NASA / OHIO SPACE GRANT CONSORTIUM

2020-2021
SCHOLAR / FELLOW
STUDENT JOURNAL

Students Representing Ohio Congressional Districts

Follow OSGC on:

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

TABLE OF CONTENTS

FELLOWSHIP AND SCHOLARSHIP PROGRAM

The Ohio Space Grant Consortium (OSGC), a member of the NASA National Space Grant College and Fellowship Program, awards graduate fellowships and undergraduate scholarships to students working toward degrees in **S**cience, **T**echnology, **E**ngineering and **M**athematics **(STEM)** disciplines at OSGC-member universities. The awards are made to United States citizens, and the students are competitively selected. Since the inception of the program in 1989, over 1,380 undergraduate scholarships and 187 graduate fellowships have been awarded.

The Consortium is additionally supported by matching funds provided by the 24 member universities/community colleges, the Ohio Aerospace Institute (OAI), as well as additional funds provided by the State of Ohio Department of Higher Education. With these funds, the Ohio Space Grant Consortium was able to award an additional 31 undergraduate scholarships, 4 Master's fellowships, and 24 internships.

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

18 Affiliate Members

- The University of Akron
- Baldwin Wallace University
- Case Western Reserve University
- Cedarville University
- Central State University
- Cleveland State University
- University of Cincinnati
- University of Dayton
- Kent State University
- Marietta College
- Miami University
- Ohio Northern University
- The Ohio State University
- Ohio University
- The University of Toledo
- Wilberforce University
- Wright State University
- Youngstown State University

6 Community Colleges

- Cincinnati State Technical & Community College
- Columbus State Community College
- Cuyahoga Community College
- Lakeland Community College
- Lorain County Community College
- Sinclair Community College

Ohio Space Grant Consortium • 22800 Cedar Point Road • Cleveland, Ohio 44142

http://www.osgc.org/

MEMBERSHIP

Management

Dr. Andrew Gyekenyesi
Interim Director, OSGC
Director of Research/ Chief Scientist, OAI

Timothy M. Hale
Program Manager, OSGC

18 Member Institutions

Dr. James (Jim) W. McCargar
Baldwin Wallace University

Dr. Roger D. Quinn
Case Western Reserve University

Dr. Robert Chasnov, P. E.
Cedarville University

Dr. Augustus Morris, Jr.
Central State University

Dr. Wei Zhang
Cleveland State University

Dr. Joseph D. Ortiz
Kent State University

Prof. Craig Rabatin, P.E.
Marietta College

James Moller, Ph.D., P.E.
Miami University

Jed E. Marquart, Ph.D., P. E.
Ohio Northern University

Dr. Mo Samimy
The Ohio State University

Dr. Shawn Ostermann
Ohio University

Dr. Julie Zhao
The University of Akron

Dr. Kelly Cohen
University of Cincinnati

Dr. Robert J. Wilkens
University of Dayton

Dr. Lesley M. Berhan
The University of Toledo

Deok Hee Nam, Ph.D.
Wilberforce University

Dr. Mitch Wolff
Wright State University

Byung-Wook Park, Ph.D.
Youngstown State University

6 Community Colleges

Professor Abigail Yee
Cincinnati State Technical and Community College

Professor Jeffery M. Woodson
Columbus State Community College

Professor Michelle S. Davis
Cuyahoga Community College

Professor Tom Ciferno
Lakeland Community College

Regan L. Silvestri, Ph.D.
Lorain County Community College

Eric C. Dunn
Sinclair Community College

Financial Supporters

- Choose Ohio First
- Cornerstone Research Group, Inc.
- Etegent Technologies
- L-3 Cincinnati Electronics
- Nord Family Foundation
- Nordson Corporation Foundation
- Ohio Aerospace Institute
- Ohio Department of Higher Education (State of Ohio)
- Orbital Research, Inc.
- Skyward Ltd.
- ZIN Technologies, Inc.

