration, indicating the biosensor successfully detected cortisol. To evaluate the efficacy of the design, selectivity, reproducibility, and sensitivity experiments were performed. A wearable miniaturized sensing device with Bluetooth capabilities will be utilized for further detection experiments. The overall goal is to implement the developed sensing platform into a 3D printed wearable system, for the fabrication of a POC device capable of real-time monitoring of cortisol levels.

Publications: None yet.

Rebecca Gilligan



Masters Aerospace Engineering
Advisor(s): Dr. Kelly Cohen

Fuzzy Logic Based Estimator for Enhanced Precision Landing of an Uncrewed Aerial Vehicle

Biography: Rebecca Gilligan is completing her Masters of Science in Aerospace Engineering at the University of Cincinnati, after graduating with a Bachelors of Science in Mechanical Engineering in April 2023. She has been researching collaborative aerial and robotic systems since 2020, supported by OSGC. Collaboration between different types of vehicles creates the potential to complete more complex missions than the autonomous vehicles could complete on their own. She is currently working on applying optimal control and explainable AI methods to improve precision landing of a UAV.

Abstract: Combining the strengths of different autonomous vehicles in a multi-modal system creates opportunity to complete more complex missions through collaborative interaction. Precision landing is a critical technology for collaboration between aerial and ground robotics. Improvement of precision landing builds on discoveries from the development and testing of the All-Terrain Aerial Robotic Interface (ATARI), a previously funded OSGC project. ATARI consists of a collaborative unmanned aerial vehicle (UAV) and unmanned ground vehicle (UGV). The UAV features a precision landing system which is utilized to land on the levelling platform attached to the UGV. This allows the UGV to serve as a mobile landing platform for the UAV which can provide improved landing sites and enhance the flight time of the UAV. Extensive testing of the precision landing revealed many areas for improvement. Flight testing results will be validated in simulation which will then be used to test changes and improvements to the precision landing system. Techniques from coursework in soft-computing based AI will be applied to develop a fuzzy logic based estimator for enhanced precision of autonomous landing of an aerial vehicle on a beacon device. The goal is to make the precision landing process more reliable and trustworthy for future applications including landing on a moving target or in unknown environments. This lays the groundwork for further development of the precision landing system.

Publications:

- Gilligan, R., Cohen, K., "Comparison of Precision Landing vs GPS Guided Landing of ArduPilot Hexacopter using Motion Capture Ground Truth", *Frontiers in Aerospace Engineering Journal*, Women in Aerospace Engineering Research Topic
- Gilligan, R. "Collaborative Multimodal System for Long-Distance Planetary Exploration (Continuation)", *SRIDE Undergraduate Fellowship for Discovery*, April 2023.
- Gilligan, R., "Testing Approach and Precision Landing for All-Terrain Aerial Robotic Interface (ATARI)", *NASA/ Ohio Space Grant Consortium 2022-2023 Annual Student Research Symposium*, March 31, 2023, Cleveland, OH.
- Gilligan, R., Cohen, K., "Design of an All-Terrain Aerial Robotic Interface (ATARI) as a Collaborative Platform for UAVs", *International Student Competition at AIAA's SciTech Forum*, January 22-27, 2023, National Harbor, MD. <https://arc.aiaa.org/doi/10.2514/6.2023-0002>
- Gilligan, R., Cohen, K., "Design of an All-Terrain Aerial Robotic Interface (ATARI) as a Collaborative Platform for UAVs", presented at *AIAA's 2022 Region III Student Conference*, March 26, 2022, West-Lafayette, IN.
- Gilligan, R., Heitmeyer, D., Yasin, A., Palmer, H., Poplin, I., Chidambaram, N., Vesselovec, X., Driscoll, D., Assd, O., Smiley, D., Jugade, S., "University of Cincinnati UCAV 2022 AUVSI SUAS Competition Technical Design", *20th Annual Student Unmanned Aerial Systems Competition (SUAS) by the Association for Unmanned Vehicle Systems International (AUVSI) Seafarer Chapter*. February 15, 2022.

Justin Murray



Master's 1, Computer Science
 Advisor(s): Prof. Chad Mourning

Convolutional Deep Learning for Atmospheric Visibility Estimation in Constrained Environments

Biography: Justin Murray is a first-year master's student studying computer science at Ohio University. He graduated from Ohio University in May 2023 with a Bachelor of Science in computer science. Justin began his current research in May 2022 as a research assistant for Professor Chad Mourning. His research interests include machine learning and interactive computer graphics. He plans to pursue a Ph.D. in computer science and to continue research in industry or academia after.

Abstract: The goal of this project is to create a convolutional deep learning model that can accurately determine atmospheric visibility using images from an electro-optical sensor and runs in resource constrained environments; particularly for the purposes of Urban Air Mobility (UAM) and Advanced Air Mobility (AAM) where visibility must be known across large areas for the safe operation of aircraft. Currently, most Automated Weather Observing Systems (AWOS) use large and expensive forward scatter sensors to measure visibility. A model as described could be deployed on small, low-cost, and low-power devices such as a Raspberry Pi. Such a device could also potentially be powered by batteries charged by small solar panels to allow great flexibility in its placement. Existing models are being evaluated for their accuracy and potential to be modified for use in constrained environments. Methods such as quantization and knowledge distillation are being tested for their memory usage reduction and effects on accuracy. By first reducing the memory usage of a model as much as possible, it can then be modified for higher accuracy while remaining within the requirements of a specified constrained environment. There is a lack of sufficient training data for this problem and units for collecting new data are being designed to be co-located with AWOS stations.

Three existing models for estimating atmospheric visibility have been tested for accuracy and memory usage with three existing datasets. Memory usage of one model was reduced by about 60% without a loss in accuracy and is deployable on a Raspberry Pi Zero 2.

Publications: Wright, D., Mourning, C., Murray, J., Albin, T., Young, C., & Krimins, E. (2023, July). Weather Visibility Sensor Network: Platform Characterization. In *2023 IEEE International Conference on Omni-layer Intelligent Systems (COINS)* (pp. 1-5). IEEE.

Andrew Porterfield



Master's 1, Aerospace Engineering
 Advisor(s): Dr. Sidaard Gunasekaran

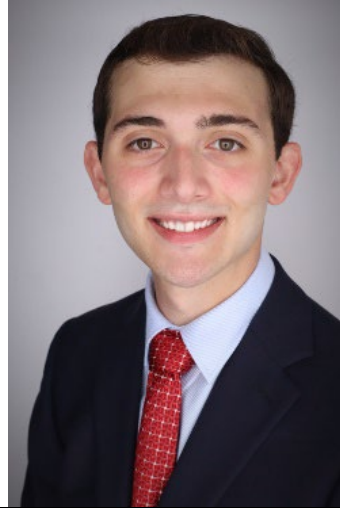
Discrete Vortical Gust Encounter and Mitigation Using Closed Loop Control

Biography: Andrew is a first-year Master's student in Aerospace Engineering at the University of Dayton. In May 2023, Andrew graduated *cum laude* from the University of Dayton with a bachelor's degree in Mechanical Engineering and a minor in Aerospace Engineering. Andrew worked in the University of Dayton Low Speed Water Tunnel on the unsteady effects of gusts. Andrew also worked as a flight simulator technician, assisting undergraduate and graduate students with testing aircraft and auto pilot designs in the University of Dayton Merlin Flight Simulator. Andrew has continued his work in the simulator and furthered his research in the water tunnel as a master's student.

Abstract: The open and closed-loop response of a wing to discrete vortical gusts of differing strengths was characterized using Time Resolved Particle Image Velocimetry (TR-PIV) in the University of Dayton Water Tunnel (UD-WaT). Discrete vortical gusts were generated by rapidly pitching a flat plate gust generator upstream of the wing. Simultaneous Time Resolved Particle Image Velocimetry (TR-PIV) and force measurements on the flat plate wing downstream of the gust generator were collected. A closed loop Proportional Integral Derivative (PID) control system was implemented in order to mitigate the influence of the discrete gust on the wing. TR-PIV was used to correlate the flow physics responsible for the force histories experienced by the wing. Peak-to-peak and average gust mitigation using closed loop control were quantified based on the deviations from open-loop results. The controller reduced the force transients during the gust entry by an average of 67% whereas the gust exit transients were only reduced by an average of 6%.

Publications: None yet.

Michael Siino



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

Dynamic Modeling and Testing of Electro-Rheological Haptic Modules

Biography: Michael is a Master’s student from Summit, New Jersey studying Mechanical Engineering at Miami University. In 2023, Michael received his B.S in Mechanical Engineering and Manufacturing Engineering from Miami University. During his time as an undergraduate, Michael involved himself in various academic programs including the Lockheed Martin Leadership Institute, the American Society of Mechanical Engineers, and the honors society, Tau Beta Pi. Michael began his research in 2021 when he was introduced to the topic of Electro-Rheological fluids by his advisor, Dr. Koo. After developing a great interest in the topic, he chose to enroll in Miami University’s combined B.S./M.S. program, continuing to work alongside Dr. Koo to investigate applications of Electro-Rheological fluids as the topic of his Master’s thesis.

Abstract: Widely employed in hand-held devices, haptic feedback technology has been proven to be effective in enhancing the overall user experience by providing additional sensory information to the user. In recent years, the demand for haptics in large touchscreen displays (TSDs) has rapidly grown. However, due to limitations of current haptic actuators used within mobile devices i.e., scalability, the technology to implement tactile haptics in larger displays is immature. To address challenges for generating haptic feedback in large touch screen displays, this study proposes a haptic module based on a “smart” fluid called Electro-Rheological (ER) fluid for use in large TSD applications. ER fluid is a fluid whose apparent viscosity is dependent upon electric field; By adjusting the input electric voltage, frequency, or waveform, the ER fluid can be manipulated to shift from liquid to solid behavior within a millisecond.

In this study, an ER haptic module is first created consisting of a vibration source, ER module, and display mass. By passing an input vibration through the ER module, the output felt at the display mass can be manipulated by adjusting the voltages and frequencies input into the module. This haptic module is then characterized using numerical methods to understand the parameters for reliably manipulating the input vibration source to create a range of tactile haptic responses that are felt by the user interacting with a large TSD. The ER module will be subjected to various magnitudes of electric fields and waveforms of varying frequencies to determine the change in physical properties, including the magnitude of acceleration and force that the ER module transmits to the output. Following characterization, numerical findings are validated through experimental evaluation. A voltage source will output directly into a voltage amplifier which increases the voltage by a factor of 1000 to reach voltages large enough to noticeably change the viscosity of the ER fluid. This voltage then inputs directly into the ER module while an input vibration is passed through the base of the module which sits behind a TSD. Using an accelerometer, the vibrational output will be recorded. The acceleration data which represents the vibration intensity will be used to evaluate the performance of the proposed ER haptic module for large TSDs.

Publications: None yet.

John Sipahioglu



Master's 2, M.S. Computer Science
 Advisor: Dr. Younghun Chae

Applying Current Wireless Security Methods to the Deep Space Network

Biography: John is a graduate student pursuing a combined master and Bachelor of Science in computer science at Kent State University. He is also double majored with a Bachelor of Arts in mathematics. Having interned at PCC Airfoils, John has had exposure to the aerospace industry, as the applications he helps develop are used in the management of aircraft engine parts. He has previously worked with his advisor, Dr. Younghun Chae, on other network security research and is excited to work with him again on this research. He has long had an interest in teaching at the university level, and early in his time studying computer science he participated as a volunteer instructor for an outreach workshop for high school students at the IHCI conference held at Kent State in 2021. In his spare time, John enjoys playing guitar.

Abstract: The primary issue to contend with in deep space communication is the distance that messages must travel, and the time it takes to do so. On Earth, messages can be sent anywhere else on the planet nearly instantaneously. However, it can take 5 to 20 minutes for messages to travel between Earth and its nearest neighboring planet, Mars. Thus, the efficiency of communication is critical as to not waste data during transmission, as in deep space communication it is only possible to send transmissions at certain times. Due to the need for transmitters and receivers to be aligned, there may only be windows for a few hours per day where communication can occur. Thus, the performance of the current security measures for deep space communication are compared with the newer security measures to see if the efficiency can be improved.

The current security measures are based on IPSec (Internet Protocol Security). Specifically, the DSN (Deep Space Network) uses the tunnel mode of IPSec to essentially create a VPN (Virtual Private Network) between the transmitter and receiver. This creates the overhead of first generating and agreeing on an asymmetric cryptographic key, and then the extra data from encryption header and trailer that must be added to each packet. One potential alternative for IPSec that was recently introduced is WireGuard, which has shown to be simpler to implement and provided superior performance to IPSec based VPNs. In this research, the aim is to see how new protocols like WireGuard could be used to improve the performance and reduce the overhead of the security protocols used for the DSN.

Publications: None yet.

6

Bill Johnson

Julia Taylor



2nd year Masters, Aerospace Engineering
 Advisor(s): Dr. Blake Stringer

Modeling Thermal Soak of Electric Aircraft Motors

Biography:

Julia Taylor graduated with her B.S. in Aerospace Engineering from Kent State University in 2022. She is currently working to complete her master’s thesis, also at Kent State University, and is expecting to defend in Spring 2024. She’s been conducting research with Dr. Stringer in the KSU eVTOL Hybrid Electric Aero-Thermal Propulsion Lab since 2020. Originally from Hagerstown, Maryland, she’s found her home in Ohio and is looking to continue her studies through to her PhD. She has been accepted into the Aerospace Engineering doctoral program at the Ohio State University and will be attending starting fall 2024 to pursue interdisciplinary eVTOL research.

Abstract:

Characterizing thermal performance is essential to optimizing system performance, reducing damage, and enhancing overall reliability and safety, especially in high-powered heat generating applications. In the growing eVTOL (electric Vertical Take-Off and Landing) ecosystem, quantifying and characterizing the thermal performance of new propulsion platforms has resorted to complex, numerical solutions via commercial software. One reason for this is how thermal performance is affected by a phenomenon called thermal soak. Thermal soak is the sudden increase of internal component temperature due to terminating any forced convective cooling from a heat-producing system (i.e., landing and shutdown after hovering). A more accessible thermal soak model was developed and explored with the aim of better understanding heat transfer properties of electric/hybrid motors under VTOL power conditions. Comparisons between the thermal soak model and experimental data from several eVTOL motor and propeller configurations at different power and ambient conditions were made.

Publications: None yet.



Mark Wolf



Master's Student, Aerospace Engineering
Advisor: Dr. Mrinal Kumar

Toward Intent Estimation of Non-Cooperative Space Objects

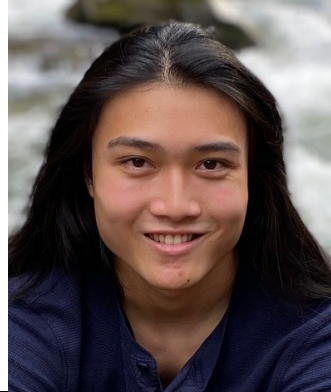
Biography: Mark Wolf is from Broadview Heights, Ohio and graduated *cum laude* with his bachelor's degree in aerospace engineering from The Ohio State University in May 2023. Mark has a passion for working on space technology and has research interests in space domain awareness and GNC. During his undergraduate career, Mark was an active participant in the Buckeye Space Launch Initiative (BSLI) competing with the club in the Spaceport America Cup as the recovery team lead, and NASA Student Launch Initiative as the deputy project manager. Through BSLI, Mark obtained his level 1 high power rocketry certification from the Tripoli Rocketry Association. Mark also served as a student representative for the Aerospace Engineering Undergraduate Studies Committee and held a research assistant position at the Gas Turbine Laboratory working to setup experiments related to turbine blade tip rub. During the summer before his senior year, Mark interned at the Air Force Research Laboratory at Edwards AFB working on liquid rocket propellant research. Mark is grateful to have received funding from the OSGC to pursue his master's degree and build his research knowledge. Mark currently works at the Laboratory for Autonomy in Data-Driven and Complex Systems participating in research related to satellite perturbation analysis for use in intent estimation. Outside of his studies, Mark is an avid reader of books related to human space travel and the future of space technology, and runner, having completed the Columbus half-marathon in 2022.

Abstract: Space Domain Awareness (SDA) is a major area of interest due to the commercialization of space and the rapid acceleration in the number of objects launched into space. This rapid increase also means there are more actors in space, from governments to private companies, leading to the need to understand and catalog space activity. However, simply maintaining a catalog of space objects is not enough. It is also necessary to estimate the intent of non-cooperative satellites to ensure the safety of space assets and allow for the best decisions to be made regarding asset maneuvers. This project uses a data-driven approach to understand the behavior of non-cooperative satellites and determine the reason these satellites perform orbital maneuvers. The initial work that has been performed relates to the characterization of perturbations experienced by satellites in orbit. A useful understanding of the perturbations experienced by a satellite is necessary for the accurate forecasting of a satellite's dynamics, thus estimation of its intent. The Adaptive Monte Carlo (AMC) platform developed at the Laboratory for Autonomy in Data-Driven and Complex Systems (LADDCS) is utilized in this project for uncertainty forecasting and parameter determination. Ultimately, this work will help satellite operators in determining future positioning of important assets in space and limiting orbital collisions leading to a decrease in orbital debris generation.

Publications: None yet.



Mitchell Wong



Master's 1, Mechanical Engineering
Advisor(s): Kiran D'Souza and Dushyanth Sirivolu

Foreign Object Ingestion Into Composite Fans

Biography: Mitchell Wong is a master's student at The Ohio State University working at the Gas Turbine Lab. He graduated from The Ohio State University in May 2023 with a Bachelor of Science in Mechanical Engineering continuing to pursue a master's degree in mechanical engineering. During his undergraduate career, Mitchell was involved in a variety of research projects and outreach programs. He started off as a research assistant at The Ohio State University Nuclear Reactor lab before going to the Gas Turbine Lab to work under Dr. D'Souza on uncrewed aircraft system ingestions into a generic commercial sized fan assembly model. He has also been a part of the outreach program Translating Engineering Research through K-8 where he had to design and deliver an engineering design problem to underserved K-8 students based on his research experience. Mitchell was also a Denman Undergraduate Research award recipient for his undergraduate research work and presentation at the Denman Undergraduate Research forum.