Lead Institution

Ohio Aerospace Institute

Government Liaisons

Dr. M. David Kankam
NASA Glenn Research Center

Ms. Susan M. Kohler
NASA Glenn Research Center

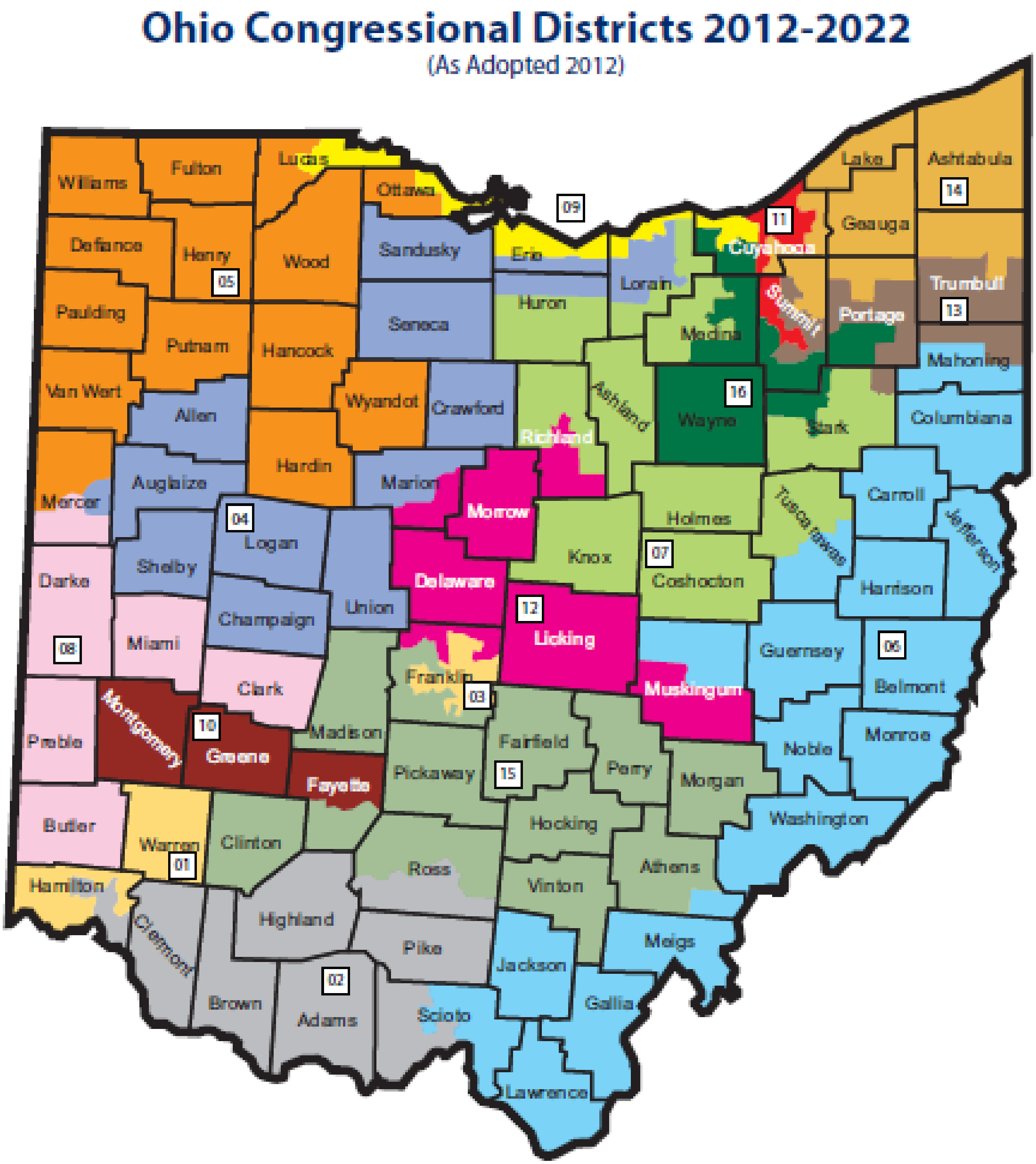
Education Outreach Partners

Mr. Constantine Regas
Cincinnati Observatory Center

Ms. Pamela Bowers
Drake Planetarium & Science Center

Ms. Sue Hare
iSPACE, Inc.

OHIO CONGRESSIONAL MAP



Source: http://www.sos.state.oh.us/sos/upload/reshape/congressional/Congressional-Statewide.pdf

Fellows

UNIVERSITY OF Cincinnati

Joshua F. Coffey

Master's 2, Aerospace Engineering
Advisor(s): Dr. Ephraim Gutmark

Magnetohydrodynamic Based Power Extraction from a Rotating Detonation Engine

Biography: Joshua Coffey is a graduate student at the University of Cincinnati (UC) currently working on the second year of a master's degree in Aerospace Engineering with an emphasis on fluid dynamics and propulsion systems. Prior to attending UC, he received a Bachelor of Science in Physics from Shippensburg University. He is a member of the Gas Dynamics and Propulsion Laboratory (GDPL), which is led by his advisor, Dr. Ephraim Gutmark. His background in physics, particularly electromagnetism, led to his interest in the combination of magnetic fields and detonation waves, which is one of the fields being studied in the GDPL. He has presented research on the impact of a magnetic field on a detonation wave in a tube at the 2020 AIAA Propulsion and Energy Conference. His current research, for which he received the OHSGC Fellowship, focuses on the extraction of power from a rotating detonation combustor using a magnetic field.

Abstract: Detonation based combustors, in which combustion occurs at supersonic velocities, have been shown to increase the thermodynamic efficiency of an engine over those that are based on deflagrative, or subsonic, combustion. This has led to them being the focus of significant research over the past several years, with rotating detonation engines (RDE) recently coming to the fore of that effort, largely superseding pulse detonation engines (PDE). It has been shown that as a detonation wave passes through a gas, the high temperatures associated with the detonation lead to a portion of the gas being ionized, the amount of which is dependent on the temperature and the makeup of the gas. When combined with a magnetic field perpendicular to the direction of the flow of the gas, a current is induced as described by the equations of magnetohydrodynamics (MHD), which combines fluid mechanics with electromagnetism. It has been suggested that this interaction can be used as a source of electrical energy and may be able to be used as a supplementary source of power for an aircraft or spacecraft. The goal of this project is to experimentally measure the amount of power that can be extracted from a rotating detonation combustor operating in the presence of a magnetic field using one such combustor that is present at the University of Cincinnati's Gas Dynamics and Propulsion Laboratory.

Publications: 1) J. Coffey, V. Anand, A. Gaetano, J, Betancourt, T, Pritschau, and E. Gutmark, "Impact of a Magnetic Field on Propagating Detonation Waves in Unconfined Tubes" AIAA Propulsion and Energy 2020.
2) V. Shaw, R. Holpp, N. Stocker, B. Wonziak, J. Coffey, A. Gaetano, T. Pritschau, and E. Gutmark, "Breakup Characteristics and Far-Field Trajectory of Liquid Jets in Subsonic Crossflow" AIAA Propulsion and Energy 2020.

Nicholas S. DeBortoli

Master's 1, Mechanical Engineering
Advisor(s): Dr. Rydge Mulford

Modeling and Validation of a Nature-Inspired, Dynamic Radiator for Thermal Management of Small Spacecraft

Biography: Nicholas DeBortoli is currently a first-year Master's student studying Mechanical Engineering at the University of Dayton. He graduated summa cum laude with a Bachelor's Degree in Mechanical Engineering in May 2020, also from the University of Dayton. While an undergraduate, Nicholas began research with Dr. Rydge Mulford in 2019 and presented their work at the 45th Dayton-Cincinnati Aerospace Sciences Symposium. Alongside his studies, Nicholas also works as a barista, plays trombone in the Dayton Jazz Ensemble, and is a member of the University of Dayton Club Tennis Team.

Abstract: In the past, radiators for thermal control of small spacecraft have been static, with a constant geometry. However, spacecraft in orbit experience a large fluctuation in the magnitude of heat inputs. Despite this fact, current static radiators constantly reject maximum waste heat. To counteract the excess heat rejected in colder environments, heaters are placed onboard these spacecraft. In order to reduce the power resources consumed by these heaters, small spacecraft would benefit from radiators that are capable of variable thermal control. This study proposes nature-inspired, dynamic spacecraft radiators which utilize a collapsible surface capable of large variations in emitting surface area to account for variations in heat inputs.

The main portion of this work involves a thermal model developed in Python. This model, referred to as the Segmented Fin Algorithm (SFA), is a 2D model that quantifies the rate of heat loss and the temperature profile of the aforementioned dynamic radiative fin. One of the primary goals of the study is to optimize the shape of the radiator fin for maximum heat transfer. This work is partially inspired by the cooling properties of flower petals. As a result, the fin shapes will be varied to replicate different petal shapes, ranging from a square fin to a triangular fin. Another goal is to use the SFA to model the heat loss of four of these optimal fins placed on a cube-sat. Finally, this work aims to create a transient model for passively actuated triangular fins.

Publications: None yet.

UNIVERSITY OF Cincinnati

Nicholas S. DeGroote

Master’s 1, Aerospace Engineering
Advisor(s): Dr. Kelly Cohen

Multi-Agent UAS Resource Allocation for Disaster Response in a 3D Dynamic Environment

Biography: Nicholas grew up in Columbus, Ohio, developing an interest in aviation and engineering from a young age. He received his Bachelor of Science in Aerospace Engineering from the University of Cincinnati (UC) in April, 2020. During his undergraduate studies, he completed five coop rotations, including four semesters of full-time undergraduate research. Nicholas decided to continue his education at UC and is currently in the first year of pursuing his Master of Science in Aerospace Engineering. At UC, Nicholas works in the Unmanned Aerial Vehicle Multi-Agent Systems Technology Research (UAV MASTER) Lab. He has worked on a variety of projects involving unmanned aerial systems (UAS), including development of custom ground control stations (GCS) and the Universal Autopilot Translator (UAT). He has presented his work at the Dayton Engineering Sciences Symposium (DESS) and the 2021 SciTech Forum and Exposition.