Abstract: In recent years, there has been an increase in the popularity of uncrewed aircraft systems (UASs) in commercial and hobbyist use leading to an increased chance of a midair collision between a UAS and commercial aircraft. Research has been conducted to understand the differences between the hard body impact of a UAS compared to a soft body impact of a bird. However, these previous studies have generally looked at impacts with titanium fan blades and do not typically consider the use of composite fan blades, which are becoming more common for large diameter fans. The composite material structure differs greatly from titanium since it is orthotropic compared to titanium which is modeled with isotropic properties. This work looks at verifying a composite material model on the finite element software LS-DYNA and then incorporating this material model into an open representative fan rig model used for previous bird and UAS ingestion simulations. Worst case ingestion scenarios will be tested in this fan assembly model to compare how an ingestion of a UAS into a composite fan assembly model compares to an ingestion into a titanium fan assembly model.

Publications:

- K. D'Souza, D. Sirivolu, M. Wong, and E. Kurstak, Annex A to Task A17: OSU Representative Fan Model and UAS Ingestion Studies, FAA, January 2023, https://assureuas.com/wp-content/uploads/2021/06/Task_A17_Final_Report_OSU_AnnexA.pdf
- K. D'Souza, M. Wong, D. Sirivolu, Experimental Validation of a UAS at Engine Ingestion Conditions: Part 1 Experiments, International Journal of Impact Engineering (in preparation)
- K. D'Souza, M. Wong, D. Sirivolu, Experimental Validation of a UAS at Engine Ingestion Conditions: Part 2 Model Validation, International Journal of Impact Engineering (in preparation)

Scholars



Sanskruti Admane



Senior, Physics and Astronomy
Advisor(s): Dr. Wayne Schlingman

Quantifying Debris Production in Imperfect Merger Planetary Formation Models

Biography: Sanskruti is a fourth year Astronomy and Physics double major, minoring in Computer Science. She has been doing research on the formation of terrestrial planets and the asteroid belt for two years. Sanskruti also does research on the Augustan era, in Latin literature. She grew up in Columbus, Ohio where she likes to run, bike, hammock, and play piano. Sanskruti intends to obtain a PhD in astronomy or planetary science following her graduation in May 2024.

Abstract: The giant impact era includes the Moon-forming impact but the overall scope and severity of this phase across the terrestrial planets is unknown. These violent collisions produce ejecta, some of which escape onto heliocentric orbits. Using astrophysical N-body simulations, we show that a remnant fraction of this debris likely survives from the giant impact era of planet formation to today. The capture of impact ejecta onto long-term stable orbits in the main asteroid belt is enabled by gravitational interactions with Mars. Even when considering very different terrestrial planet formation scenarios, impact debris is stranded in the asteroid belt. We study the amount of debris remaining in the asteroid belt after planet formation.

Publications: None yet.

15

Mike Carey

Douglas Baker



Academic Senior, Electrical Engineering
Advisor(s): Dr. Weisong Wang

Power Distribution and Sustainability on the Moon

Biography: Douglas Baker is a senior in the College of Engineering and Computer Science at Wright State University pursuing a bachelor's degree in electrical engineering. Prior to his enrolment at Wright State University, Douglas attended Sinclair Community College and graduated with an Associate of Science in Electrical Engineering. Douglas has always been intrigued by electronics and mathematics, which led him to his degree accordingly. This interest led him to become a teaching assistant at Wright State University. At the end of Spring 2023, Douglas will graduate with a Bachelor of Science in Electrical Engineering and is excited to start his professional career.

Abstract: With the announcement of NASA's Artemis missions, conversations about manufacturing solar cells on the moon have been more prevalent than ever. With this production of solar cells using only lunar materials, it may be beneficial to also manufacture electrical wire on the moon using the aluminum trapped in the lunar regolith. This production could free more space on the incoming spacecrafts to the moon, allowing more efficient supply missions. The refining process of this aluminum will also have a useful byproduct, that being oxygen. Having the ability to procure oxygen on the moon will be a vital step for the future of lunar expeditions. The melting point of aluminum oxide is 2,072 degrees Celsius, a temperature that will demand a significant amount of energy, depending on the ambient temperature. For this refining of aluminum to take place, energy generated on the moon, ~95% pure aluminum oxide, an efficient method of converting energy into heat must all be investigated, and energy storage devices to sustain the reaction for its entire duration.

This study is interested in finding an estimate of how much energy it takes to refine one kilogram of aluminum oxide into aluminum metal, along with the amount of oxygen produced. Should this number be sufficiently efficient, the future Artemis missions could see the use of this for their electrical wire and oxygen. This study will compare the energy cost for this reaction on two locations: south pole of the moon, and near the equator of the moon. Should the energy consumption of this refining process be sufficient, this technology has the potential to save money and reduce the payload for the Artemis missions.

Publications: None yet.

10

Michael R. Turner

Rachael Ballentine



Junior, Mechanical Engineering
Advisor(s): Dr. Subhashini Ganapathy

Digital Twin for Manufacturing Purposes

Biography: Rachael Ballentine is a junior at Wright State University, majoring in Mechanical Engineering with a minor in Computer Science. She grew up in Beavercreek, Ohio and was a College Credit Plus scholar while in high school, eventually graduating from Sinclair Community College with an Associate of Science. During her time at Wright State, she has become a member of Engineers Without Borders and the Society of Women Engineers, and currently serves as the 2023-24 Treasurer for the Ohio Mu chapter of Tau Beta Pi. During her first two years of her undergraduate degree, she discovered an interest in computer science and manufacturing, and investigated those interests through her minor and her OSGC scholarship project. After graduation, she hopes to further her education by pursuing a master's degree in computer science.

Abstract: Industry 4.0 and Smart Manufacturing are revolutionizing the field of manufacturing. A push to rethink programming of manufacturing robots using Internet of Things data has come with Industry 4.0, in particular developing and utilizing the digital twin. The concept of a digital twin is a fairly recent development; today, a digital twin can be defined by three significant features: a physical model, a virtual model, and a bidirectional link for data transfer between the two. In this project, the topic of digital twins will be explored by examining the history and development of the digital twin, its structure and utilization of Industry 4.0 concepts, and current applications in manufacturing environments. A Yaskawa GP8 robotic arm and accompanying MotoSim simulation software will be used to support this research.

Publications: None yet.

Lauren Bower



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

Photovoltaic Solar Energy Collection Impacts on Ecology

Biography: Lauren Bower is a senior undergraduate student at the University of Dayton pursuing a degree in Mechanical Engineering. Lauren is interested in renewable energy and clean energy systems as she loves the outdoors and has always held a strong desire to protect the environment. At the University of Dayton, Lauren is engaged in multiple groups related to sustainability and clean energy. These include her position as president of the University of Dayton chapter of RE-volv, a national organization that strives to help non-profits implement solar panels on their buildings. She also volunteers in a peer education group on sustainable current events and living called the Sustainability Activation Program through the Hanley Sustainability Institute. Lauren has participated in multiple research projects related to increasing the equality of benefits from renewable and clean energy systems throughout her time at the university. She has worked in engineering internships for Emerson Commercial and Residential Solutions and Battery Electric Vehicle (BEV) technology with Ford Motor Company. In 2023, Lauren joined a research project consisting of collaboration between the University of Dayton Renewable and Clean Energy Systems and Ecology Departments. This project is a venture to gather more information on how photovoltaic solar prairies affect ecosystems through data collection and analysis. This research aims to mitigate effects on surrounding insect populations in future solar prairie designs.

Abstract: Reliance on renewable and clean energy is becoming more prevalent due to a need to collect energy in a way that reduces carbon emissions, reducing further pollution and harm to the environment. With the increase in usage of renewable energy collecting technology, it is important to ensure that other environmental factors are not harmed along the way. Due to their metal materials and nature of functioning, PV solar panels can change the temperatures in the areas they are placed in. However, there is not a great deal of literature on how these temperature fluctuations impact local insect life and in turn impact the ecosystems the panels are placed in. The goal of this research was to determine how the temperature fluctuates in different locations of a solar prairie due to the presence of these panels and how these temperature fluctuations affect local insect life. The study was conducted using Thermochron iButton temperature loggers. The temperature loggers were strategically placed throughout a 36-row solar prairie every four rows. The temperature loggers were placed so that in each location tracked, one resided under the panels, one resided in the aisle between the panels, and one resided in the buffer region next to the panel row. The data from the iButtons were collected using OneWireViewer and analyzed to determine trends and differences between the different locations. The trends discovered were then compared with weather data such as cloudy and sunny days as well as time of day to determine if one or more of these conditions had a large impact on the temperature differences. This information was then presented to the Ecology team to determine whether it matched with their observations of ant behaviors and how the temperatures affected ants' physical ability to live in the area.

Publications: None yet.

Grant Brautigam



Senior Mechanical Engineering
 Advisor(s): Dr. Jed Marquart

The Magnus Effect on Non-Circular Cross Sections

Biography: Grant Brautigam studies Mechanical engineering at Ohio Northern University. He is from the small town of New Bremen Ohio. Grant became a member of the Ohio Iota Chapter of Tau Beta Pi his junior year and continues to stay involved during his senior year. Over the course of Grant’s studies, he has become interested in robotics and aerospace topics. Grant will begin his career in the automation industry with hopes of becoming a very skilled and knowledgeable engineer.

Abstract: Most of the time the magnus effect is only associated with rotating objects with circular cross sections. It was desired to determine if the magnus affect can be seen in cases where a non-circular cross section is present. It is also desired to quantify the increase in lift between rotating and non-rotating situations. A flat plate produced boundary layers on its top and bottom surfaces when moving forward though air. By turning the flat plate into a conveyor belt the boundary layer on top is now reduced and the bottom is increased due to the no slip condition. This does not produce a large increase in lift, however an effect similar to the magnus effect may be present. Small increases in lift sometimes can create big cost savings for big airline companies but only if the cost of the system is not too large to install and operate.

Publications: None yet.

Megan Brockway



Undergraduate Junior, Mechanical Engineering
 Advisor: Dr. Mark Sidebottom

Evaluation of Wear and Friction Properties of High Temperature Polymer Blends

Biography: Megan Brockway is a 3rd year student at Miami University studying Mechanical Engineering, with a minor in Humanitarian Engineering and Computing. She will graduate in May 2025, and will look to join the workforce after graduation. She started work in the Materials Tribology lab at Miami University in August of 2022, working under Dr. Mark Sidebottom. She has also worked for Miami's Wilks Institute as a Leadership Development, working to create leadership programming for students, especially surrounding Gallup's Clifton Strengths. She worked for GE Aerospace in the Summer of 2023, with the facilities team.

Abstract: Understanding the wear and friction properties of an exciting polymer blend system composed of polyimide (PI) and polytetrafluoroethylene (PTFE) manufactured using a new method could have broad applications. Prior studies on PI-PTFE blends have shown excellent friction and wear performance but manufacturing of this blend requires excellent dispersion of PI and PTFE powder before processing begins. Without proper dispersion, this material loses significant mechanical properties and wears away significantly faster. An alternative manufacturing process, developed by a leading fluoropolymer manufacturer (Fluoroplastics, Inc., Philadelphia, PA), will be used to develop an alternate blend of PI-PTFE. Samples of this material and other commercially available polymer blends/polymer composites will be provided by Fluoroplastics Inc. to Miami University to evaluate their friction and wear properties in identical conditions. Samples are being tested using a Linear Reciprocator Flat-on-Flat Tribometer. Preliminary testing of eight polymer and polymer composite samples over a total sliding distance of 25 km was performed. Other testing conditions included a 50 mm/s sliding velocity and 6.3 MPa contact pressure. Results from testing show a coefficient of friction values ranging between 0.11 - 0.24 (unitless), and a wear rate in the range of 2.09×10^{-8} - 3.66×10^{-4} (mm^3/Nm). Additional tests will be completed at a wide range of temperatures to determine the allowable temperature range. This data will be used by the tribology community and by Fluoroplastics, Inc. to help suppliers match customer needs for high temperature bearing applications.

Publications: N/A

8

Warren Davidson

Marek Brodke



Junior, Aerospace Engineering
Advisor(s): Khare Prashant

Workflow Generation and Implementation for the Simulation of Hypersonic Flows

Biography: My name is Marek Brodke and I am a 4th year Aerospace Engineering and Mathematics student at the University of Cincinnati. I developed my interest in these topics at a young age while working on a cattle farm. There I was exposed to large machines that I was soon fascinated by; I was particularly fascinated by how a diesel engine operates (I am still fascinated by it). This fascination led me down the path of studying engines and other forms of extracting energy and along the way I became a member of a FIRST robotics team. As a member and mentor of that team, I gained the skills to further explore my passion as well as valuable connections for the future. Currently, I am exploring more advanced topics in math, specifically analysis, and I am looking forward to continuing to share my passions with others.

Abstract: Traditionally, the time from the acquisition of geometry and conditions for a fluid dynamic simulation to the simulation result is long, often it can be years. We hope to shorten this time by developing a workflow to decrease the time per simulation. This workflow starts with geometry, moving to gridding of the simulation domain, and finally executing the simulation. The final result of our efforts will be a clear procedure and an automated process to go from geometry to the simulation result. Additionally, an automated data analysis tool set to help visualize the results efficiently and effectively. We will then apply this workflow to a variety of solvers to simulate hypersonic flows, the solvers include DSMC and traditional continuum flow solvers. In doing this, we will compare the accuracy and the computation cost of each solver.

Publications: None yet.

Bryant Burton



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

Aircraft Vehicle Thermal Management through Modeling and Simulation

Biography: My name is Bryant Burton, and I am a student at Wright State University. I am currently a junior studying mechanical engineering and have learned so much about the aerospace industry. I am currently employed at Wright Patterson Air Force Base (WPAFB), as a student intern and expected to graduate in Fall 2024. I am an accomplished programmer and designer planning to pursue a 4 + 1 master's degree in mechanical engineering. The question to pursue a PhD is unknown, my goal is to receive a Doctorate at Purdue University. As an undergraduate student what I want to study is not defined but I am interested in the thermal fluid track at Wright State. In the far future, hopefully I can educate young adults and continue to collaborate with large facilities such as WPAFB.

Abstract: For most aerospace applications, modeling and simulation of the different components like the engine, flight controls, airframe, etc. need to be accurate and able to interface with each other. This study examines a previous tip-to-tail (T2T) aircraft model and adjust subsystem models in order to meet the needs of future aircraft. The original model consists of different transient subsystems including the thermal management system of a fourth-generation F-16. The initial T2T model was developed by AFRL and WSU researchers in 2015. The purpose of this research is to improve the T2T models for fifth-generation aircraft like the F-35. Not only will the model be updated to the most recent software, various subsystems of the aircraft will be modified to model a fifth-generation aircraft. Finally, research on different subsystem's affects will be analyzed for both a manned aircraft and an unmanned aircraft. The current model has capabilities to be a versatile source for aircraft analysis and this project will expand these boundaries. Along with versatility, an updated model would bring higher accuracy and time efficiency to the conceptual design process.

Publications: None yet.

10

Michael R. Turner

McKenzi Buttrey



Senior, Mechanical Engineering
 Advisor: Dr. Brian L. Davis

Relationship between shear stress distribution and spatial derivatives of plantar pressure.

Biography: McKenzie Buttrey is an undergraduate student at Cleveland State University studying Mechanical Engineering. At a young age she was diagnosed with type one diabetes. McKenzie’s diagnosis sparked an interest in participating in research and a passion for helping others. Growing up she was always intrigued with how things work and how they are made which led her down the path of engineering. McKenzie was a Quality Engineering Co-op for PCC Airfoils, starting in the summer of 2022 until January of 2023. During the summer of 2023, she interned at Xellia Pharmaceuticals in Bedford, Ohio. Upon completion of her bachelor’s degree, she plans to establish a career in the engineering field and potentially further her education.

Abstract: This study investigates the relationship between shear stress and skin pressure (or its spatial derivatives). Cleveland State University has a ISSI Gait Analysis System that utilizes a system called FootSTEPS. This machine measures skin shear and pressure on a human foot during the gait cycle with a resolution of 2mm by 2mm, and a sampling rate of 100Hz. FootSTEPS produces high resolution images of shear as well as pressure across the foot as an individual walks across the platform. Subjects are both patients with diabetes and control subjects. The data analysis utilizing artificial intelligence to determine if shearing stresses can be estimated using pressure alone. If this relationship is able to be determined, this will offer a potential solution to the problem of assessing skin shearing inside of a subject’s shoe without additional in-shoe devices.

Publications: None yet.



Ethan Cartwright



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

Jet Thrust Vectoring with Plasma Actuators

Biography: Ethan is a 4th year undergraduate aerospace engineering student at the Ohio State University. His research interests include aerodynamic and propulsion applications wherein he plans to pursue a PhD in aerospace engineering. Additionally, he has passions for teaching, humanitarian engineering and engineering education.

Abstract: Thrust vectoring, the action of altering the direction of jet flow, has been used in aerospace applications to enable more aggressive maneuvers and allow for a shorter take off distance. It accomplishes this by effectively generating additional lift in a particular direction. Past works have successfully achieved significant thrust vectoring accompanied by drawbacks such as increased mechanical complexity and weight, or reduction in thrust output. This study seeks to use Localized Arc Filament Plasma Actuators (LAFPAs) to achieve thrust vectoring. This strategy for thrust vectoring leverages instabilities inherent in turbulent flow to establish authority over vortex formation in the exhaust nozzle boundary layer. LAFPAs are embedded just upstream of the reaction surface and pulsed at discrete intervals which form plasma arcs at a constant pulse-repetition frequency. The plasma arcs impart high-temperature disturbances in the flow, causing it to trigger vortex formation which entrain fluid as they propagate downstream. Alteration in excitation frequency is expected to impact vortex growth and development which results in entrainment of differing amounts of fluid. This causes the jet to attach to the reaction surface by varying amounts and in varying directions, thus deflecting it and the thrust vector.

This study looks to explore the thrust vectoring capability of these LAFPA plasma actuators. In particular, a curved nozzle extension embedded with 8 LAFPA electrodes just upstream of the reaction surface—symmetrically spaced by 45 degrees azimuthally—is secured to a jet nozzle housed in an anechoic chamber. The jet opens to a backward facing step within the nozzle extension containing the curved reaction surface which flares to a 15-degree termination angle. LAFPA capability in altering the thrust vector by deflecting the jet is assessed across actuation frequencies and number of active LAFPAs. Their effects are documented using an azimuthally static pressure tap array and will be expanded upon in the future. An expected trend of increased suction at low actuation frequencies and decreased suction at higher frequencies is found. To verify and quantify the connection between these pressure profiles and thrust vectoring of the jet, data collection will be expanded to include streamwise PIV and oil-flow visualization which will better capture vortex dynamics within the shear layer.