Abstract: Resource allocation problems have evolved as computation methods and resources have allowed, utilizing Unmanned Aerial Systems (UAS) for a variety of complex tasks, and presenting a plethora of new, highly constrained resource allocation problems. The ability for UAS to operate in intricate 3D environments opens the door for a variety of applications, with one such being disaster response. A scenario is considered where several areas of interest need to be investigated by disaster response crews, seeking out a person in need of help, then providing surveillance over the area for use by ground-based search and rescue (SAR) teams. Areas of interest are generalized in this research as either a point, a line, or a polygon, each representing a different mission objective. Several base stations are available to dispatch UAS to the region being considered, each of which have a finite number of available resources. The allocation of UAS is optimized with the intent of finding a distressed person in a minimum time, then providing continuous surveillance for as long as is needed. The UAS are heterogeneous, having different characteristics for each class of vehicle. An additional cooperative path planning model is also developed which optimizes the routes of each UAS over the course of their flight path. Considerations are also made to account for airspace management, modeling both non-compliant and manned aircraft as dynamic obstacles. The full mission for each UAS is then decomposed into a list of waypoints for a practical implementation into a real-world flight test demonstration.

Publications: N. DeGroote, E. Barnes, J. Burton, M. Terry, J. Ouwerkerk and K. Cohen, “A Solution for the Challenges Presented by the 2020 AUVSI SUAS Competition,” AIAA SciTech Forum, 2021.

Cleveland State University

Ana M. DiLillo

Master's 1, Chemical Engineering
Advisor(s): Dr. Geyou Ao

Glycopolymer-Wrapped Carbon Nanotubes and Their Interactions with Proteins

Biography: Raised in Cleveland, Ana DiLillo is currently a Master's student enrolled in the 4+1 accelerated Master's Program in Chemical Engineering at the Washkewicz College of Engineering, Cleveland State University (CSU). She graduated in 2012 from Ohio State University with a B.A. in Anthropology and a B.A. in Art History before deciding to pursue engineering. She received her B.S. in Chemical Engineering from CSU in 2020, graduating summa cum laude. Ana has worked as an undergraduate and graduate research assistant in the Bio-Nano Materials Lab at CSU since 2018 under the supervision of Dr. Geyou Ao. She was partially supported by the National Science Foundation Research Experiences for Undergraduates program. Ana is an active member of Tau Beta Pi Engineering Honors Society, Society of Women Engineers (SWE), and American Institute of Chemical Engineers (AIChE). After graduation, she plans to pursue a career in biotechnology.

Abstract: Single-wall carbon nanotubes (SWCNTs) have unique optical, electronic, and chemical properties which can be utilized for a wide range of applications, including biosensing and imaging advancement in the near-infrared spectral range. These applications are facilitated via stable dispersion of SWCNTs by biopolymers in an aqueous environment. In this work, we study the behavior of synthetic glycopolymers (i.e., polymers with carbohydrate pendant groups) and their ability to stabilize SWCNTs via noncovalent complexation resulting in water soluble, glycopolymer-wrapped SWCNT (Glyco-SWCNT) hybrids. Particularly, disaccharide lactose-containing polymers of various chain lengths will be tested to optimize dispersion stability, quality, and yield of SWCNTs. These Glyco-SWCNT complexes will be utilized to explore the multivalent interactions between carbohydrates and various carbohydrate-binding proteins via optical spectroscopy and transmission electron microcopy with the goal of determining the selectivity and sensitivity of targeted interactions between carbohydrates and proteins. If successful, these Glyco-SWCNT complexes can be utilized as fluorescent probes to detect specific carbohydrate-protein interactions in biology that are important for many cellular events, such as cancer development and metastasis.

Publications: 1. A. DiLillo, G. Ao, "Optical Characterization and Purification of DNA-Wrapped Single-Wall Carbon Nanotubes at Controlled pH" (Poster) American Institute of Chemical Engineers Annual Meeting, Orlando, FL, USA (November 2019).
2. A. DiLillo, G. Ao, "Effects of pH on Optical Properties of DNA-Wrapped Single-Wall Carbon Nanotubes." (Poster) The Fall 2019 Undergraduate Research Poster Session, Cleveland State University, Cleveland, OH, USA (September 2019).
3. A. DiLillo, G. Ao, "pH-Dependent separation of DNA-wrapped Carbon Nanotubes in Polymer Aqueous Two-Phase Systems", To be Submitted.
4. A. DiLillo, K. K. Chan, X.-L. Sun, and G. Ao, "Glycopolymer-Wrapped Carbon Nanotubes Probe Targeted Carbohydrate-Protein Interactions To be Submitted.

THE OHIO STATE UNIVERSITY

Brandon L. Emshoff

Master’s 2, Aerospace Engineering
Advisor(s): Dr. James Gregory and Dr. Matthew McCrink

Classification of Manned Aircraft in a Cluttered Low-Altitude Radar Environment Using Artificial Neural Networks

Biography: Brandon Emshoff is from Tiffin, OH, where he attended Mohawk High School. After graduating high school, Brandon attended Ohio Northern University where he earned his Bachelor’s Degree in Mechanical Engineering in May, 2019. During his time at Ohio Northern, Brandon took aerospace engineering focused electives and took part in a summer research project funded by the Ohio Space Grant Consortium that pushed him to pursue a master’s degree in aerospace engineering. Brandon is currently on his second year of his master’s program in aerospace engineering at The Ohio State University. He works at the Aerospace Research Center under Dr. James Gregory and Dr. Matthew McCrink and performs research to better understand small unmanned aerial vehicle flight performance. Brandon also aids in the research for integration of these unmanned vehicles into a shared airspace with manned aircraft. Outside of schoolwork and research, Brandon volunteers with Habitat for Humanity.