Publications: Mills, D., Cartwright, E., & Webb, N. J. (2023, June 12). Asymmetric Control of Subsonic Axisymmetric Jet Aerodynamics using Plasma Actuators. *AIAA AVIATION 2023 Forum*. AIAA AVIATION 2023 Forum, San Diego, CA and Online. <https://doi.org/10.2514/6.2023-3954>

Andreas Chaffey



Junior, Mechanical Engineering
Advisor(s): Timothy Norman Ph.D.

Fatigue and Fracture of 3D Printed Titanium

Biography: My name is Andreas Chaffey, and I am a Junior Mechanical Engineer studying at Cedarville University. I was born in the Bay Area of California but moved to Charlotte, North Carolina when I was about eight. My dad grew up in the Bay Area, while my mom grew up abroad in South/Central America and Africa. I've always been building things, taking things apart, and figuring out how they work for as long as I can remember. My dad has worked in construction his whole life, so I learned how to use tools and basic building concepts at a young age. I have designed and built many different things in my free time, and I'm always thinking of how to make something new. This carried over in my studying Mechanical Engineering and seeking to better understand how various machines and their components are made. I hope to one day bring these skills to bear on whichever field I end up in, whether that be Aerospace, Automotive, or Defense.

Abstract: Three-dimensional (3D) printing has become common among manufacturers of small complex parts. More recently high-performance metals like Titanium are being used. However, the effects of 3D printing on mechanical behavior are not well understood. In particular, as-printed surfaces can have irregular rough topography resulting in high roughness (Ra) compared to traditionally manufactured parts. Of particular concern is notches, where stress concentrations for conventional manufacturing are well understood. This project will investigate the mechanical behavior of 3D Printed titanium. We hope to answer the questions "how does the printing process alter the notch sensitivity" and "how do current methods (e.g. hipping) to mitigate effects of printing influence the mechanical properties." Material characterization will include strength, hardness, hardness fatigue and fracture mechanics. Analysis will include testing and failure characterization using photomicrographs.

Publications: None yet.

Kennedy Couch



Senior, Biochemistry
 Advisor(s): Dr. Suzanne Parsons

Analysis of Paraben Induced Caspase-3 Activation in Human M624 Melanoma Cells versus Normal HaCat Epithelial Cells

Biography: I am a senior at Marietta College majoring in Biochemistry and minoring in Leadership. I aspire to be a dermatologist and will be attending medical school in the fall. I am involved with many organizations on my campus and community. I founded Women in STEM at Marietta College which was established in 2022 and through this opportunity, mentorship has become one of my passions. I am also vice president of biology club, a hospital volunteer at Marietta Memorial, and a resident assistant at my campus. Over the past four years, I have had the opportunity to pursue melanoma cell research which I plan to continue in the future. Outside of the lab you can find me running, hiking, or enjoying time with friends and family!

Abstract: Paraben, a common antimicrobial agent used in a wide variety of industrial, cosmetic, and pharmaceutical products, has been used for many years due to their ability to maintain a neutral pH and their odorless and colorless properties. While parabens have been found in everyday products for a number of years, controversies over their use have arisen as they have been linked to adverse effects and multiple skin cancers including malignant, melanoma, and contact eczema in the last several years. In this study, human melanoma cells and human normal epithelial cells were treated with 0.05-10mM paraben solution, consistent with IC_{50} values. Parabens were dissolved in ethanol or methanol solvent and added to complete DMEM for cell treatment. Methylparaben (methyl 4-hydroxybenzoate) and two paraben derivatives, mononitroparaben and helptylparaben, were used. A colorimetric Caspase-3 microplate assay kit was used to assess the ability of these compounds to induce apoptosis. Previous research has shown parabens have induced apoptosis in human melanoma cells, while this study will assess parabens' ability to induce apoptosis in normal human epithelial HaCat cells versus human melanoma M624 cells and provide support for the continued study of paraben as a possible topical treatment for melanoma.

Publications: In progress



Natalie Dando



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

Thermo-Responsive Bacteria-based Engineered Biohybrid Material Platform

Biography: Natalie is currently a third-year undergraduate student at Youngstown State University working on dual degrees in both Chemical Engineering and Mathematics. She is involved in several clubs and organizations at Youngstown State University, including the Honors College, Choose Ohio First, Club Tennis, Society of Women Engineers, Association for Women in Mathematics, and Pi Mu Epsilon. Through the Honors College, Natalie serves the Youngstown community through her work as Community Fellow for Pen Pals, where she coordinates a pen pal program between honors students and over 400 elementary students between three local schools. Natalie is from Green, Ohio. At home, she enjoys spending time with her family, friends, and dogs. After earning her bachelor's degrees, Natalie hopes to attend graduate school to continue learning and growing.

Abstract: The combination of multifunctional biomaterials and living cells has given rise to the field of engineered living materials where living cells such as bacteria function as active components of material's design and performance. Genetically modified microorganisms have been encapsulated in hydrogels and used as a part of the living therapeutics for the treatment of skin diseases. On-demand drug delivery is often required for advanced therapeutic applications. In this project, the thermo-responsive bacteria-based engineered biohybrid material platform (EBMP) was developed as a proof of concept transdermal design for production and regulation of green fluorescence protein (GFP) expression has been explored. The thermo-responsive EBMP consists of a hydrogel containing genetically modified probiotic bacteria, *Escherichia coli* Nissle 1917 (EcN). This study investigates the growth and metabolic activity of bacteria within an associative hydrogel.

Publications: None yet.

Simon DeBruin



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

Development of a Pulse Simulator Using a Solenoid System to Reproduce Human Radial Pulse Waveforms

Biography: Simon is a senior undergraduate student studying Mechanical Engineering with a minor in Humanitarian Engineering & Computing at Miami University. An active member of the student body, he is a member of Theta Tau, sings with the Miami Men’s Glee Club, and is president of Alpha Phi Omega’s Zeta Delta Chapter. Previously, Simon worked on an engineering education research project during his junior year. After graduation, he is planning on working in the healthcare field. Outside of school, Simon enjoys playing board games, going for walks, and creating spreadsheets.

Abstract: Radial pulses, measured in the radial artery at the terminal region of the wrist, are widely used to infer one's health. For thousands of years, Oriental medicine practitioners have employed palpation of radial pulses using three fingers as their primary diagnosis method. In recent years, wearable technology has enabled continuous monitoring of many vitals in real-time, and wrist-worn devices, such as smartwatches, strive to measure blood pressure non-invasively using radial pulses. Thus, pulse simulators that can generate a range of radial pulses consistently and repeatedly can play an important role in advancing radial pulse-based technologies and medical practices. Regenerated actual human radial pulses can be used to validate or calibrate wearable sensors and to study the pulse diagnosis method toward standardization of radial pulses. The goal of this study is to design and test a new pulse simulator that incorporates solenoid valves to reproduce a wide range of radial pulses. The overall experimental setup includes two solenoid valves, an air compressor, an Arduino board, and a relating circuit. The air compressor feeds pressure into the input solenoid valve. Using inputs from the user, the circuit opens and closes the input value and an optional release valve to regulate the pressure waveform. This changed waveform is read by a pressure sensor at the end of the system. Using this setup, a series of testing will be conducted by varying inputs the solenoid valves receive. By editing the responses, different pressure waveforms can be generated. This study examines the pulse shaping performance of the solenoid system by comparing the reproduced radial pulses with those of in vivo radial pulses. The findings of this study can lead to the development of a sensor evaluation platform that will contribute to enhancing the sensor technology for wearable healthcare devices. Moreover, they could aid in modernizing the pulse diagnosis technique and training healthcare professionals with pulse diagnosis.

Publications: None yet.

Ryan Dippolito



Senior, Mechanical Engineering
 Advisor(s): Dr. Manigandan Kannan, Dr. Julie Zhao

Computer Aided Design and Finite Element Analysis of Vibration Tested Components

Biography: I am a Senior Mechanical Engineering student at the University of Akron. Since starting at Akron in the Fall of 2018, I have been involved thoroughly on our school’s rocket design team, the Akronauts. During my time with the rocket team, I served as the team’s Aerostructure lead, then the team’s Chief Mechanical Engineer for two years. This year, I am the team’s safety officer. A couple of our notable awards are winning 3rd overall in the NASA Student Launch Initiative in 2019, the Jim Furfaro Award for Technical Excellence at the Spaceport America Cup in 2022, and then runner-up in the 30K SRAD Category at Spaceport America in 2023. Outside of rocket team, I spent two co-op rotations with Collins Aerospace working in Stress Analysis and Design for military landing gear in Spring 2020 and Fall 2020. From there, I obtained a Pathways Internship with Johnson Space Center in Houston, Texas where I completed 5 co-ops ranging from Mission Control, Liquid Propulsion, Life Support Systems, and Active Thermal Control for human rated spacecraft. At UA, I’ve had the opportunity to work under Dr. Kannan as an undergraduate research assistant for about two years. Last year, I obtained the OSGC undergraduate scholarship and completed a full year of research on surface treatments for Additively Manufactured Titanium, which led to my first publication. This scholarship has not only helped me tremendously financially, but it has allowed me to grow as an engineer in the world of research. For this, I am very grateful. Moving forward, I have accepted a full-time position as an Aerospace Engineer with JSC working in Active Thermal Control. Outside of work/school, I love powerlifting, cooking, and am a blue belt in Brazilian Jui-Jitsu.

Abstract: This work is in support of Department of Air Force funded projects focused on fatigue elimination in aerospace parts and fatigue assessment of new materials and manufacturing processes. Specifically, the Inherent Damping via AM Processes (i-DAMP) solution is being used to design a compressor blade with a known defective at a high stress region, and an accelerated fatigue testing apparatus and method for rapidly acquiring low-cost data is being validated and demonstrated. The proposed activity will focus on create a CAD model for the i-DAMP compressor blade and the accelerated fatigue specimen. The CAD models will then be imported to a finite element software package, and a detailed modal analysis will be conducted. This process is iterative as needed to support the objectives of the funded efforts.

Publications: None yet for this project. For last years OSGC Project:

<https://www.researchgate.net/publication/374907394> Grinding EB-PBF based additive manufactured Ti6Al4V A surface integrity study



Alex Dotson



Senior, Manufacturing Engineering
Advisor(s): Augustus Morris

High Altitude Ballooning (Atmospheric Validation)

Biography: My name is Alex Dotson, I am 23 years old. I was born and raised in Cincinnati, Ohio. I am a full-time student at Central State University in Wilberforce, Ohio, where I am pursuing my bachelor's degree in manufacturing engineering. I graduated from Purcell Marian High School. I'm someone who loves to challenge myself and uplift others. My hobbies are swimming, fishing, and working out. My fluency in ASL is one of my unique personal traits. Having volunteered as a youth mentor in previous summers, I would say that I have a strong enthusiasm for coaching. I have coached and counseled young people in basketball, baseball, and swimming at a local youth organization called the Friars Club. This is only an example of ways I try to give back to my community and the local youth as this is the same program I attended in my past.

Abstract: High altitude ballooning research serves as a pivotal platform for a multitude of scientific investigations and technological advancements. By employing high-altitude balloons, researchers can access the stratosphere, offering unique opportunities to study various phenomena, including atmospheric conditions, cosmic radiation, and climate patterns. Additionally, high altitude ballooning facilitates the testing of novel instruments and technologies destined for space missions, offering a cost-effective and controlled environment for validation. Moreover, these endeavors contribute to our understanding of Earth's atmosphere and provide invaluable insights into space exploration, remote sensing, and environmental monitoring.

The primary objective of conducting a high altitude balloon project is to achieve scientific or technological goals that necessitate access to the stratosphere. Whether it's studying atmospheric dynamics, monitoring environmental conditions, testing new instruments, or conducting experiments relevant to space exploration, the end goal is to gather data and insights that contribute to advancing our understanding of the universe and improving technology. These projects often aim to push the boundaries of knowledge, solve pressing scientific questions, or develop practical solutions for real-world challenges. Ultimately, the overarching objective is to leverage the unique capabilities of high altitude ballooning to facilitate research that has significant implications for various fields, from Earth science to astrophysics to aerospace engineering.

Publications: None yet.

Julie Dunlap



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

Ethanol-induced neural activity in male compared to female rats

Biography: Julie Dunlap is a junior at Baldwin Wallace University pursuing a bachelor's degree in neuroscience. Julie is currently following the pre-med track required to apply for medical school. She grew up in North Canton, Ohio, and attended Hoover High School, where her interest in the medical field grew after taking a three-year set of biomedical science classes provided by Project Lead the Way. At Baldwin Wallace, she is a member of many clubs including Pre-Medical Society, the Interdisciplinary Neuroscience Society, and the Fellowship of Christian Athletes. She also plays Varsity Soccer, is a Choose Ohio First Stem Scholar Peer Mentor, and is the campus outreach chair of the Student Athlete Advisory Committee. Her research aims to investigate sex differences in neural activity induced by ethanol using a rat model.

Abstract: The goal of this study is to determine if systemic ethanol administration induces neural activity in brain regions in female rats differently than it does in male rats. Most of the studies reviewed used exclusively male rats, and this project seeks to determine if alcohol's impact is different in female rats. This experiment may be used as preliminary research for future studies in the behavioral neuroscience lab at BW that will focus specifically on female rats.

To do this, a group of female and a group of male rats will be exposed to saline injections prior to the experiment to acclimate them to the injection so that stress of the large injection on experiment day will not influence our data. On experiment day, the group of female and the group of male rats will either be exposed to a different concentration of ethanol or saline. Thirty minutes after injection the blood alcohol levels will be taken via a breathalyzer container. Then, two hours after the injection, the rats will be euthanized and perfused, after which their brains will be collected. The brains will be sliced and stained, and we will evaluate neural activity (as shown by expression of Fos protein) in brain regions that are part of the limbic system, which processes information and guides behavior based on reward. The data will be analyzed to determine if there are differences in Fos levels induced by ethanol between female and male rats.

Publications: None yet.

Grant Eifert



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

Design Space Exploration for a Novel Self-Healing Elastomer, Informed by Bayesian Optimization

Biography: Grant Eifert is a fifth-year undergraduate student at the University of Dayton (UD) pursuing a degree in Mechanical Engineering with a graduate certificate in Six Sigma and Operational Excellence. At UD, Grant has been involved in a variety of activities including leadership roles as Vice President of the American Society of Mechanical Engineers student club and President of the Pi Tau Sigma Mechanical Engineering Honor Society. Grant has been an engineering intern for multiple rotations at Allison Transmission as well as Ethicon, a subsidiary of Johnson & Johnson. In 2022, he joined the Behavior of Advanced Materials and Structures (BAMS) Lab to support the development of proof-of-concept soft robots. Continuing his research in the space of soft materials, Grant engaged in a collaborative effort between the BAMS Lab and the Polymer and Responsive Materials Team at the Air Force Research Laboratory (AFRL/RXES) to explore material optimization throughout 2023.

Abstract: Self-healing elastomers are an emerging class of materials capable of mitigating vulnerability to externally-induced damage, similar to biological tissues. Recent advancements in polymer chemistry have led to self-healing elastomers that are 3D-printable, exhibit real-time self-healing in the absence of external stimuli (e.g., heat, light), and use commercially available (COTS) precursors to enable production at scale. However, at present, the trade-offs between virgin mechanical properties and self-healing efficiency that can be enabled by tuning chemical composition are not well known. To address this compelling research opportunity, this talk presents an experimental program – informed by a Bayesian optimization platform – to (a) facilitate design space exploration and (b) investigate the interplay between virgin mechanical properties (i.e., hardness and toughness) and self-healing efficiency (e.g., ratio of healed toughness to virgin toughness) as chemical composition is varied. The material of interest is BeckOHflex, a new hybrid acrylate/thiol-ene elastomer that exhibits real-time, autonomous self-healing and is exclusively prepared from COTS precursors. The experimental design was conducted by varying the crosslinker and thiol components from 0-10% by volume while holding the molar ratio of acrylate and photoinitiator constant. Test samples were cast in custom silicone molds and cured using an external UV lamp. Hardness data was obtained using an analog Shore OO durometer, and mechanical property data was collected through uniaxial tension testing, leveraging machine vision cameras and open-source image processing software to optically measure strain. Informed by previous-iteration experimental inputs (chemical composition) and the resulting outputs from mechanical testing (virgin hardness, virgin toughness, and self-healing efficiency), a Bayesian optimization platform (EBDO+) was used to suggest next-iteration experimental inputs. Through this iterative process of synthesizing, testing, and analyzing different compositions throughout the experimental campaign, a well-defined Pareto frontier will be determined to bound the design space, allowing for a fundamental, quantitative understanding of tradeoffs between virgin mechanical properties and self-healing efficiency. It is expected that the Pareto frontier will be determined after tens of experiments out of a possible 2,000+ discrete input parameter combinations.

Publications: None yet.

10

Michael Turner

Duncan Fraser



Senior, Biochemistry

Advisor(s): Dr. Suzanne Parsons, Dr. Eric Parsons

Synthesis of Novel Paraben Derivatives

Biography: I am a senior biochemistry major attending Marietta College. I am also a member of my school's Division 1 men's rowing team and an Eagle Scout. Throughout my undergraduate research career, I have focused both on the biochemical aspects of parabens and how they relate to cell death as well as the organic synthesis of these parabens. Outside of my usually busy schedule, I enjoy cycling, cooking, and camping.

Abstract: Parabens are a chemical preservative typically used in personal hygiene products and other household items. While the effects of parabens with carbon chains or nitro groups attached have been studied, there is a lack of research on what the effect of the combination of these two groups results in. Using an esterification and a nitration reaction, a new paraben synthesis pathway was developed. This pathway, if successful, allows for the use of these two reactions to create a library of parabens which contain both a nitro group and carbon chains.

Publications: None yet.

Angelina Gentilin



Senior, Neuroscience and Psychology
 Advisor(s): Dr. Jeffrey Zahratka

Modulation of Noxious Stimuli Reactivity and AMPA Receptor Localization in Sensory Neuron Development in a *C. elegans* Autism Spectrum Disorder Model

Biography: Since I began my research proposal, I have contributed around 2000 hours to this project, including data collection, literature reviews, grant proposals, and research competitions. I first became interested in this topic due to personal loved ones sharing an ASD diagnosis, which drew me towards the subject. However, the translational nature of this research is what most closely aligns with my career aspirations. Investigating the neural circuitry involved with a developmental disorder for a potential treatment mechanism could significantly influence my career in the future. My career plans include going to medical school in the specialty of psychiatry. I have always been passionate about mental health work, and my past experiences reflect my love for the field. Therefore, the drive behind my research is to contribute to the knowledge base surrounding these disorders in hopes of securing treatment that could help a patient. Hopefully, that patient will be in my care, and I will be able to witness the influence of these treatments.

Abstract: Neurodevelopmental autism spectrum disorder (ASD) is a common diagnosis, where one in every 100 children is diagnosed globally, typically characterized by aberrant social behaviors and reactions to sensory stimuli (Bailey et al., 1996; Orefice et al., 2016; Zeidan et al., 2022). While there is limited research investigating the mutations of this diagnosis, 22q13.3 deletion syndrome, specifically the recurring breakpoint in the *SHANK3* gene, has been correlated with ASD development. (Bonaglia et al., 2001; Leblond et al., 2014; Uchino & Waga, 2013). The SHANK3 protein is part of a family of scaffolding proteins involved in excitatory glutaminergic signaling in postsynaptic densities (Lim et al., 1999). Some of these signaling pathways target the ionotropic glutamate AMPA receptor, to which the GluA1 subunit of the receptor directly binds to the PDZ domain of SHANK3 (Colquhoun et al., 1992; Julio-Pieper et al., 2011; Uchino et al., 2006). Further implications demonstrate decreased AMPA receptor-mediated signaling in a SHANK3 mutant model (Arons et al., 2012). While this suggests a basis for the neural mechanism behind ASD, the SHANK3 mutation needs to reflect similar behavioral patterns. While SHANK3 mutant mice models have displayed similar abnormal social and repetitive behaviors, there has been limited research on reactions to nociceptive stimuli (Han et al., 2016; Monteiro & Feng, 2017). Therefore, to further the knowledge on ASDs, the model organism *Caenorhabditis elegans* can be investigated with a mutation in SHN-1, a SHANK3 protein homologue, to image the localization of AMPA receptors in postsynaptic densities and measure reactions to noxious stimulus presentation (Jee et al., 2004; Oh et al., 2011).

C. elegans are essential in measuring biological processes and their development (Brenner, 1974). Their genome has been completely sequenced, and a significantly large percentage of the *C. elegans* genome has been identified to possess a human counterpart (Harris, 2004). Moreover, around 40% of human disease genes have been characterized with *C. elegans* homologs (Baumeister & Ge, 2002). The vast knowledge of their genome allows for simple genetic manipulation, to which identifiable phenotypes can be observed (Hariharan & Haber, 2003). Some of these phenotypes are displayed through behavioral responses, which *C. elegans* exhibit to a wide range of stimuli. In addition to observable phenotypes, *C. elegans* are translucent, allowing *in vivo* fluorescent markers to tag a desired protein during live animal imaging. Due to the identical development of the organism in a short (3.5 day) life cycle, *C. elegans* provide the useful opportunity to investigate the developmental processes within a specific strain. From this, SHN-1 in *C. elegans* has been identified as a reliable protein homologue of SHANK3 in humans, to which a mutation can be studied as an autism spectrum disorder model.

Publications: None yet.

Julia Gersey



Senior, Computer Science & Applied Mathematics
 Advisor(s): Dr. Brian Krupp

Fine-Grained Air Quality Sensing with IoT

Biography: Julia Gersey is a Senior at Baldwin Wallace University, majoring in both Computer Science and Applied Mathematics. She grew up in Solon, Ohio, and attended Solon High School, where her interests in Computing and Mathematics grew after taking AP Computer Science and Algebra/Calculus classes. At Baldwin Wallace, she is a member of the MOPS (Mobile and IoT for Planet and Society) Research Group and leads multiple student clubs focusing on environmental action (SEA), women in computing (ACM-W), and hosting computing camps for kids (CS+). Her research interests focus on using computing to help her community and the environment through IoT and mobile sensing platforms. Upon graduating in May of 2024, she plans to pursue a PhD in Computer Science.

Abstract: The World Health Organization states there are “4.2 million deaths every year as a result of exposure to ambient (outdoor) air pollution”. Additionally, they report that “9 out of 10 people worldwide live in places where air quality exceeds WHO guideline limits”. For Northeast Ohio, there are only a few sparsely deployed EPA air quality sensors monitoring particulate matter 2.5 (PM 2.5) levels, the PM type that poses the most significant health risk for humans. We built and deployed low-cost, low-power Internet-of-Things (IoT) monitors to provide more fine-grained data. We partnered with PCs for People, a company that offers refurbished computers and internet access to the community at low to zero cost, allowing our sensors to be placed in their existing Wi-Fi hotspot towers, giving power and connectivity. From this deployment, we could determine a significant difference between two locations less than 4 miles apart where the average particulate matter reading was more than double. These findings show that fine-grained air quality monitoring can give the community more meaningful data about their air. We have publicly made this air quality data available on our website (<https://mops.bw.edu/>).

Currently, we are working on deploying more sensors both on our campus and throughout Cleveland, implementing LoRa and BLE connectivity to be able to expand our area of coverage, and teaching an after-school computer science curriculum to a local middle school so the students can build air quality monitors, providing an opportunity for them to learn computer science and engineering topics.

Publications:

3. **Julia Gersey**, Brian Krupp, Jonathon Fagert, Tony Mlady. "Pilot Study of Deploying IoT Micro Air Quality Sensors in an Urban Environment: Lessons Learned". 2023 ACM Consortium for Computing Sciences in Colleges Midwestern Conference.
2. Brian Krupp, **Julia Gersey**, Jonathon Fagert, Tony Mlady. "Towards Fine-Grained Air Quality Sensing in Urban Environments". 2022 ACM Conference on Embedded Networked Sensor Systems.
1. Brian Krupp, **Julia Gersey**, Franklin Lebo. "Campus Plate: Connecting Students on College Campuses to Reduce Food Waste and Food Insecurity". 2022 International Conference on Research in Adaptive and Convergent Systems.

Aimee Ghanem



Senior, Aerospace Engineering and Mechanical Engineering
 Advisor(s): Dr. Chirag R. Kharangate

Flow Visualization Studies for the Closed Loop Two-Phase Flow Chill-down Test Module for Future Integration with the Flow Boiling and Condensation Experiment onboard the International Space Station

Biography: Aimee Ghanem is a senior at Case Western Reserve University double majoring in Aerospace Engineering and Mechanical Engineering. Aimee is also enrolled in the BS/MS program which enables her to take graduate courses while still an undergraduate. She aims to complete her Master of Science in Aerospace Engineering, thesis-focused with a concentration in aeronautics, a year after graduation. As an undergraduate student she is a member of the Case Aeronautics Team, the Lux chapter of the Mortar Board National Senior Honors Society, and Women in Science and Engineering Roundtable (WISER). In fall 2023 she interned at Lincoln Electric in the machine R&D department, and in summer 2023 she interned at NASA Glenn Research Center in the Acoustics branch. Recently, she has joined the Two-Phase Flow and Thermal Management lab where she supports the “Flow Visualization Studies for the Closed Loop Two-Phase Flow Chill-down Test Module for Future Integration with the Flow Boiling and Condensation Experiment onboard the International Space Station” project.

Abstract: Success of NASA’s future space exploration missions is dependent on cryogenic fluid management systems being able to provide safe, effective, and reliable supply of cryogenic fluid to a variety of systems. A key technological challenge in this, as recognized by NASA, is the line chilldown and transfer process. For understanding chilldown process under microgravity, chilldown tests with a simulant fluid like normal perflourohexane (nPFH) can be conducted in the Flow Boiling and Condensation Experiments (FBCE) module currently available in the International Space Station (ISS). The focus of the present work is to develop and test a chilldown experimental setup under terrestrial conditions in a closed loop with PF-5060 as the working fluid.

In this project, the study will focus on high-speed imaging of the different flow boiling regimes, viz., film, transition, and nucleate boiling regimes during the chilldown of a pyrex tube. The flow regimes will be captured and correlated with the wall heat flux data to better understand and predict the transfer line chilldown process. The results from these ground-based flow visualization experiments are crucial to the development of the flow visualization test section for the space station experiments.

Publications: None yet.

James Gilger



Junior, Aerospace Engineering
Advisor(s): Dr. Donghoon Kim

Digital Twin Model Design and Development for a Spacecraft Simulator

Biography: I am a third-year student from the University of Cincinnati in Aerospace Engineering and Computer Science. Within my career, I hope to utilize and apply the technical knowledge of software to spacecraft systems. Currently, I am an undergraduate research participant the Integrated Autonomous Systems Research Laboratory led by Dr. Donghoon Kim, in which I have learned and practiced how to implement mathematic/computing tools to astronautics research. Additionally, I have experience working with ENSCO Avionics Inc, where I was a member of the software development team for an updated test environment for Lycoming engines. Participating in this valuable experience during my undergraduate career will greatly benefit me as I intend to pursue a master's and doctorate degree in engineering or computer science upon graduation. Outside of school, I am also a founding member and Secretary of the Ohio Theta chapter of the Phi Delta Theta fraternity at the University of Cincinnati and a member of UC Campus Outreach.

Abstract: Advances in space missions and technologies, including spacecraft control, fault-tolerant control algorithms, and in-space service mission support technologies, require hardware-in-the-loop (HIL) spacecraft and satellite simulators to validate these technologies on the ground. As part of these simulators, we are building a CubeSat model to test various postural control algorithms, along with a digital twin counterpart. A digital twin is a digital representation of an intended real or physical product, system, or process that is used as an effectively indistinguishable digital product for real-world purposes, such as simulation, integration, testing, monitoring, and maintenance. This model is planned to be developed by a HIL simulator supplemented with a digital twin to validate the posture control algorithm's performance, allowing researchers to improve accuracy while performing both hardware and software simulations.

The objective of this project is to design and develop a Digital Twin Model to support real-time HIL simulation of the attitude control mechanism in satellites. The Digital Twin will be created by detailed examination of physical hardware components, modeling the digital counterparts, and comparing the output data of the HIL tests to the output of the model. Based on discrepancies in this output data, the twin will be refined and modified to better represent the output of the hardware system in a computationally efficient, near-real-time manner. This will allow the researchers to supplement the data from hardware testing with the concurrent data from the digital twin in their tests, providing researchers with a wider range of input conditions to the model than would be possible for the hardware counterpart, allowing tests to be completed in a shorter amount of time at less cost.

Publications: None yet.

3

Joyce Betty



Ian Harris



Junior, Aerospace Engineering, Astrophysics and Astronomy, and Physics
Advisor(s): Dr. John Horack

Cabin Atmosphere Filtration using Ambient Air Ionization

Biography: My name is Ian Harris and I am a junior at The Ohio State University majoring in Aerospace Engineering, Astrophysics and Astronomy, and Physics, and minoring in Nuclear Engineering and Mathematics. I am currently working at the Starlab Ground Location – US located on Ohio State’s campus where I have been assisting the Ohio State Starlab team with designing workbenches for space applications and drop rig assemblies. Outside of work, I helped found the Diamond Grove Scholars, a student-led research community and non-profit at Ohio State working to engage and involve K-12 and college students in the space industry. It is our mission to create a place for all students in space. Outside of work and school, I am working on my startup company, Ian’s Guides, where I make educational videos and tutorials to teach others about the content in my degrees and my hobbies in coding and programming for free.

Abstract: In microgravity environments, such as the International Space Station, the mitigation of microbial life, encompassing bacteria and fungi, presents heightened challenges compared to terrestrial environments. Consequently, astronauts frequently contend with prevalent bacterial and fungal infections due to constant exposure in confined spaces. Addressing this issue necessitates the development of a cost-effective and low-waste mechanism for the continuous neutralization of bacteria and fungi. One promising avenue involves exploring ambient air ionization as a potential solution.

Cabin Atmosphere Filtration using Ambient Air Ionization (CAFAAI) is a specialized ambient air ion thruster, created to neutralize microbial life. It operates on a voltage amplifier circuit that converts low-voltage AC into high-voltage, low-current DC. This conversion is crucial for producing an electric field concentrated enough for effective ionization, typically around 10 kV, but with effectiveness increasing up to a certain voltage threshold.

This study aims to test CAFAAI's effectiveness in neutralizing *Aerobasidium pullulans*, a fungus found on the International Space Station. Cultures of *A. pullulans* will be nebulized and introduced into agar plates in two distinct manners: direct injection and pre-treatment through CAFAAI. The comparison of the growth of surviving spores on these plates will provide insights into the effectiveness of ambient air ionization for microbial neutralization in microgravity environments.

Due to concentrated electric fields removing electrons from valence shells of molecules, byproduct production, including ozone, must also be considered. Ozone's affinity towards targeting double-bonded molecules makes it valuable for potential applications in space station environments, such as cleaning surfaces or treating clothing. CAFAAI could serve as a reliable source of ozone for experiments and cleaning procedures. Furthermore, the resulting ozone can be efficiently converted into a more stable molecule, oxygen, utilizing a metal oxide catalyst.

Publications: None yet.

Elyse Hensley



Junior, Biological Sciences
 Advisor(s): Dr. Mitchell Day

Differential expression of E3 ligases in *Arabidopsis thaliana* in spaceflight and ground control

Biography: Elyse Hensley is an undergraduate student at Ohio University in her third year. She is pursuing a degree in Biological Sciences, with a minor in German and a certificate in Global Health. Elyse is an undergraduate research assistant in the Wyatt Lab, where she studies plant gravitropism. In her free time, Elyse is a volunteer for Habitat for Humanity and an assistant coach for her synchronized swim team; she also enjoys outdoor activities like sailing, rock climbing, hiking, and snowboarding. In the future, Elyse plans to pursue a career in biotechnology, with an interest in drug development and discovery.

Abstract: A plant's perception and response to changes in gravity is necessary for normal growth and survival, but the pathways causing gravitropism are not fully understood. The Wyatt Lab has been studying the biochemical components of a plant's gravity response to better understand these pathways. In the BRIC-20 spaceflight experiment, we identified 968 genes that were differentially regulated in seedlings flown on the ISS, as compared to ground control replicates. A group of proteins that functions in the ubiquitin pathway, E3 ligases, were among those differentially expressed genes. These proteins are involved in the pathway that labels molecules for degradation in the cell. Two of these E3 ligases were later identified to be gravity mutants through reorientation experiments conducted on Earth: KFB and PP2-A13. My current research has been characterizing the role of KFB, a kelch domain-containing F-box protein, (AT1G23390, KFB) in the gravitropic pathway through knockout and overexpression mutants. Once mutant lines are identified, mutant phenotypes are analyzed through root curvature, shoot curvature, gravity persistent signaling, and clinostat disorientation experiments. These data are then compared to the wild-type response to identify the effect of KFB on gravitropism. These findings will further the knowledge on gravitropism and aim to improve our ability to grow plants in space to fuel long-term spaceflight missions.

Publications: None yet.

7

Max Miller

Emily Hyland



Senior, Environmental Science
 Advisor(s): Dr. Brice Grunert

Moving Past Chlorophyll for a More Refined Monitoring of Water Quality in the Great Lakes

Biography: Hello, my name is Emily Hyland! I am a Senior at Cleveland State University, pursuing a degree in environmental science, and I'll be graduating with my B.S. in May 2024. I am a student in the Jack, Joseph, and Morton Mandel Honors College. I was born in Cleveland, Ohio, and my upbringing along the shores of Lake Erie ignited my fascination with water quality and algae. Since Fall 2022, I've been contributing as an undergraduate research assistant in Dr. Grunert's Carbon and Optics lab at Cleveland State. Through this opportunity, I've developed many skills both in the field and lab environments, gaining proficiency in operating various optical instruments. Additionally, I have gained substantial experience with QGIS and Python, particularly in analyzing satellite data. Looking ahead, I am excited to continue my academic journey as an MS student at Cleveland State University starting this summer of 2024.

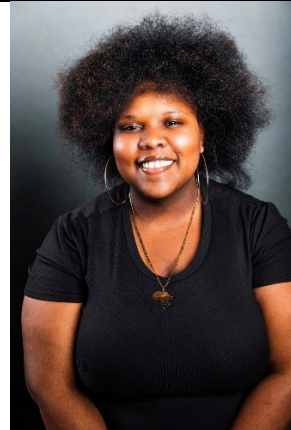
Abstract: Chlorophyll has long been ubiquitous with water quality. However, individual optical constituents like phytoplankton absorption (related to community composition) and colored dissolved organic matter are more representative of specific ecological processes and water quality stressors, like wastewater inputs or ecosystem state. We can model the contributions of these parameters to satellite-observed reflectance using radiative transfer code to assess how well these components can be observed. This project will build off demonstrations of satellite retrievals of phytoplankton absorption and community composition in Lake Erie, by using select satellite imagery paired with the open-source bio-optics Python package to compare individual biogeochemical components alongside traditional water quality indices (e.g., chlorophyll and harmful algal bloom indicators). Using code and radiative transfer workflows established by Dr. Grunert and others, I will examine the extent to which colored dissolved organic matter and phytoplankton are observable in remote sensing reflectance in Lake Erie to improve our ability to retrieve more advanced ecosystem metrics for the system.

Publications: None yet.

7

Max L. Miller

Cynthia James



Academic Level, Major: Senior, Neuroscience
 Advisor(s): Clare Mathes

The Effects of Early Ingestion of Non-Nutritive Sweeteners on Anterior Tongue Taste Bud Morphology

Biography: I am a senior Neuroscience major from Jackson, TN. My love for STEM started at an early age and has developed me into the person I am to this day. Upon graduating, I will be pursuing a career in neuroscience research in relation to virology and neurodegenerative diseases. A quote that I live by is “Success isn’t about how much money you make, it’s about the difference you make in people’s lives” by former first lady Michelle Obama. This quote has stuck with me throughout college and being a black woman in STEM, it’s just a constant reminder to never give up and to focus on the people within my community.