Abstract: As small unmanned aerial systems (sUAS) become more prevalent and begin beyond visual line of sight (BVLOS) operations, airspace surveillance systems capable of deconflicting the shared airspace become more important, especially in rural, uncontrolled airspace. Radar presents itself as a suitable surveillance system for the low-altitude environment where sUAS and manned aircraft are likely to interact. Radar can see all cooperative and non-coperative – without ADS-B out – aircraft in this environment and radar is centralized and independent of the sUAS and manned aircraft operations. However, at low altitudes, radar clutter becomes an issue. A machine-learning, artificial neural network algorithm was created to declutter the low-altitude radar feed to provide better situational awareness for the deconfliction of sUAS and manned aircraft. Truth data sets obtained from ADS-B and onboard flight recorders were used to correlate radar tracks to build a training data set that allows the model to ingest strictly radar data to make a classification. This algorithm is both lightweight and accurate in its classifications, removing greater than 90% of the clutter tracks seen by the radar and increasing the usability of the radar feed.

Publications:

1. Emshoff, B, Payne, B., & Marquart, J. E., “Blunt Body Vortex Structure and CFD Turbulence Model Investigation,” AIAA SciTech Forum, 2019.
2. Emshoff, B., McCrink, M., Gregory, J., “Low-Altitude Radar Track Filtering and Classification Using Deep Learning,” AIAA SciTech Forum, 2021.

Erin P. Hubbard

Master's 1, Mechanical Engineering
Advisor(s): Dr. Wei Zhang

Experimental Uncertainty Quantification and Mitigation Strategies in Support of Flow Physics of Rooftop Vortices Study

Biography: Erin Hubbard received a Bachelor of Science degree in Mechanical Engineering in 2003 from The Ohio State University and is currently a graduate student in the Mechanical Engineering program at Cleveland State University. Erin is a Data Engineer for Jacobs, working to support NASA Glenn Research Center's testing division under the TFOME contracts in Cleveland, Ohio since 2014. She has been leading an effort to develop uncertainty quantification standards and provide comprehensive uncertainty estimates for critical facility parameters to customers and personnel at NASA's major wind tunnel facilities. Erin has presented uncertainty propagation methods and results at the 2016 AIAA SciTech conference, the 2016 Supersonic Tunnel Association International meeting, the 2018 National Partnership for Aeronautical Testing annual meeting, and the 2019 Air Vehicles Technology Symposium. Erin was also a recipient of NASA's Early Career Public Achievement Medal in 2018. She has participated as a member of the Wind Tunnel Characterization Working Group, serves as a member of AIAA's Ground Test Technical Committee (GTTC), and is chair of the AIAA GTTC Wind Tunnel Measurement Uncertainty Working Group.

Abstract: Current research is underway at Cleveland State University to understand the flow physics of transient rooftop vortices in an effort to find wind mitigation techniques which may be useful in protecting structures from damage during high wind events such as hurricanes. The research has as one of its objectives to "determine the correlation of rooftop vortices to the peak pressures." This critical objective requires obtaining flow characteristics and surface pressure measurements during wind tunnel simulation tests. The uncertainty in the surface pressure measurements and flow measurements must be understood and quantified to ensure the reliable characterization of flow.

Uncertainty quantification is critical to any experiment. It provides an understanding of the degree to which measurements are known and insight into whether or not the physical phenomena is actually detectible within the uncertainty of the measurement device/technique being used. A thorough uncertainty propagation analysis can be performed using the Monte Carlo method, and leading uncertainty sources can be identified. At the end of this effort, uncertainties in measurements and/or calculations of interest will be quantified and reported with all uncertainty sources considered and assumptions made in the analysis. Experimental results can then be presented with the understanding of their statistical significance.

Publications: 1. J. Stephens, E. Hubbard, et.al. Uncertainty Analysis of the NASA Glenn 8x6 Supersonic Wind Tunnel. Contractor Report NASA/CR-2016-219411, National Aeronautics and Space Administration, 2016.
2. J. Stephens, E. Hubbard. "Uncertainty Analysis of the NASA Glenn's 8- by 6-Foot Supersonic Wind Tunnel." Proceedings of the AIAA SciTech Conference; 4-8 Jan 2016, San Diego CA. American Institute of Aeronautics and Astronautics, 2016.
3. E. Hubbard. Uncertainty Analysis of the CE-22 Advanced Nozzle Test Facility. Contractor Report NASA/CR-2019-220065, National Aeronautics and Space Administration, 2019.