Abstract: Non-nutritive sweeteners (NNS) are promoted as healthier alternatives to caloric sweeteners like sugar. However, their long-term implications on health require further investigation, especially during critical periods of development. Rats provide an informative model of the impact of early-life experiences on health due to their neural and behavioral similarities to humans. We have shown that rats that ingested NNS chronically in their early life lick more avidly across concentrations of the caloric sugar fructose than rats not exposed to NNS while also expressing lower amounts of mRNA that code for a portion of the sweet taste receptor. NNS-exposed rats also display a smaller taste field on the posterior tongue (e.g., circumvallate papillae). Since a higher density of sweet taste receptors is found on the anterior tongue, early-life NNS exposure may have an even more significant impact in this region. Here, we seek to assess if rats that have chronically ingested NNS early in life have fewer fungiform papillae on the anterior tongue than do unexposed control rats. We are currently piloting on naive rat tongues the process by which to stain and quantify taste buds on the anterior tongue. After a transverse cut of the tongue, the mass on the new ventral side of the tongue is removed, leaving the surface of the tongue. A one-millimeter slice of the most dorsal part of the anterior tongue will be stained and flattened between two microscope slides to quantify these taste buds. Flattening the tongue slice allows for a better visual and greater surface area of the tongue to quantify taste buds through the microscope. We then plan to use this protocol to assess differences in taste bud number and density in the anterior tongues of rats provided daily with the NNS acesulfame potassium (AceK) from postnatal day 27-77 as well as their unexposed littermate controls used in previous behavioral studies and for which the posterior tongue has already been analyzed (n=8-9/grp). We expect to see fewer taste pores on a given section and/or a reduced density across the anterior tongue of NNS-exposed rats. These results would suggest that early-life exposure to NNS can alter the morphology of both the posterior and anterior tongue, which may explain these animal’s altered behavior towards caloric sweeteners. Collectively, these results may shed light on the impact of NNS ingestion early in life and influence dietary recommendations, especially for children.

Publications: None yet.

Tara Keller



Senior, Molecular Biology
Advisor(s): Dr. Mark Gathany

The Impact of Solar Panel Presence on the Biogeochemical Response of Soil Cultures and Their Atmospheric Effects

Biography: Tara is a senior on the pre-PA track of Cedarville University’s molecular biology program, with a minor in Bible. On Cedarville’s campus, Tara stays involved in several service roles; she serves as a certified volunteer EMT, leads a biweekly bible study, and tutors fellow college students in biology and chemistry. These opportunities have grown her confidence in servant leadership positions, and she plans to continue to practice those skills as she begins a Master’s of Physician Assistant Studies. She has been admitted into Cedarville’s PA program, and will begin this program in May. This is her second long-term research project, and it has grown her understanding and appreciation of microbiology and land management considerations.

Abstract: The use of solar energy has increased especially in the past two decades, as the need for renewable energy sources has become increasingly apparent. However, the effect that these solar panels have on the ecosystem, particularly the microhabitats underneath them, is largely understudied. For this experiment, we are interested in studying the effect that solar panel presence and operation has on soil microbial communities, and consequently the soil-atmosphere exchange of greenhouse gasses. This will be accomplished by quantifying CO₂ production in samples from both locations using LI-6400XT with a soil chamber attachment, and further specifying results by selectively inhibiting bacterial and fungal communities using biocidal agents, bronopol and captan respectively. Results from this study will hopefully provide a greater insight into current contributions of microorganisms in varying microhabitats to greenhouse gases, a broader consideration of the consequences of solar panel land usage, and motivation to take a deeper look into further areas of study such as the effects of increasing temperature or using different biocide agents.

Publications: None yet.

Suraju Lawal



Junior, Manufacturing Engineering Minor Nuclear Engineering
Advisor(s): Dr. Augustus Morris

Aircraft Winglet Design with Limited Cost, Using an Efficient Optimization Method and Calculations.

Biography: I was born and raised in West Africa (Nigeria). I moved to United State of America over a decay ago. I attended Sinclair Community College where I obtained an Associate Degree in Aviation Maintenance Technology, then transferred to Central State University where I am currently a Junior pursuing a Bachelor Degree in Manufacturing Engineering and Minor in Nuclear Engineering. I am the President of Society of Manufacturing Engineers (SME) Central State University student chapter. I am currently working for PSA Airlines a subsidiary of American Airlines as an Aircraft Mechanic.

Abstract: Aerodynamic drag can be decreased with respect to a wing's geometry, and wingtip devices, so called winglets, play a vital role in wing design. The focus has been laid on studying the lift and drag forces generated by merging various winglet designs with a constrained aircraft wing. By using computational fluid dynamic (CFD) simulations alongside wind tunnel testing of scaled down 3D-printed models, one can evaluate such forces and determine each respective winglet's contribution to the total lift and drag forces of the wing. At last, the efficiency of the wing was furtherly determined by evaluating its lift-to-drag ratios with the obtained lift and drag forces.

Publications: None yet.

10

Michael Turner

Abigail Leslie



Junior, Biochemistry and Environmental Studies
 Advisor(s): Bridget Hegarty

Examining the Effects of the Introduction of *Chlorophytum comosum* on the Microbiome of a Built Environment

Biography: I have been an Ohio resident my entire life, as I have graduated from Parma Senior high and received a scholarship from the Choose Ohio First Program. I am currently a student at Case Western Reserve University (CWRU) seeking two bachelor’s degrees in biochemistry and environmental studies. These two majors were chosen because of my previous interest in medicine, as well as a new appreciation for the natural world we live in. I am a part of CWRU’s club fencing exec, like to embroider, and listen to music in my free time.

Abstract: The interplay of green architecture, abiotic factors, and microbiota is not well understood, despite the effects that each have on human well-being. Understanding the interplay of these factors is critical for terrestrial environments, as well as for space flight, where plants may be introduced as a source of fresh food or for bioregenerative life support systems. However, before studies on space stations are feasible, preliminary studies of the possible effects of indoor plants on the microbiome of a built environment are essential. To this end, we will perform a pilot on the effect of the addition of indoor plants on the microbiome in seven offices in an academic building in Cleveland, OH. Abiotic conditions will be recorded using real-time sensors, while biotic samples will be taken from the plant soil and dust from a nearby surface. Biotic samples were analyzed using ddPCR and are planned to be sequenced via amplicon sequencing. Whether or not the office previously had an indoor potted plant was considered. The results from this pilot study will launch larger future studies on Earth, as well as for low-earth orbit, where the effects of added plants can be separated from the effects of the outdoor environment.

Publications: None yet.

James Lyons



Undergraduate Junior, Mechanical Engineering
 Advisor(s): Dr. Nicholas Gordon Garafolo

Shape Memory Alloy Adaptive Wing Prototype Model

Biography: From a young age, I have been fascinated by anything that flies. Even before I understood what an aircraft was, I became excited as my mother drove past helicopters on the commute to preschool. Eventually, this interest grew to wish lists of toy planes that I would play with for hours. Touring the National Museum of the USAF at age 12, I was absolutely fascinated, and from that moment I knew I wanted to work in aeronautics. When choosing a university program I landed on the Engineering department at the University of Akron, drawn by excellent design teams and research opportunities. I spent two years on the Zips Aero Design Team, and I am an active member in Tau Beta Pi and Engineering Student Council. I completed an internship at Schaeffler Transmission Systems during Summer 2022 and have completed two semester-length co-op rotations at Collins Aerospace. During Summer 2023, I attended USMC Officer Candidate School seeking a commission through the Platoon Leaders Class program. I hope to receive an air contract and one day pilot the high-performance military aircraft I'm currently working on. Upon receiving my degree, whether I enter the armed forces, begin a career in the aerospace industry, or continue my engineering studies in graduate school, I am certain that my endeavors will demand dedication and mental fortitude. Over the coming year I will be enrolled in full-time course work during the academic semesters and will attempt the latter half of the PLC program during the Summer. This time will be crucial as I refine my skillsets and mentality in preparation for the challenging path ahead. I am thankful for the research opportunity that OSGC has provided and excited for the bright opportunities in aerospace that lie before me.

Abstract: An adaptive wing improves aircraft fuel efficiency, aerodynamics, and functionality, like a traditional flap system, while additionally maintaining surface integrity and avoiding gaps. Hydraulic adaptive wing systems are heavy and complex, which has historically prevented their implementation. The objective of this research is to develop an alternative adaptive wing technology using a shape memory alloy blended flap. Integrated heating of trained shape memory alloy samples will elicit precise deformations to articulate the flap with savings in weight, maintenance, and complexity, over a hydraulic system. The concept will be researched in three phases. These phases are as follows:

1. Production of a bench prototype to develop familiarity with the material and produce a prototype flap that consistently articulates using temperature controlled SMA.
2. Iterative redesign of the model based on wind tunnel data to achieve the desired flight characteristics developed from concurrent computational simulations.
3. Implementation of an SMA blended flap on a scale RC plane enabling the team to evaluate the functionality of the concept.

The bench model prototype includes a two-piece scale wind tunnel model 3D printed from polycarbonate, with molded silicone flaps epoxied into voids within the wing. The current objective is to integrate SMA into the silicone flaps and utilize joule heating to heat the SMA and elicit articulation from the flaps.

Publications: None yet.

Sydney Maller



Senior, Aerospace Engineering
 Advisor(s): Dr. Yanhai Du

Zero Emission Aeronautical Systems using Hydrogen Fuel Cells

Biography: Sydney Maller is a senior at Kent State University studying Aerospace Engineering with a focus in Sustainability. She grew up in Van Wert, Ohio and attended Van Wert High School. During her time at Kent State University she has held leadership positions in a variety of organizations including The High Powered Rocket Team, Undergraduate Student Government, Design Innovation Fellows, Community Engaged Learning, and Kent Interhall Council. With a strong background of volunteering she has always pushed towards a better future, her passion for environmental justice continues that trend into her academics as she prepares for graduation and a career with zero emission technologies.

Abstract: Developments in aviation are closely associated with performance characteristics, however there are other important advancements to consider. Aviation is consuming a noteworthy amount of our total Carbon Footprint here on Earth with no foreseeable decline. Hydrogen Fuel Cells are a promising alternative to standard jet fuel, with no Carbon Footprint. The objective of this research is to evaluate the potential and viability of hydrogen fuel cell power as an alternative for combustion fuel. The scope of this research is commercial flight; however, the intent of this research is to broaden the implementation to all types of propulsion.

Combustion engines are very common in the field of aviation, but in order to properly eliminate emissions, we can no longer rely on the combustion of fuel to propel an aircraft. The implementation of propeller aircraft is a reliable way to turn hydrogen fuel cell generated power into thrust.

Publications: None yet.

5

Robert Latta

Anthony Marino



Senior, Biological Sciences
Advisor(s): Nathaniel Szewczyk

Title: Examining Biological Changes to Spaceflight in *C. elegans*

Biography: Hello, my name is AJ Marino and I'm a Senior studying Biological Sciences at Ohio University. I've always had a love for sciences, especially biological and space related sciences, and I would love to pursue a career working with both. The Ohio Space Grant Consortium has given me the opportunity to do just that.

Abstract: I will support pre-flight testing for two NASA Space Biology experiments – CBIOMES and iGCE. I completed biocompatibility and selected appropriate worm strains for flight. Missions are targeting launch for 2025.

Publications: None yet.

Sophia Matar



Academic Level, Major: Senior, Computer Science
 Advisor: Dr. Jong-Hoon Kim

Lunar Navigation System in The AARON System for xEMU

Biography: Sophia Matar is a student at Kent State University, doing the combined Master's and Undergraduate programs, graduating in the Spring of 2024 with her bachelor's in computer science and in the Spring of 2025 with her Master's. Sophia is a student researcher at the Advanced Telerobotics Research (ATR) Lab, and she has published several papers with the ATR Lab, including a paper proposing a Mixed Reality-based immersive virtual environment system for social interaction and behavioral studies, which was a collaboration project between the BMS Lab at the University of Twente in the Netherlands. The other publication is a proposed AI and Robotics education model with cascade mentoring and project-based learning. After she graduates with her bachelor's degree, Sophia will be joining Sherwin Williams as a Software Engineer.

Abstract: Space exploration stands at the forefront of human endeavors, pushing the boundaries of our knowledge of the universe. This project introduces a groundbreaking initiative to advance lunar exploration by developing a navigation system. The proposed method offers a broad platform to guide and instruct astronauts, accommodate multi-operator users, and integrate state-of-the-art technologies for autonomous operation. The lunar navigation system is redefining how astronauts navigate and conduct research. Its main objective is to provide astronauts with a versatile and reliable navigation tool that supports various mission objectives.

A necessary feature in the system is the visual interface for multiple robots, addressing the complexities of multi-operator scenarios. This interface enhances situational awareness and allows users to control multiple robots simultaneously, providing a seamless switch between the robots and external perspectives. This unique facet ensures a comprehensive understanding of the lunar environment and mission tasks, fostering a new era of human-machine interactions in space exploration. The lunar navigation system represents a necessary step forward in navigating the challenging and dynamic lunar environment. Beyond facilitating the immediate needs of astronauts, the system contributes to the overarching goal of advancing technology for continued lunar exploration.

Publications:

1. Sophia Matar et al. "Design of a Mixed Reality-based Immersive Virtual Environment System for Social Interaction and Behavioral Studies" The 14th International Conference on Intelligent Human-Computer Interaction.
2. Sophia Matar et al. "Cascade Mentoring Experience to Engage High School Learners in AI and Robotics through Project-Based Learning" The 15th International Conference on Intelligent Human-Computer Interaction.

Anne Mathew



Junior, Neuroscience

Advisor(s): Dr. Nathaniel Szewczyk

Conserved, gravity independent, gene expression changes in response to spaceflight

Biography: Anne Mathew is a junior at Ohio University, majoring in neuroscience, and pursuing a minor in biology and a certificate degree in bioinformatics. She grew up in Cincinnati, Ohio, always eager to learn about the human body and its functions in space travel and space biology. She has plans to pursue higher education in the field of computational biology.

Abstract: Recently, investigators have shown that there are gravity-dependent and independent changes in gene expression in response to spaceflight. These changes have been reported in the model systems *C. elegans* (worms) and *Drosophila melanogaster* (flies). Interestingly, the gravity-dependent changes have been proposed to be a generic stress response whereas the gravity-independent changes appear to be neuron-specific in flies. Worms, flies, and astronauts all display neuronal defects in response to spaceflight. In flies and astronauts these changes have been proposed to be due to altered oxidative metabolism and altered oxidative metabolism also occurs in worms in space. Thus, the overall goal of my project is to test if there are common gravity-independent changes in gene expression in response to spaceflight in worms and flies.

To conduct this project, I will reprocess past published gene expression data for worms and flies flown in space. In each case, one set of animals was on a centrifuge in space at 1x gravity and one set of animals was not on a centrifuge in space at micro-gravity. I anticipate that the comparison of the non-centrifuged worm and fly data will find that neuronal gene expression changes are conserved independent of gravity. In contrast, alterations in insulin-regulated gene expression changes will be gravity-dependent (as previously published for both the worm and fly datasets).

If the data analysis returns the hypothesized results, then the conserved gene expression changes in worms and flies can be used to understand further the reason(s) why astronauts show changes in brain structure in response to spaceflight.

Publications: None yet.

Ethan Miller



Academic Level, Major: Sophomore, Petroleum Engineer
Advisor(s): Andrew Beck

Effect of Geologic Conditions on Human Settlement

Biography: I'm Ethan Miller, a Petroleum Engineering Major currently in my sophomore year of studies at Marietta College. I was born and raised around the area of Marietta and mainly chose Marietta College because it was local and was similar to my high school in terms of smaller class sizes. Some of my hobbies include outdoor activities, working out and staying in shape, and hanging out and playing games with friends. My current goals are to maintain a 3.5 or higher cumulative GPA all throughout my years at Marietta and also to graduate and find a company that aligns with my interests as a Petroleum Engineer here in the next couple of years.

Abstract: In this project I plan on comparing the depositional environments of different cities throughout Ohio. I also plan on talking about how the different climates and different topography of certain areas may affect the settling of a population. I also want to talk about how these different depositional environments, climates, and topography encourage the emergence of certain species that bring with it opportunities for other organisms to thrive and opportunities for humans' survival and to do things such as finding oil and gas.

Publications: None yet.

Madisyn Moore



Junior, Civil Engineering
 Advisor(s): Dr. Josiah Owusu-Danquah

Artificial Neural Network Models to Predict the Response of High-Temperature Shape Memory Aerospace Actuators

Biography: Madisyn Moore is pursuing a bachelor’s of science in Civil Engineering at Cleveland State University. In her time at CSU Madisyn has been very involved in the academic community on campus including participation in the National Society of Black Engineers where she holds the position of programs chair, as well as various academic programs such as Link Scholars and Engineering Student Success Scholars. Following completion of her undergraduate degree, Madisyn plans to attend graduate school to earn a master’s in architecture. Her passions for technical building advancement and creative visionaries have given her an aspiration to bridge conversations between architects and engineers. The Ohio Space Grant Consortium Scholarship has given Madisyn the opportunity to further explore technical building materials on a research level with Dr. Josiah Owusu-Danquah in his exploration of Artificial Neural Network Models to Predict the Response of High-Temperature Shape Memory Aerospace Actuators. Madisyn shared that she is thankful for this opportunity given by the OSGC to refine her research skills that will undoubtedly contribute to her personal, professional and academic development.

Abstract: Over the past years, several high temperature SMAs have been developed by NASA Glenn Research Center (NASA GRC) to design aerospace actuation components. In their application process, the actuator conforms to different shapes per each heating and cooling cycle under an applied bias stress. It is important to assess the evolutionary behavior, i.e., changes in the stress-strain-temperature responses as these materials undergo hundreds to thousands of cycles. Mostly, such stress-strain-temperature characterization has been obtained through experiments that may be supplemented with predictive finite element constitutive models. For cases where it is important to study different SMA compositions, and material performance at thousands of cycles, most of the currently available models are not applicable. The objective of this research is to develop and use Artificial Neural Network (ANN) models to predict the cyclic, non-linear shape memory behavior of high-temperature SMAs, i.e., NiTiPd, and NiTiHf alloys, used to design aerospace and aeronautic structural components.

Publications: None yet.

Jean Nash



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

Solar Panel Tilt Optimization Validation for Fixed Tilt Solar Systems

Biography: Jean is a senior who is pursuing a major in mechanical engineering complimented by a minor in sustainability, energy, and the environment at the University of Dayton (UD). Jean later added a concentration in mechanical energy systems to focus her studies on her passion for renewable energy. While at UD, Jean serves as the president of the Society of Women Engineers chapter at UD, where she plays a pivotal role in fostering an inclusive environment for female students. Additionally, she is an employee for the Women Engineering Program at UD, demonstrating her dedication to empowering and supporting aspiring women engineers on their academic journey. Jean has also completed multiple co-ops and internships with GE Aerospace and GE Vernova, specifically onshore wind projects. In the Fall of 2022, Jean was accepted into the Grand Challenges Scholars Program where she chose to take on the grand challenge of making solar energy economical as it connects to her passions for renewable energy. Currently collaborating with Dr. Rydge Mulford in the Dayton Thermal Applications Lab, Jean is working on a project to verify the efficiency of tilt degrees via experimental analysis. With the support of the NASA/OSGC Scholarship, Jean will continue her experiments until her graduation in May of 2024.