WRIGHT STATE UNIVERSITY

Daniel T. Ketterer

Master's 1, Computer Science & Engineering
Advisor(s): Luther Palmer, Ph.D.

Joint Inference and Control Framework and Operating Space Exploration

Biography: Daniel Ketterer was born in Cincinnati, but lived most of his life in Texas, where he received his Bachelor's Degree in Mathematics at Schreiner University in Kerrville. After working for two years at Accenture as a Federal System Developer Analyst he went back to school and received a Master's in Mathematics at Wright State University. He is currently a graduate student at Wright State University who is pursuing a Master's Degree in Computer Science & Engineering, with plans of getting a Ph.D. in the subject following graduation. He is a research assistant under Dr. Luther Palmer that works with machine learning and artificially intelligent control strategies for surveillance and reconnaissance using an unmanned aerial vehicle. Outside of work, Daniel enjoys hiking in the woods and is a member of the Philosophy Club.

Abstract: The Air Force is presented with a variety of sensing missions where it is desired for an autonomous platform to navigate a three-dimensional space to a mission objective while simultaneously collecting information about the objective location to be achieved. In an ideal scenario, the platform will be given precise information regarding the objective location at the outset of the mission, and the platform would simply plot the most efficient path from its starting point to that final location. This path would vary from a line in open space, to more complicated paths in environments with obstacles (e.g. terrain, unauthorized airspace) to be avoided. However, in an anti-access/area-denied context, it is unlikely for the sensor platform to have complete information regarding its mission objective at the outset. Instead, the platform is provided limited information at the outset, and must learn its objective as the scenario progresses.

Publications: Ketterer, Daniel T. An Inquiry into Multidimensional Spaces, May 2015, Schreiner University, Undergraduate Research Thesis.

Shane T. Kosir

Master's 2, Chemical Engineering
Advisor(s): Dr. Joshua Heyne

Optical Dilatometry Measurements for the Quantification of Sustainable Aviation Fuel Materials Compatibility

Biography: Shane Kosir is currently in the second year of his master's in chemical engineering at the University of Dayton (UD). He has a passion for sustainability and is excited about technologies that can reduce carbon emissions. He began working at the University of Dayton HEAT Lab in the spring of 2018 and has researched high-performance jet fuel optimization, sustainable aviation fuel (SAF) prescreening, and, most recently, SAF materials compatibility under the guidance of his advisor, Dr. Joshua Heyne. Since beginning in the HEAT Lab, he has authored two journal papers and presented at numerous conferences. Shane is also involved in research with the UD chemical engineering professor Dr. Sarwan Sandhu related to the electrochemical performance evaluation of lithium-ion batteries. Beyond engineering, Shane enjoys going for hikes and volunteering with the Five Rivers MetroParks. After graduation, he intends to pursue a PhD in chemical engineering with a focus on catalysis. His long-term goal is to work for the Department of Energy, applying catalysis to sustainable energy and materials production.

Abstract: Sustainable aviation fuel offers a near-term opportunity to reduce aviation's greenhouse gas emissions. Many currently-approved SAFs are limited to a maximum blend ratio of 50% with conventional jet fuel due to materials compatibility issues (i.e., O-ring volume swell). Specifically, aircraft have been found to leak significant fuel quantities over the timescale of hours when volume swell is not sufficient. Aromatics provide the majority of volume swell for conventional jet fuel but are generally undesirable due to their low specific energy (SE) and tendency to form soot. Previous high-performance jet fuel (HPF) optimization efforts indicate that blends consisting primarily of cycloalkanes can meet volume swell requirements while achieving 1.9% and 5.1% SE [MJ/kg] and energy density [MJ/L] gains relative to conventional jet fuel. Given these optimization results, it is proposed that cycloalkanes can overcome the blend limit and add to the value proposition of SAFs. Here, the process development and results of optical dilatometer (OD) measurements for SAFs are reported. These measurements serve to validate the previously mentioned HPF optimization study's findings and screen candidate SAFs at an early stage of the approval process. OD measurements have been taken for a collection of conventional jet fuels to establish a conventional swell range for two materials common in commercial fuel systems: nitrile rubber and fluorosilicone. These conventional swell ranges will serve as a reference to determine whether candidate SAFs and neat molecules meet materials compatibility requirements.

Publications: 1. Kosir S, Heyne J, Graham J. A Machine Learning Framework for Drop-in Volume Swell Characteristics of Sustainable Aviation Fuel. Fuel 2020; 274. https://doi.org/10.1016/j.fuel.2020.117832.
2. Kosir S, Stachler R, Heyne J, Hauck F. High-Performance Jet Fuel Optimization and Uncertainty Analysis. Fuel 2020; 281. https://doi.org/10.1016/j.fuel.2020.118718.
3. Kosir S, Heyne J, Kirby M. High-Performance Jet Fuel Optimization and Aircraft Performance Analysis Considering O-ring Volume Swell. East. States Sect. Combust. Inst. Spring Tech. Meet., Columbia: 2020.

Taylor W. Mason

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

Design and Testing of an Electrostatic Actuator With Dual-Electrodes for Generating Haptic Feedback in Large Touch Displays

Biography: Taylor Mason is a Mechanical Engineering student that is pursuing his Master's Degree at Miami University. His graduate research is in the field of mechanical vibrations and vibrotactile feedback technologies. Taylor began his research as an undergraduate student and has continued his work into his graduate studies and master's thesis project. Taylor published his first research article last summer in the Applied Sciences Journal. In addition to working in Miami University's Mechanical Vibrations lab, Taylor enjoys playing intramural hockey and being an active member of the Ski and Board Club. After graduation, Taylor plans to work in the fields of structural dynamics or mechanical vibrations.

Abstract: Vibrotactile feedback is a key feature of many modern touch displays, which greatly enhances user experiences when interacting with an onscreen interface. Despite its popularity in small touch screen devices, this haptic feature is absent in most large displays due to a lack of suitable actuators for such applications. Thus, a growing need exists for haptic actuators capable of producing sufficient vibrations in large touch displays. This study proposes and evaluates a novel electrostatic resonant actuator (ERA) with a moving mass and dual electrodes for increased vibration feedback intensity. The dual-electrode ERA was compared to a similar single-electrode ERA to determine the impact of electrode configuration on vibration output. The maximum vibration intensity of the dual-electrode actuator increased by 73% compared to the single-electrode actuator, showing promising potential for its use in large touchscreen applications. Moving forward, a traveling vibration wave study will be conducted to see how vibration waves generated from the actuator travel along a surface and interact with one another. This will be done through both simulation and experimentation. Knowledge about the interaction of the waves will be used to design an optimal full-scale touchscreen system that may utilize enhanced haptic feedback features, such as moving vibration sensations or localized increased vibration intensity at specific locations. This system will be simulated using COMSOL Multiphysics and experimentally evaluated to determine the feasibility of the proposed actuator for generating vibrotactile haptic feedback in large touchscreen displays. This research not only provides a valuable learning opportunity for the student but also contributes to the developing field of haptic feedback technologies.

Publications: T. Mason, J.-H. Koo, Y.-M. Kim, and T.-H. Yang, "Experimental Evaluation on the Effect of Electrode Configuration in Electrostatic Actuators for Increasing Vibrotactile Feedback Intensity," Applied Sciences, vol. 10, no. 15, Art. no. 15, Jan. 2020, doi: 10.3390/app10155375.

MIAMI UNIVERSITY

David L. Pearl

Master's 2, Mechanical Engineering
Advisor(s): Dr. Carter Hamilton

Characterization of Friction Stir Welding Under Temperature Control

Biography: Dave Pearl is a graduate student at Miami University, working towards a Master's Degree in Mechanical Engineering. Through his work with Dr. Carter Hamilton, he is developing a deeper characterization of the friction stir welding (FSW) process, enabling high-performance joining applications. Partnering with the researchers at BYU(Provo) and AGH University of Science and Technology (Krakow) has allowed him access to a larger knowledge base and more extensive resources to accomplish this through data acquisition and advanced microscopy and microhardness profiling. Dave has also been heavily involved in Baja SAE at Miami, and enjoys mountain biking and backpacking.

Abstract: Friction stir welding is a novel, solid-state joining process with significant advantages over traditional fusion welding. Previously unweldable materials can be joined with this technique, including aluminum alloys, copper, and steel. The present study focuses on the active temperature control of this process in two aluminum alloys, 2024 and 7075, and the resulting weld properties and microstructure. Welds were performed at a high and low temperature setpoint, and an "uncontrolled" trial with constant parameters. Telemetry data from the welding trials shows the thermal history, in conjunction with spindle torque and position. Mechanical testing, microscopy, and thermal modelling has been performed and correlated to the telemetry data. Preliminary results highlight the importance of the process temperature, but more analysis will be completed to fully understand and characterize the effect of active temperature control. Characterizing joint efficiency is important to the case for FSW, and tensile testing is a common and widely accepted method of proving this, and then SEM will be applied to analyze the fracture surfaces. Positron annihilation lifetime spectroscopy (PALS) data has been gathered across the weld profile and will be correlated with microhardness, and then simulation data to model thermal history and predict the strength profile.
A distinct gap in the literature exists in the characterization of temperature-controlled friction stir welds, where the maximum temperature is controlled and thus used as a variable to identify weld properties. Further, many characterization methods have been applied to FSW, but applying PALS to these welds also requires more research to become fully understood. This project aims to aid the process of filling both gaps.

Publications: Hunt, J., Pearl, D., Hamilton, C., Hovanski, Y., "Preliminary Investigation of the Effect of Temperature Control in Friction Stir Welding," 2021 TMS Annual Meeting and Exhibition, Friction Stir Welding and Processing XI.