Abstract: The imperative shift toward sustainable and clean energy solutions has positioned solar power as a critical renewable energy source. Photovoltaic solar panels, integral to this transition, play a pivotal role in capturing sunlight and converting it into electricity. Optimizing their orientation becomes crucial for maximizing efficiency. While conventional installations rely on fixed angles based on geographical latitude, factors such as seasonal variations in the sun's angle and intensity can influence the ideal tilt angle. Achieving a tilt that allows sunlight to strike the panels as close to perpendicular as possible enhances intensity and profoundly impacts energy output. Therefore, determining the optimal fixed tilt angle is essential for maximizing energy production from mounted solar panels.

This study seeks to determine the optimal fixed tilt angle for solar panels by comparing two specific angles. One panel will be positioned at the latitude angle of Dayton, Ohio, while the other will adopt a lower angle to account for seasonal variations. Summer months have a higher sun position and more hours of daylight compared to winter months. Thus, setting the second panel at a lower angle to capture more sunlight in the summer may be more energy efficient overall. The research will be conducted experimentally to address the gap in literature regarding the experimental validation of computed optimal tilt angles. The experimental comparison aims to discern the performance differences between the two tilt angles and their respective energy outputs. This research, spanning approximately a year, is designed to contribute insight into the practical implications of solar panel tilt angles for fixed tilt systems.

Publications: None yet.

Lee James Nestor



Senior, Computer Engineering, Applied Mathematics
 Advisor(s): Dr. Nghi H. Tran

Autonomous Photogrammetric Data Collection and Analyzation

Biography: Lee (James) Nestor is a current student at the University of Akron where he is working on his degrees in both Computer Engineering and Applied Mathematics and is expected to graduate Spring of 2024. He is from Akron, Ohio and attended Ellet High School and graduated in 2018. Being so close to the University of Akron, and given the reputable engineering program that the university is known for, it was a solid choice for his goals and desired career path. During his undergraduate time, he participated heavily in a wide variety of student organizations in both engineering and applied mathematics. He became president of the Electronics Club of the University of Akron, a club centered around teaching and giving students Hands on experience with working on and designing Electronics. He also became Software Head Lead for the NASA Robotics Design Team as well. He also was a Design Team Lead for Engineers For a Sustainable World and did environmental volunteer work through the organization. He also became a member of the Pi Mu Epsilon National Honorary Mathematics Society with the University of Akron’s Society of Industrial and Applied Mathematics group. He has taken up this project as a part of his Senior Design project with some design overlap with his work in NASA Robotics. After graduation James is looking to pursue his PHD in Computer Engineering while also working in the field.

Abstract: The main objective of this project is to develop an autonomous system concerning image data gathering function for remote structural construction and examination. The use of photogrammetric analysis and synthesis allows us to sample a structure across time and space, simultaneously, from multiple collocated positions. A novel structural analysis can then be performed to check for potential damage or any points of failure in the structure. As part of this work, a prototypical device is also developed to implement the proposed algorithms.

This prototype will be a small-scale drone that is designed for close-quarters navigation in industrial and commercialized environments. The drone will be able to collect data on the affected area or object, then transmit the information to a central computer for processing and interpretation. The processed data will then be displayed for the user. The device will be equipped with cameras for image processing, and sensors as well for navigation features such as localization and mapping. This form of implementation will allow for potentially higher accuracy and safety as opposed to a human form performing these actions.

Publications: None yet.

Joel Neville



Academic Level: Senior, Major: Biochemistry
 Advisor(s): Dr. Parsons

Paraben-Induced Cleavage of the Apoptotic Effector Protein PARP-1 in Human Cutaneous Melanoma Cells

Biography: I am a senior at Marietta College studying biochemistry with a minor in biology. I plan on going to medical school after I graduate from college. My advisor, Dr. Parsons, introduced me to undergraduate research during the summer after my freshman year. I had the opportunity to present research at ACS in Indianapolis last year along with other members of Parsons' research group. I started my own research project last summer through the investigative studies program at Marietta College.

Abstract: Parabens are chemicals that are widely used worldwide as household items. They are found in makeup, hair-care products, and shaving creams. On a structural level, parabens are molecules that are p-hydroxybenzoic acid with different R groups attached to the ester to give them different chemical properties. In this research, we studied human melanoma cells, specifically M624. Melanoma cells are cancerous skin cells, and in this research, we treat these melanoma cells with three different parabens, mononitro, heptyl, and methylparaben to try and induce apoptosis.

Apoptosis is a form of cell death, and it is programmed cell death. When a cell is damaged, or it is time for it to die, cell signaling initiates cell death in the form of apoptosis. Apoptosis is preferred over other forms of cell death such as necrosis, because in necrosis the cell ruptures, and the organelles are not recycled. In this research, I will investigate paraben-induced cleavage of the apoptotic effector protein PARP-1. Apoptosis will be characterized by Poly(ADP-ribose) polymerase or PARP-1, an enzyme in the cell that helps with the repair of damaged DNA by adding poly (ADP-ribose) polymers in response to DNA damage in the cell. Irreparable cell damage leading to PARP cleavage is a clear indicator of apoptosis in melanoma cells. In past research, we found that mononitro paraben was less toxic and more capable of inducing apoptosis in human melanoma cells. Based on this fact my prediction for this research is that mononitro paraben-treated samples will have the highest level of PARP-1 cleavage compared to the other two parabens.

Publications: None yet.

6

Bill Johnson



Jinit Patel



Sophomore, Jinit Patel

Advisor(s): Dr. Nathan Webb & Dr. Mo Samimy

Plasma Induced Active Flow Control for Jets

Biography: Jinit is currently a second-year student at The Ohio State University pursuing a degree in Aerospace Engineering with a minor in Computer Science. Outside of school he is a member of the Buckeye Space Launch Initiative's NASA team. Also he currently researches at the Aerospace Research Center at the Gas Dynamics and Turbulence Laboratory. His current interests include aerodynamic efficiency and ML aided flight technology. Eager to bring his experiences into the professional field, Jinit is currently seeking internship opportunities where he can apply and expand his knowledge in aerospace engineering.

Abstract: Thrust vectoring, a critical aspect in aerospace for enabling agile maneuvers and shorter takeoff distances, is traditionally achieved through complex and heavy nozzle designs or Coanda-based methods that can reduce primary airflow efficiency. This study introduces an innovative approach using Localized Arc-Filament Plasma Actuators (LAFPAs), which utilize inherent flow instabilities for more energy-efficient thrust vectoring. LAFPAs, mounted near reaction surfaces, manipulate the flow by triggering vortex formation through high-temperature disturbances. The research aims to understand how different initial parameters affect the direction of thrust and assess the potential of LAFPA technology in practical applications. Key methods include experimental sweeps of excitation frequency, schlieren and pressure measurements, and Particle Image Velocimetry (PIV) to evaluate the jet deflection capabilities and underlying physics of this advanced flow control concept.

The experimental setup for this study features a curved nozzle extension with LAFPA electrodes, leading to a reaction surface within an anechoic chamber. This design aims to investigate the LAFPAs' ability to alter the thrust vector by deflecting the jet flow, assessed through various actuation frequencies and the number of active LAFPAs. Initial tests have shown asymmetric pressure profiles on the reaction surface, indicating a relationship between actuation frequency and thrust vectoring. Future steps include expanded data collection using time-resolved schlieren imaging and PIV to capture comprehensive flow behavior. This research not only seeks to demonstrate the effectiveness of LAFPAs in modifying the thrust direction but also aims to address challenges in experimental repeatability and setup, paving the way for more efficient and adaptable thrust vectoring methods in aerospace applications.

Publications: None yet.

4

Jim Jordan

Brady Phelps



Junior, Advanced Computing (B.S.A.C.)
Advisor(s): Chad Mourning

XR Visualization of OUNPPM

Biography: Brady Phelps is a Junior studying Advanced Computing at the Honors Tutorial College at Ohio University. He has strong research interest in space, computer graphics, aviation, mixed reality, and quantum information/networks. He has completed both internships and research experiences with Procter & Gamble, the University of Connecticut, Mammoth Cave National Park, and Ohio University. He has accepted an internship with the NASA Glenn Research Center for this coming summer, focusing on graphics, networks, and space.

Abstract: This paper utilizes XR technologies to create environment for the Ohio University Navaid Performance Prediction Model for public, private, and military runways on Earth, as well as navigational aids on Mars using the Mars rover image data. The Ohio University Navaid Performance Prediction Model (OUNPPM) is a globally used tool for the certification of navigational aid compliance and safety at airports. The main purpose of OUNPPM is to calculate multipath interference from structures close to the navigational aid equipment and provide corresponding error plots. The project utilizes an XR interface for users to experience a new form of data visualization and an enhanced user experience. This new interactive medium promotes interactivity, efficiency, and safety. This project has implications for airport safety on Earth as well as missions relating to Mars and aligns with “Airspace Operations and Safety” goals by further improving the safety of current and future aircraft through conducting research pertaining to the navigational aid and performance of airport systems.

Publications: None yet.

Maxwell Phillips



Junior, Computer Science
 Advisor(s): Dr. Firas Hassan, Dr. Ahmed Ammar

High-Precision Integer Arithmetic and Multi-Level Hardware

Biography: I am a junior at Ohio Northern University studying computer science with a minor in astronomy. I am from the village of New Washington, Ohio. During my childhood, I became primarily interested in two topics: outer space and video games. Through gaming, I became familiar with computers, participated in robotics competitions, and learned to program. My fascination with the stars led me to study them academically. Now, I am combining these interests in my current program of study and in my future career. I am honored to be supported by NASA and OSGC in my research which I hope to apply to encryption and scientific computing related to extraplanetary endeavors.

Abstract: High-precision integer arithmetic is critical for applications in physics, mathematics, and most importantly, encryption. One facet of our work consists of improved general integer multiplication and division algorithms designed to reduce hardware complexity and latency. These two algorithms leverage a novel two-level priority encoder, decoder, and barrel shifter to achieve such results. Interestingly, this causes the latency of the algorithm to depend directly upon the number of high bits in the multiplier or dividend, respectively. These algorithms also take inputs as sign-and-magnitude and produce outputs in the same format. As such, they are best paired with another of our research ideas, an improved hardware design for negation, absolute value, and two's complement based upon the ideas of the carry-look-ahead adder. This structure also aims to reduce hardware complexity and latency, which are on the order of $O(n)$ and $O(\log n)$, respectively. Our current technical work focuses on generalizing the two-level priority encoder and decoder structure to multiple levels. We are also working to improve the current project-based lab structure for our introductory digital logic class by implementing parts of our research as a final project for the lab.

Publications:

1. Maxwell Phillips, Firas Hassan, Ahmed Ammar, and Nathan Hagerdorn, "Leveraging a novel two-level priority encoder for high-precision integer multiplication," 66th IEEE International Midwest Symposium on Circuits and Systems, Tempe, Arizona, USA, Aug. 6-9, 2023.
2. Riley Jackson, Maxwell Phillips, Firas Hassan, and Ahmed Ammar, "High Precision Carry-Look-Ahead Logic for Negation, Absolute Value, and Two's Complement," 30th IEEE International Conference on Electronics, Circuits, and Systems, Istanbul, Turkey, Dec. 4-7 2023.

Alex Posey



Sophomore, Petroleum Engineering, Geology
Advisor(s): Andrew Beck

The New Concord Meteorite

Biography: Alex grew up in New Lexington, Ohio where he attended high school there. After graduating he enrolled at Marietta college for petroleum engineering with an engineering leadership certificate. After his first semester he added geology as a second major. Last summer he gained valuable field experience as a flowback hand intern at Tetra Technologies.

Abstract: The New Concord meteorite is arguably the most well-known meteorite to fall in Ohio. falling on May 1st. 1860, between noon and one in the afternoon. The largest known piece of the meteorite weighing 103 pounds was then collected by EB Andrews of the Marietta College Geology department. The meteorite currently resides in the Brown Petroleum building at the college. The aim of this project is to gather and summarize the relevant information regarding the meteorite. The general history and significance of the meteorite will be the primary focus.

Publications: None yet.



Kyle Preusser



Senior, Chemical Engineering
Advisor(s):

Electrochemical Detection of Multiple Heavy Metal Ions Using a Metal Organic Framework and Biohybrid Nanocomposite Modified Electrodes

Biography: My name is Kyle Alan Preusser. I am a first-generation student. My mom and dad never finished college, so I never had a clear goal about the major I would be pursuing. That would be until my junior year of high school when I realized that I had always loved to create new things and adored chemistry and the world of atoms. I grew up building LEGOs and K'Nex. I also liked to create home movies during high school. Learning about Chemical Engineering, I decided that it would be a fantastic way to turn the ideas I am enthusiastic about into a major I can pursue and a career to undertake. Since pursuing my undergraduate degree, I took part in the Choose Ohio First Program for research. I have been participating in undergraduate research since my first year at YSU. I want to pursue my master's in chemical engineering to have the qualifications necessary to work on efficient processes to manufacture new medicines used for people who need them.

Abstract: Heavy metal pollution has become a worldwide problem. Particularly, lead, cadmium, mercury, and copper ions. Lead ions (Pb^{2+}) have received growing concerns due to their increased discharge and deleterious effects on the environment as well as human health. Cadmium ions (Cd^{2+}) may cause renal dysfunction and metabolism disorders. Copper ions (Cu^{2+}) are an essential element of biological processes. However, higher concentrations of Cu^{2+} may lead to cancer and genetic disorders. Mercury ions (Hg^{2+}) can interfere with the nervous, immune, and endocrine systems.

In this study, a novel biohybrid nanocomposite was fabricated through a simple one-pot hybridization method, and the square wave anodic stripping voltammetry (SWASV) technique was used as the electrochemical technique for the detection of the heavy metal ions. In this study, the developed electrodes using the metal organic framework and cellulose nanocrystals (MOF-CNC) proved to be an effective material to detect leads ions at levels down to sub-ppm in aqueous solutions. The layer consists of 1uL of PEDOT:PSS, 100uL of CNC, and 5mg of MOFs kept in 399uL of ethanol. 10uL of this solution are drop cast onto glassy carbon electrodes (GCEs) for testing. Various electrochemical tests such as cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) were performed to characterize the fully modified electrode to compare it with GCEs. Adding the modifications increased the current peaks for detection, decreasing the resistance during electron transfer. The experimental parameters were optimized for detection. These include accumulation time and potential range. Care was taken to ensure parameters did not harm the layer during testing. Research was done to determine the optimal pH of 5 for detection. Selectivity and reproducibility tests indicated an excellent anti interference ability of the electrode to other interfering ions. Individual and simultaneous calibration tests determine linear relationships between the concentration and peak current detected as well as limits of detection at the nanomolar levels, which is low enough for EPA standards of safeguarding farmland from heavy metals. Real samples such as Mahoning River, East Palestine, and tap water were tested. The real samples were spiked to determine the electrode's ability to detect ions in aqueous media. The MOF-CNC/PEDOT:PSS/GCE modified electrodes offer portable and efficient methods of safely detecting heavy metals in aqueous media.

Publications: None yet.



Andrew Sanders



Senior, Industrial/ Systems Engineering
Advisor(s): Constantin Solomon

Investigation of the environmental printing conditions and ironing process on the mechanical behavior of FDM 3D printed components for aerospace applications

Biography: I am from New Middletown, Ohio, and came to Youngstown State University to receive an engineering degree for my love of creation. During my time here at YSU I have picked up 3D printing on the side and have loved learning more and more about it while procuring my own pair of printers. As such I took up this project to learn more about 3d printing as a whole.

Abstract: This work investigates the use of 3D printing for aerospace applications by looking at the failures encountered by YSU's aerospace competition teams over the last two years. The major issue the YSU's aero team ran into with the parts printed by fused filament fabrication (FFF) using the light-weighted PLA, it was the reduced mechanical strength and rapid failure of the printed components, such as landing gear and the airplane wing. The poor layer adhesion in the FFF process might be related to the non-uniform environmental conditions (especially temperature variations) during the printing process. This research is proposing the usage of a Fused Deposition Modeling (FMD) Snapmaker Artisan hybrid manufacturing printer, equipped with an environmental chamber design to regulate the temperature during the printing process. Moreover, this research is proposing to use a relatively new method known as ironing to try and strengthen the prints in the final steps of the process. The influence of the environmental temperature and ironing on the mechanical behavior of 3D printed components will be investigated by tensile and compressive testing of printed samples. The project goal is to improve the mechanical properties of FMD 3D printed components for aerospace applications.

Publications: None yet.

Collin Schofield



Senior, Mechatronics Engineering Technology
 Advisor(s): Dr. Syed Shihab

Strategic and Tactical Deconfliction Between Birds and Aircraft

Biography: Collin Schofield is a senior at Kent State University. Prior to college, he completed many Project-Lead-The-Way engineering courses at Bellbrook High School, along with numerous math and computer science courses. Collin was also an active member of Boy Scouts of America throughout High School; he completed a week-long leadership training course and earned the Eagle Scout award. Through all these courses and activities, Collin gained an immense passion in STEM, and knew he wanted to pursue a career where he could regularly use a combination of all these skills. Upon discovery of the Mechatronics Engineering program at Kent State, Collin knew it would be a perfect career path for him. In the spring of 2023, Collin began doing research with Dr. Shihab’s Green and Advanced Mobility Engineering (GAME) lab, with which he later participated in the Summer Undergraduate Research Experience (SURE) program. After graduation, Collin plans to further his education in pursuit of a master’s degree in Mechatronics Engineering at Kent State.

Abstract: As the amount of aircraft activity has continuously grown over the last several decades, the number of collisions with avian wildlife has also been continuously increasing. This critical safety concern is the highest for aircraft flying at lower altitudes, such as during takeoff and landing, as this is the altitude that birds tend to occupy the most. In the past, the technology required to effectively predict, warn, and avoid these collisions has not been feasible. Thanks to the recent developments in artificial intelligence and machine learning, it is becoming much more feasible to effectively predict the precise locations of birds.

For this project, we are working to develop optimization-based strategic and tactical deconfliction algorithms to prevent collisions between aircraft and birds, based on flight track forecasts of birds and aircraft. This project has 3 distinct components: (1) strategic deconfliction of conflicts during takeoff through the addition of a minimized delay, (2) tactical deconfliction through mathematically optimized flight path adjustments to prevent collisions once in the air, and (3) the bird prediction algorithm. Ultimately, all three of these algorithms will be fully integrated into a single program system. The bird prediction algorithm exists from a previous project, but we also will be working to improve the effectiveness and precision of this algorithm throughout this project. The algorithms we are developing are anticipated to improve flight safety by ensuring collision-free aircraft operations.

And Publications: None yet.

Anastesia Smith



Sophomore, Electrical Engineering
Advisor(s): Professor Coray Davis, Professor Deok Nam

Airspace And operation and Safety

Biography: Anastesia is a Sophomore Studying Electrical Engineering at Wilberforce University. She was Born and raised in Chicago Illinois. She Graduated High school at Hansberry College Preparatory. She is Driven to Graduating with a bachelor's in electrical engineering and going for with getting her phd in Biomedical Engineering.

Abstract: In order to assess the practical viability of gravitational control, a series of flight tests are conducted. These tests encompass a wide range of flight profiles, including both standard and advanced maneuvers. Through these assessments, the glider showcases exceptional agility, responsiveness, and reliability, affirming the potential of gravitational control as a transformative technology in aerospace engineering.

The implications of this research extend to various applications within the aviation industry. The utilization of gravitational control in gliders holds promise for enhancing aerial surveillance, search and rescue missions, and environmental monitoring. Additionally, the energy-efficient nature of gravitational control makes it a viable option for autonomous long-endurance flights, extending operational capabilities without the need for frequent refueling.

In conclusion, this research endeavors present a pioneering approach to glider control through gravitational manipulation. The demonstrated improvements in maneuverability, stability, and energy efficiency highlight the potential of gravitational control systems as a transformative technology in aerospace engineering. Further development and optimization of this innovative approach may redefine the future of glider operations and pave the way for advancements in aerial control systems.

Publications: None yet.

Elizabeth Sultan



Senior, Geology and Environmental Science
 Advisor(s): Professor Thomas Rice, Dr. John Whitmore

Topographic Analysis of Ohio's Little Miami and Great Miami Gorges

Biography: Elizabeth is a senior Geology and Environmental Science double major studying at Cedarville University in Cedarville Ohio. She has interests in biogeochemistry and paleoclimatology. She has conducted several independent studies on biogeochemistry, paleoclimatology specifically looking at ice age modeling, and marine sediment thicknesses. She would love to pursue further education and potentially end up in a teaching or research position herself one day.

Abstract: Ohio has many gorges that are believed to have been formed due to ice age processes, however, the exact method of their formation remains a mystery. Many hypotheses have been proposed. This project tests several of these hypotheses by collecting topographic data at 1 km intervals down the Little Miami and Great Miami Streams to determine gorge locations. The strike of the joints at the gorge locations were then measured and compared to the gorge orientations. ArcGIS was also used to see if any correlations could be found between bedrock geology or karst terrain and gorge location.

Publications: None yet.

Aaron Suter



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

Hypersonic Vehicle Ablation Investigation

Biography: Aaron Suter is a junior at Wright State University pursuing a bachelor's degree in mechanical engineering. He was born and raised in Greenville, Ohio and began taking an interest in the field of engineering while participating in Greenville High School's introduction to engineering program. He is most interested in the thermal and fluids area of mechanical engineering and is especially partial to thermodynamics and heat transfer. After completing his undergraduate degree, he plans on remaining at Wright State University to obtain his master's degree through the university's 4+1 program.

Abstract: Bodies that exceed speeds of Mach 5 are in hypersonic flow. This is most commonly observed today in reentry vehicles. In this state, heat transfer rates to the body are extreme, and the boundary layer becomes significantly larger and more complex to predict. To account for this heat transfer, bodies can be covered in a carbon heat shield that ablates from the surface during flight and reduces the total heat transfer to the body. As the carbon ablates, the surface changes shape, and the heat transfer to the body is affected. Therefore, being able to predict how the surface material will ablate is vital to the successful operation of the vehicle.

Models used to predict the rate of carbon ablation from the body's surface during hypersonic flow are complex and require significant resources to be used. A simpler, although less accurate, ablation model will be created based on the boundary layer and heat transfer rates to the body. This model will represent the body as a flat plate and compute the inviscid aero solution over it. The approximate heat transfer rates to the body will be computed based on the work of Ernst R.G. Eckert. The temperature trends throughout the body will be modeled based on the material properties and thickness of each layer. NASA's Fully Implicit Ablation and Thermal Analysis (FIAT) program will be used to determine the effect of carbon ablation on the heat transfer rates. The flow conditions will be set to mimic similar conditions seen by reentry vehicles.

Publications: None yet.

Victoria Swiler



Senior, Environmental and Plant Biology
 Advisor(s): Dr. Sarah Wyatt

Potential Role of AHA2 Protein in Plant Gravity Signaling

Biography: Victoria Swiler is a senior studying plant biology at the Ohio University Honors Tutorial College, where she is also minoring in communications. In spring 2021, Victoria joined Dr. Sarah Wyatt's lab to research the molecular mechanisms of plant gravity response, where she now is completing her senior thesis. Victoria also interned at the Boyce Thompson Institute in the summer of 2022 to genetically engineer groundcherry plants for crop improvement. She volunteers with Community Food Initiatives and at OU she is a writer for the Athens Effect and a Climate and Sustainability Ambassador. After graduation, she will pursue a Ph.D. to improve crops via genetic engineering.

Abstract: A plant's survival is largely impacted by its ability to sense and respond to gravitational changes, such as the changes that occur in space. However, the pathway that allows plants to respond to gravity, orienting their stems upward and their roots downward, is not fully understood. In the BRIC-20 experiment aboard the International Space Station, the Arabidopsis proton pump AHA2 was found to be differentially phosphorylated in microgravity compared to ground controls, meaning it had a change in activity. AHA2 is hypothesized to be involved between plant hormone movement and differential growth during gravity signaling. Thus far, *aha2* knockout mutants have been phenotyped and show a decreased ability to respond to gravity, indicating that AHA2 is involved in gravity response. AHA2 has multiple phosphorylation sites. To determine which sites on AHA2 are needed for gravity signaling, several lines of transgenic Arabidopsis with modifications in two phosphorylation sites are being developed. Each site is modified to prevent or biomimic phosphorylation, which affects AHA2 activity. The transformants will then be phenotyped for altered gravity response, showing if the phosphorylation of the AHA2 protein is involved in a plant's gravity response. These findings will further knowledge on the molecular mechanisms of plant gravity response to develop space-tolerant plants for bioregenerative life support.

Publications: None yet.

7

Max Miller

Justin Verhosek



Junior, Computer Science and Philosophy
 Advisor(s): Dr. Brian Krupp

Fine-Grained Air Quality Sensing with IoT – LoRa Network Feasibility

Biography: Justin Verhosek is a Junior at Baldwin Wallace University, majoring in both Computer Science and Philosophy. He grew up in Cleveland, Ohio, and attended Saint Ignatius High School. In high school, his interests in both coding and ethics grew independently from each other and converged when attending Baldwin Wallace University. At Baldwin Wallace, he is a member of MOPS (Mobile and IoT for the Planet and Society) Research Group, the president of the ACM chapter, practices Archery, and holds leadership positions in the Honors Leadership Board, Philosophy Club, and Mythology Club, while also hosting computing camps for middle and high schoolers as a member of CS+. He plans to graduate in the Spring of 2025 and work as a Software Engineer while continuing to pursue his philosophical interests.

Abstract: The World Health Organization states there are “4.2 million deaths every year as a result of exposure to ambient (outdoor) air pollution.” Additionally, they report that “9 out of 10 people worldwide live in places where air quality exceeds WHO guideline limits.” For Cuyahoga County, an area of 459.07 square miles and a population of 1,245,337 (as of 2020), only one air quality sensor monitors PM 2.5 (particulate matter) levels, which is proven to be the most dangerous kind for humans to breathe. With that large area to cover, the EPA cannot provide communities with a solid sense of the air they breathe. There is room for improvement through increased accuracy in the reporting by increasing the number of sensors.

Through a previous partnership with PCsForPeople, who allowed use of their Wi-Fi hotspot towers around Cleveland, it was proven that a more fine-grained approach was needed to effectively detect the air quality. To further this research, Dr. Brian Krupp and I will test the feasibility of LoRa technology to connect a network of these sensors. Since the benefit of these sensors has already been demonstrated previously, we now plan to further their capabilities by testing if LoRa, long range radio waves, will be feasible to use to send and retrieve data from the sensors.

LoRa is being considered because it would allow for a cost-effective way to create a network across the devices within a specified region. In order to test the feasibility of LoRa’s use here we will need to test both the ability of the range of LoRa in optimal and suboptimal conditions, as well as test how well LoRa can function within a network of devices. This research will further inform the potential deployment of LoRa access points on our campus to serve future research and services within our university as well as local government.

Publications: None yet.

Bailey Wimer



Senior, Computer Science
 Advisor(s): Dr. Jong-Hoon Kim

eXtended Reality Base Assistance Interface for NASA's xEMU

Biography: Bailey Wimer is a Senior in the Computer Science program at Kent State University. Soon after starting at Kent State University, Bailey joined the Advanced Telerobotics Research (ATR) Lab, where he has been working on artificial intelligence and robotics research ever since. He has published several papers with the ATR Lab, including a paper proposing a custom-designed educational drone for use in K-12 classrooms, and a knowledge-sharing system for search and rescue robots. He also travelled to France in July 2023 to compete in RoboCup Rescue, an international robotics competition. After he graduates with his bachelor's degree, Bailey is excited to join the Netflix team as a software engineer. He anticipates furthering his education in the field soon and plans to eventually found his own startup company.

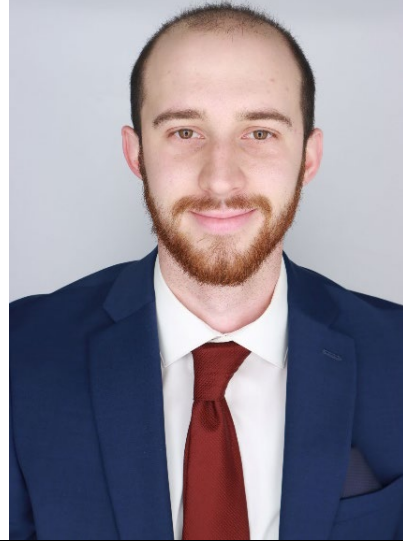
Abstract: As space missions continue to advance and reach new horizons, it is likely that their duration will continue to grow. With longer space missions comes more time away from Earth for the astronauts partaking in them. Much like our day-to-day life on Earth, astronauts will have down-time during their time in space. It is important to prioritize convenience and comfort during this down-time. The eXtended Reality Base Assistance Interface (XRBAI) helps accomplish this by providing a mixed-reality Heads-Up Display (HUD) for astronauts' day-to-day life.

The XRBAI system, developed in Unity, provides astronauts with a customizable display containing information pertinent to their life in space. This information includes a map of the base, their current location, incoming messages from crew members and from Earth, and other details. Additionally, the XRBAI system allows astronauts to interact with their suit and the base in two ways. The system implements hand-tracking to allow gesture control as the primary interaction method. This gesture control could be used to open doors in the base, control music, or type on a virtual keyboard. The astronaut can also leverage the built-in AI chatbot to accomplish similar tasks with natural language conversations. Overall, the XRBAI system provides new ways for astronauts to understand and control their environment in day-to-day life.

Publications:

1. Shuvo, M. & Wimer, Bailey & Mahmud, Saifuddin & Kim, Jong-Hoon. (2023). A Novel Collaborative Knowledge Sharing and Self-Learning Framework for Robotic Systems in Search and Rescue Operations. 1-6. 10.1109/IECON51785.2023.10312013.
2. Bailey Wimer, Justin Dannemiller, Saifuddin Mahmud, and Jong-Hoon Kim, "Low-cost Entry-level Educational Drone with Associated K-12 Education Strategy", The 14th International Conference on Intelligent Human-Computer Interaction, Tashkent, Uzbekistan, Oct. 20 – 22, 2022.

Nikolas Younker



Junior, Aerospace Engineering and Mechanics

Advisor(s):

AI and Human Teaming

Biography: Hello! My name is Nikolas Younker, I am from Pataskala, Ohio and I am a Junior majoring in Aerospace Engineering and Mechanics at the University of Cincinnati. In my field I have interests in AI and its applications in engineering, aerodynamics, and structures. When I have free time, I enjoy hanging out with friends, reading, and watching movies.

Abstract: AI and Human Teaming will be important as technology progresses. It can already be seen in platforms such as ChatGPT, Google Bard, and other platform's AIs. This project's aim was to create a simulation that could be tested and display a human's ability to trust and successfully interact with an AI companion. This was done utilizing Unreal Engine 5 and Python.

The project turned into a hide-and-seek game which aimed to have an generic AI seeker, a user-controlled hider, and a Fuzzy AI which assists the hider. Utilizing Unreal Engine's game building capabilities, the environment was created which was similar to a Pac-Man maze. The seeker was built using the blueprint and blackboard components in UE5 and utilized sound and sight to find the hider. The fuzzy AI was built in UE5 using the same techniques as the seeker but was trained in Python in which a similar environment was built in PyGame to train the AI. This was done to ensure the fuzzy AI could interact in any environment and successfully aid the user in hiding as long as possible. Tests showed that the hider/AI team was successfully able to hide up to around 1.5 mins on average. These findings will be used to incorporate in other projects going on involved in AI applications in space and other aerospace projects.

Publications: None yet.

Jennifer Zayac



Junior Mechanical Engineer
 Advisor(s): Dr. Jed Marquart

Effect of Airfoil Design on Wing Performance

Biography: Jennifer Zayac is a Junior mechanical engineering major at Ohio Northern University. She is involved in many clubs around her campus including becoming the President of the ONU AIAA student branch. She is also raising a service dog in training that will help a little kid in need one day! She is very outgoing and enthusiastic about the aerospace community and has been fortunate enough to receive three internships at NASA Glenn over the last two years. Jennifer is excited to continue her career in the aerospace field and is incredibly grateful for the opportunity to get the OSGC scholarship.

Abstract: The impact of various airfoils on the effectiveness and efficiency of an aircraft wing can be significant. Airfoils play an important role in determining the aerodynamic characteristics of an airplane. By altering the shape and design of the airfoil, the lift and drag forces acting on the wing can be altered, which ultimately influences the overall performance of the aircraft. Every aircraft has a different airfoil with distinct properties that affect the performance of the wing for different conditions in flight. Some airfoils are designed for easier maneuvering while others are designed simply for high speed flying. The airfoil selection process depends on several factors, including the weight, size and purpose of the aircraft. The experiment designed will test three separate airfoils in a wind tunnel, to analyze which one provides the most effective performance based on the lift versus drag conditions. The properties of the aircraft used will be based on the Ohio Northern University SAE Aero competition team's aircraft, using the weight, size and slow speeds.

Publications: None yet.

Community College

Olivia Bogna



Freshman, Universal Sciences
Advisor(s): Regan Silvestri

In An Active Galaxy Far Far Away...

Biography: I am a college freshman currently majoring in Universal Sciences, planning on transferring to a full time university for a major in Aerospace or Mechanical Engineering. I have an interest in working with aircraft structures and jet propulsion systems once I graduate, and hope to work with organizations or companies that specialize with anything from spacecraft technology to civilian aircraft. Outside of school I enjoy working with art, and I fill my free time with crocheting, playing one of the six instruments I know, reading or drawing.

Abstract: Active Galaxies are galaxies that contain an active galactic nuclei. All galaxies are predicted to contain black holes, but what sets apart active galaxies is that their nuclei release comparatively large amounts of radiation and energy as compared to non-active galaxies. The notable characteristics of an active galaxies are the supermassive blackholes that are found in the galaxy's center, as well as the relativistic jets and accretion discs produced by the blackhole. Active galaxies are thought to be what the early stages of galaxies looked like, shown by the redshift many produce when observed and the conditions needed for their formation.

AGNs all have different levels of activity and emissions that have been observed, with each different class of AGN having certain variables that set them apart from the others. The most notable types of AGNs are quasars, blazars, seyfert galaxies and radio galaxies. There are also some little understood AGNs, are others scientists aren't sure of, such as BL Lac Objects, OVV and LINER galaxies. The emission lines to determine the strength and ages of these galaxies will also be shown and studied.

Publications: None yet.

Lia Douglas



Sophomore, Micro-Electromechanical Systems
Advisor(s): Dr. Regan Silvestri, Johnny Vanderford

The Causation and Prevention of Tin Whiskers on Tin Coated Electrical Components

Biography: Lia Douglas is a student in the Micro-Electromechanical Systems program at Lorain County Community College. Lia began her studies at LCCC through the College Credit Plus program, learning manual machinery operations and graduating high school with certification in AutoCAD. Following earning an Associates of Applied Science in pre-engineering, Lia enrolled in the Micro-Electromechanical Systems (MEMS) program where she became qualified in hand-soldering, cleanroom procedures, and various other electronic manufacturing techniques. In January 2023 Ms. Douglas began working at Lincoln Electric in Euclid, Ohio, where she is an engineering support/technician in the electronics factory. Ms. Douglas is a two-year recipient of the Choose Ohio First scholarship. In her spare time, Lia enjoys reading, hiking, drawing, and playing TTRPGs.

Abstract: Tin whiskering is a phenomenon in which electrically conductive, crystalline structures develop from the surfaces of electronic components coated in tin. Tin whiskers have been attributed to causation of major electrical failures, due to the formation of bridging between components resulting in short circuits. Despite whiskering being reported as far back as the 1940's, the causes of whiskering remain unknown.

This project will begin with extensive research into what is currently known about tin whiskers, defining what tin whiskers are and recorded instances of their involvement in electrical failures. The project will then proceed into the theoretical causations of tin whiskers and how they may contradict. In conclusion, the project will focus on one of the potential causes of tin whiskers, and attempt to recreate a scenario that produces tin whiskers on tin coated components.

Publications: None yet.

Jilyan Hustic



Associate's Degree, Biology
Advisor(s): Harry Kestler

Determining the Ability of CCR5 Mutants to Serve as a Gene Therapy for AIDS

Biography: My interest in science began at a very early age. It began with visual disturbances that took months to formally diagnose. Neurology offices began to feel like home. I was diagnosed with Visual Snow Syndrome, which causes me to see small flickering dots that resemble snow or static. This also includes light sensitivity, difficulty seeing in the dark or at night, floaters, tinnitus, and afterimages. I have learned to adapt to this condition, but I became focused on the mechanism of the disorder process after I was diagnosed at the age of twelve. To satisfy my curiosity about this syndrome, as well as other neurological anomalies, I would like to pursue a career in the neuroscience field. As a first step to obtaining a career in neuroscience, I was given the opportunity to work in Dr. Harry Kestler's lab. My work in the lab has focused on developing a gene therapy that manipulates the gene expression of the receptors needed by HIV to gain entry into T-cells. I thoroughly enjoy solving biological problems. In the future, I can see myself working in a lab with other scientists and working on clinical trials to find treatments that will improve people's quality of life.

Abstract: AIDS viruses such as HIV-1 require two receptors to enter a cell. Thus, the principal receptor CD4 is not sufficient for infection to occur. In addition to CD4, one of two co-receptors, CCR5 or CXCR4 is required. A mutation in CCR5 has been shown to confer resistance to viral infection. That mutation, CCR5 delta 32, appears to also alter the cell surface expression of the second receptor, CXCR4, as well as the wild-type version of CCR5 in heterozygous individuals and cell culture. The ability to down-modulate co-receptors by the delivery of lentiviral particles containing CCR5 delta 32 will be determined. Lentiviral vector systems were employed to construct viral particles that contained CCR5 wild-type and CCR5 delta 32. Lentiviral vectors have been previously employed as a cure for Sickle Cell Anemia thus the safety of our approach is probable.

HEK293ft cells were transfected with pLenti puro HA-ubiquitin plasmids containing the CCR5 wild-type or delta 32 along with two plasmids containing genes needed for viral packaging. We have also constructed a mutation delta 33 that encodes an 11 amino acid deletion. This construct will be used to generate lentiviral particles as well. Stable t-cell lines will be constructed by transducing various alleles of CCR5 into Jurkat, H9, and CEMX174 cells. Flow cytometry and immunofluorescence will be employed to determine the surface expression of CCR5 and CXCR4. With varying degrees of success, HIV persistence has been altered by bone marrow transplant and cord blood transplant. These treatments have not been able to help more than a few people due to safety, histocompatibility, and applicability. Lentiviral particles that modulate cell infectibility have the potential to treat many patients without the need for donor histocompatibility or the destruction of existing immune cells.

Publications: None yet.

5

Robert Latta

John Martin



Sophomore Level, Universal Science

Advisor: Dr. Regan Silvestri

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

Biography: John Martin is a 20-year-old student at Lorain County Community College and is in his final year before he earns his Associate of Science degree. He will then pursue a Bachelor of Science degree in Computer Science and Engineering at the University of Toledo in partnership with LCCC, a program he began in the past semester. John has many interests but may pursue graduate degrees later in his academic career, potentially becoming the first in his family to obtain a Ph. D. In January, he took on a leadership role at LCCC as the Student Senate Executive Secretary and in May became elected as Vice President for the 2023-24 academic year. In his free time, he tends to play video games, listen to music, and has recently begun writing a science fiction novel.

Abstract: A significant problem in the treatment of pediatric scoliosis is that implants must be designed to grow alongside the child, a process that allows for significant error compared to the treatment of scoliosis in adults. To aid the design process, implants can be modeled electronically and analyzed using Abaqus CAD computer modeling finite element analysis. Finite element analysis simulates stress and strain mathematically, approximating defects in the design, allowing for said defects to be located and resolved before a physical model is created. This analysis provides a more time and cost-effective design process, reducing the number of times expensive mechanical models must be created, tested, broken, and redesigned.

Publications: None yet.

5

Robert Latta



Emily T. Williams



Senior, Micro Electromechanical Systems
Advisor(s): Dave VanArsdale

Tensile Strength of Woven Material

Biography: Emily Williams is a fourth year Micro Electromechanical Systems (MEMS) student at Lorain County Community College and will be the first woman to graduate from her program in May 2024. She works as a Laboratory Technician for the MEMS department at the college as well as with the Ohio Space Grant Consortium as a Program Assistant. Emily is a Student Leader of SMTA Ohio Valley Chapter, a member of Northeast Ohio’s Society of Women Engineers, and spent Fall of 2022 serving the Office of Science and Technology Policy in the White House.

Abstract: To study various configurations of affordable woven materials, such as Kevlar and wool, with the ability to prevent the penetration of an airborne projectile when launched at an angle perpendicular to the woven swatch. Testing for the deformation of the material after it has been impacted, by identifying and measuring variables such as fiber tensile strength and thread count to determine the proportionality constant between the variables and identify which variable(s) best protect against deformation and penetration of the woven material.

Publications:

1. Williams, E. T. (2021, March). *A Study on Solder Fume Inhalation and the Long-Term Health Effects on Industry Workers*. Ohio Space Grant Consortium. <https://osgc.org/wp-content/uploads/2021/09/2-Proceedings-PDF.pdf> (Pg. 280-282)
2. Williams, E. T. (2022, March). *Manufacturability of Micro-Scale Components with Modern SMT Equipment*. Ohio Space Grant Consortium. <https://osgc.org/wp-content/uploads/2022/06/2022-Proceedings.pdf> (Pg. 253-254)

Education Scholars

Ari Babcock



Senior, Middle Childhood Education
Advisor(s): Dr. William Jones

Beyond Earth: Space's Effect on the Human Body

Biography: Ari Babcock grew up in the small village of Eagle, Michigan. From an early age, Ari knew that she wanted to be a teacher. Her love for math and science made the choice of Middle Childhood Education: Math and Science an easy one. Ari is heavily involved in the Children's Ministry programs at her local church and leads small groups for both upper elementary and middle school girls. Ari will be completing her 4th year at Cedarville University in May.

Abstract: In the year 2015, Astronaut Scott Kelly went up into space to fulfill a one-year low-Earth atmosphere mission. Data was collected regarding the human body's reaction and adaptation to long exposure to space environment. This data is extremely interesting when looking at the results of Astronaut Kelly's journey compared to the data taken from his twin Astronaut Mark Kelly (who stayed on earth and provided an ideal control group to which to compare the results).

In this lesson, students will look at the effects of space travel/orbit on the human body and compare that to human health on Earth. Students will be looking at different aspects of human health, in addition to how space travel would impact the health of a human determining if these effects are detrimental or beneficial. Students will be using inquiry and group discussions in order to pinpoint the cause of these conditions and look for ways to alter these effects. Students will use research given by NASA, to support their ideas to better human health in space. Their findings and ideas will then be presented in a multimedia format of their choosing.

Publications: None yet.

Ruthie Curry



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

Sun's Impact on Earth

Biography: Ruthie Curry is a senior studying Early Childhood Education and Special Education at Baldwin Wallace University and will graduate in May of 2024. She is originally from Westerville, Ohio, a suburb of Columbus. While at Baldwin Wallace University Ruthie was a part of the women's soccer team during her four years, president of the Baldwin Wallace Student Education Organization, as well as a member of Kappa Delta Pi, the Education Honor Society. Ruthie went to a Math and Science based magnet school (K-4th grade) in which scientists came to the school to complete hands-on projects that helped motivate students to stay interested in STEM. She hopes to create a hands-on learning environment similar to the one she had for her own students one day.

Abstract: This lesson, titled *Sun's Impact on Earth*, emphasizes what the sun does for the people on Earth. I will begin the lesson by reading a book titled *The Sun Is Kind of a Big Deal*. While reading the book I will ask students guiding questions that will lead them to knowing how big the sun is, that the sun is the biggest star, and that the sun never goes away. After getting an idea of how big the sun is through the picture book, we will watch a video provided by NASA of the sun and students will write down what they notice and share it outloud after. This will lead to a class conversation about the light and heat that the sun provides for us here on Earth.

Students will then be able to test these ideas through a class activity which will reteach the facts that the sun provides light energy and heat. Each student will get a piece of paper and put their handprint on it using sunscreen. We will put the papers outside in the sun for 3-4 hours and then talk about how the paper is not only warmer, but also how the light faded the fingerprint. Overall, the use of a book, video, and a hands-on activity is sure to keep each student engaged and will provide the takeaway that the sun provides light and heat for people on Earth.

Publications: None yet.

Roemello Davis



Academic Level: Bachelor's student, Senior
 Major: Mild/Moderate Education
 Advisor(s): Dr. Brandi Seither

Water, Water, Everywhere!

Biography: My name is Roemello Davis, and I currently attend Baldwin Wallace University in Berea, Ohio. I majored in mild/moderate education and minored in psychology. My hobbies include watching TV/Movies, reading comic books/graphic novels, playing video games, and listening to music. I specifically chose Mild/Moderate Education because of my personal experience within special education due to having a learning disability and wanting to help children who are similar to me. Growing up, I constantly found myself helping my classmates with homework and assignments and giving advice. At the same time, I found myself having to work harder than others to maintain good grades and get to the position I'm currently in. As a result, teaching was the most realistic choice for me when deciding to choose my major. I genuinely enjoy helping people and wanting them to become the best versions of themselves. My goal as a teacher is to see growth within my students, increase advocacy for my special needs students, and encourage more people of color to become educators to offer a more diverse education for all students. After graduation, I plan to teach for at least 1-2 years before working on getting my Master's degree.

Abstract: This research/project aims to teach students a lesson on how valuable water is. This will be accomplished by teaching the water cycle process, specifically focusing on the subject of Earth Science. The lesson will address that water is presented within the atmosphere. More specifically, as a water vapor. As a result, when water becomes a vapor in the atmosphere, it can form a clouds, snow, fog, rain, and much more. Students will conduct hands-on experiments to learn about the 3 different phases of the water cycle (condensation, evaporation, and precipitation). At the end of the lesson, students will learn why water is an important and valuable resource within our atmosphere and make the connections between how water is involved in our daily lives. Within the lesson, students will also be asked the main essential question, which is how are global precipitation, evaporation, and the cycle of water changing?

Publications: None yet.

Cora Gill



Junior, Secondary Education Integrated Sciences:
Chemistry
Minor: Biological Sciences
Advisor(s): Laura Dell

Using Knowledge of Human Anatomy to Determine the Effects of Longterm Space Exploration

Biography: My name is Cora Gill. I am a junior at the University of Cincinnati. I am studying to be a high school biology or chemistry teacher. My father is a physics teacher at my alma Mater and has been the main source of my love of the sciences. I hope to be as inspiring to my students as he has been to his.

Abstract: This lesson would be for a senior or AP anatomy class. The lesson would be based on the different anatomical systems in the body and how they would be affected by extended time in space. This would be an end-of-the-year project that fully encompasses what the students have learned throughout the year. There are 10 body systems: skeletal, muscular, nervous, endocrine, cardiovascular, lymphatic, respiratory, digestive, urinary, and reproductive. The students would be split into equal groups of two or three and assigned one of the body systems to research. The students would have to use what they learned throughout the year and what they found in books and websites. Students will be expected to use at least two NASA resources to obtain their information. Students will also be expected to present what they found in a formal presentation to their peers and a written group report of their findings and any data they may have used to justify what they found. The final part of the project is students will have to theorize a way to prevent the effects of space on the body. If prevention is not possible, that should be included in their reports.

Publications: None yet.

5

Robert Latta



Molly MacLochlan



Senior, Bachelor of Science in Education ILA 7-12,
Intervention Specialist K-12
Advisor(s): Karen Henning

Human in Space

Biography: Molly MacLochlan is a 23-year-old college student majoring in education, specifically language arts and special education. Her hobbies include biking, camping, and enjoying the outdoors. Molly enjoys spending time with her parents and sisters. She pursued an education career because she believes it is very rewarding and will positively impact the lives of students. She studies education at Youngstown State University and is set to graduate in the Spring of 2025. She has taken courses such as Shakespeare and his World, American Literature, British Literature, and Literary Study. Although her education is mostly in literature, Molly still shares an interest in science and other subjects.

Abstract: This study was conducted on how humans and space correlate. Humans must adapt to their environment in space by adjusting what/how they consume food. Humans also must adapt to the change of gravity and other factors in space. Specifically, Astronauts must undergo many adaptations during space expeditions. NASA is collecting a set of consistent core measurements, called Spaceflight Standard Measures, to characterize how the body and mind change in space. These measures help them better understand how to handle hazards that astronauts will encounter on missions to the Moon and future trips to Mars. For years, NASA has studied the way specific systems of the body react to the stressors of spaceflight. The Spaceflight Standard measures include actigraphy, biochemical markers, carotid intima-media thickness, cognition, cellular profile, microbiome, personality questionnaire, sleep quality questionnaire, and sensorimotor tests. This paper will discuss the Spaceflight Standard Measures and how humans must adapt to space to explore it.

Publications: None yet.

Ryah Moner



Senior, Early Childhood Education and Special Education

Advisor(s): Dr. Brandi Seither

Spaghetti Antennas

Biography: I am from Brunswick, Ohio. I will be graduating from Baldwin Wallace University in May 2024 with my bachelor's in early childhood education with a specialization for students with mild/moderate needs. I have had previous experiences at STEM and language and literacy summer camps, where I worked with a variety of students to create learning experiences across all subject areas. I have a passion for creating hands-on and experiential learning activities.

Abstract: The STEM activity I completed with second grade students is called Spaghetti Antennas. I found this activity on Nasa's Jet Propulsion Laboratory website. Students will be creating a tower using limited amounts of uncooked spaghetti noodles and masking tape. This tower must be able to hold a full-sized marshmallow to represent the large communication satellites that NASA uses to communicate to different spacecraft. Students will be introduced to NASA's Deep Space Network and the various satellites that are used for communication before building their own satellites.

Publications: None yet.

7

Max Miller

Elizabeth Roche



Senior, Integrated Science (Biology); Adolescent Young Adult Licensure
 Advisor(s): Courtney Glover, Erica Miller Arpajian

The Solar System: A Planetary Chemical Comparison

Biography: Elizabeth (Libby) Roche attends Cleveland State University as a senior in the College of Arts and Sciences pursuing a degree in integrated science with a focus in biology and a licensure in education for grades 7-12. Libby grew up in Warren, Ohio and moved to Cleveland in 2020 for college. She worked as a student assistant in the dean’s office of the Levin College of Public Affairs and Education for three years during school. Libby is currently student teaching at Garrett Morgan School of Engineering and Innovation teaching chemistry, biology, and anatomy with students grades in 10-12. She intends to begin teaching next year and pursue a master’s degree in biology. Libby has specific interests in evolutionary biology and population genetics.

Abstract: Students will use online NASA materials to construct a presentation about the difference between the planets in our solar system. This project will focus on the different elements present in the planets and will go along with the HS-PS-1 Ohio learning standard. Students may choose two or more planets to explore and will work in groups to foster collaboration. The presentations will be media of the students’ choice (slide show, trifold poster, video, webpage, blog, etc.). Students will be directed to NASA’s Spaceplace webpage as a starting point to familiarize themselves with the planets (students have wide range of prior scientific knowledge). Students will be required to use NASA’s online image database to find pictures of the planets to include in their presentations. Required in the presentation will be: the most common elements found on the planets, characteristics of the elements (atomic number, number of subatomic particles, etc.), and atmospheric characteristics. Students will also display at least two other interesting facts. When the projects are completed, the students will present to their peers so the whole class may learn more about the chemical composition of our solar system.

Publications: None yet.

Nate Samblanet



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

The Water Cycle

Biography: I am from Dublin, Ohio. I am currently studying early childhood education, and I am in my final semester. Teaching is my passion and I love to present my students with unique ways to learn and take in information. I hope to be a positive role model that helps students find their love for learning.

Abstract: This lesson will have students learn about how the water cycle works through an experiment. For the experiment, the teacher will have shaving cream on the whiteboard and place drops of water on the top. Over time, drops of water will come through the “clouds” like rain. Students will be able to make observations and predictions about what part of the water cycle it could be. Students will be able to observe and participate in the lesson and will record the findings. Then throughout the coming weeks the students will observe the weather and relate it to what part of the water cycle it is on that day.

I feel that students learn best by doing and applying the knowledge that they gain through their experiences. I feel that this lesson does a great job of providing students with an experience to help them learn about the water cycle. This plan also will allow for students to predictions to help them futher connect to the content.

Publications: None yet.

3

Joyce Beatty

Grace Turcotte



Junior, Comprehensive AYA Science Ed Major Advisor:
Dr. William Jones

A Lesson in Ocean Ecology: The Intersection of the Carbon Cycle, Climate Change, and Ocean Biota.

Biography: Grace Turcotte is a Junior attending Cedarville University. Grace developed a passion for science and teaching during her time in high school. Her teachers had a positive influence on her life which motivated her to become an educator herself. She believes each branch of science is fascinating as each branch has its own unique challenges. This is why she has chosen to study AYA integrated science education. Grace is looking forward to teaching any discipline of science whether that be chemistry, physics, or biology. She is currently a tutor for a first-year chemistry college course and has enjoyed the experience this job has provided. She has simultaneously been employed by a professor on campus as a grader for Principles of Biology. Grace has always loved learning and is now excited to be in the position to guide the next generation.

Abstract: The ocean covers over seventy percent of the surface of our planet and has a major impact on the survival of humanity. The purpose of this lesson is to educate students on how biochemical cycles function and how these cycles contribute to environmental change. This lesson connects the importance of the carbon cycle with the real-world issue of climate change. It is important for the students to be able to make this connection so that they are inspired to learn of how the actions of humans and other organisms impact the Earth's climate. The significant role the ocean has in maintaining life will be emphasized as students are immersed in a varied learning experience.

This lesson on ocean ecology is a project-based learning activity using the resources provided on NASA's website. A particular site students will be taking advantage of is NASA's Carbon Monitoring System (CMS) to further their understanding on how data is collected and to find relevant information for their own presentations. Digital tools provide interactive models that allow for students to experience a more direct approach with understanding the carbon cycle. After learning from these models, students will be divided into groups of three to four and allowed to choose a topic that must then be approved for their presentation. The topic a group chooses should align with the provided criteria and should guide their research. This group activity will allow students to present organized information with their peers and broaden the classes understanding of this subject. The expectation for this project is that students would build collaborative skills as they conduct research and organize their findings. The students are encouraged to present their findings in a form of their choosing to allow for creative expression as long as their scientific information is shown in an appropriate manner. Peers are expected to evaluate all presentations to develop lifelong skills in assessing and providing feedback to others. A group discussion will be held at the end to emphasize the real-world application of this project.

Publications: None yet.