Scholars

The University of Dayton

Joseph G. Beckett

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

Towards DLP 3D-Printed Soft Robots: A Stereo DIC Investigation of the Mechanics of Ultra-Stretchable UV-Curable Photopolymers

Biography: Joseph Beckett is a junior undergraduate student pursuing a degree in mechanical engineering at the University of Dayton. In the spring of 2020, Joseph joined the Behavior of Advanced Materials and Structures lab and began working on a collaborative research project (with the University of Dayton Research Institute and the Air Force Research Laboratory) focused on the mechanics of additively manufactured soft materials and structures. Joseph has been accepted into the Berry Summer Thesis Institute during Summer 2021, a cohorted undergraduate research experience for Honors students at the University of Dayton. Previously, Joseph worked as an intern at the Department of Energy’s Portsmouth Gaseous Diffusion Plant in Pike County, Ohio. Outside of classes, Joseph is an undergraduate teaching assistant for theory of machines. Joseph is also the vice president of the “It Flies” competition team and a member of Pi Tau Sigma. After graduation, Joseph intends to pursue graduate studies in mechanical engineering, specializing in solid mechanics and additive manufacturing.

Abstract: Digital light processing (DLP) additive manufacturing (AM) is an emerging 3D-printing technique where full layers of photo-curable polymers are irradiated and cured with projected ultraviolet light to create a three-dimensional part. Recent breakthroughs in polymer chemistry have led to a growing number of ultra-stretchable UV-curable elastomeric materials developed exclusively for DLP AM. Coupled with the practical manufacturing advantages of DLP AM, these novel elastomeric materials are compelling candidates for soft robots. To advance the role of DLP in this promising technological space, a fundamental understanding of the mechanical behavior of UV-curable elastomeric materials over a broad range of loading conditions is requisite. At present, however, this remains an open problem. The proposed project aims to address this compelling research opportunity through the design and implementation of a custom stereo digital image correlation (DIC) system for full-field strain measurement of soft materials with extreme stretchability. Once operational, it will be used in combination with existing test equipment to gather robust datasets on photopolymer samples undergoing a variety of mechanical testing methods, including multiple deformation modes, varied strain rates, and cyclic loading-unloading. The resulting test data will be used to develop working analytical and computational models that will facilitate the design, optimization, and virtual testing of prototype soft robots. These models will be verified using component-level DIC surface strain measurements of DLP printed soft robots.

Publications: None yet.

Brian J. Berry

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

Physical Properties and Applications of Tannin Based Rigid Foams

Biography: Brian Berry is currently studying mechanical engineering at the University of Dayton. Science has always been a passion of his and joining the middle school robotics team set him on his journey to study engineering. While attending the University of Dayton Brian has been involved in the community and has spent every opportunity, including his summers, engaged with the university and its surrounding community. The summer after his freshman year he stayed in Dayton participating in an ETHOS program, and the following summer he entered as a student Co-op for Silfex in Eton, Ohio. Now Brian is working with Rydge Mulford to study applications of Tannin foam insulation.

Abstract: Tannin based ridged foams are foams comprised of natural materials. The most common material being from the bark of a tree. The goal of the research is to understand the physical properties of tannin foam, including the thermal conductivity of the material. Understanding the properties of tannin foam will help determine if tannin foams have a possible application as an insulator in space crafts. If tannin foams could be used as insulation the production of space crafts while in space would become more accomplishable. This being because the material used to make it are made of natural materials that could be cultivated in space.

Publications: None yet.

UNIVERSITY OF Cincinnati

Karlee D. Birchfield

Senior, Aerospace Engineering
Advisor(s): Dr. Yao Fu

Thermal Analysis of Laser Powder Bed Fusion using Finite Element Modeling

Biography: Karlee is a Junior studying Aerospace Engineering at the University of Cincinnati. She is originally from a small rural community in Northwest Ohio where she found her love of aerospace engineering at the age of 14. While at the University of Cincinnati, she has participated in the Co-op Education Program, where she has spent four semesters working for GE Aviation in the areas of research and development, design, performance, and lean manufacturing. She also interned one semester at Fiber Materials Inc where she worked as a manufacturing engineer for composite parts. She has also been an officer of Kappa Alpha Theta, a Bearcat Buddy tutor, a STAR club tutor, and a member of Its on Us. She is currently working as a teaching assistant for the Aerospace Department and works part time at Dean's cards to put herself through schooling. She has recently accepted a full time position at Bell Flight as a continuous improvement associate at their Dallas – Fort Worth facility and is looking forward to starting her career with such a transformative company.

Abstract: Additive manufacturing has quickly found widespread applications in various industries, because it allows for manufacturing of complex geometries, weight reduction, material waste minimization, and improved component quality. This has especially gained attention in the aerospace industry due to its ability to repair complex and expensive parts instead of replacing them. While there are many benefits that come with using additive manufacturing, there are also many challenges. One of the challenges is understanding the thermal residual stress generated during the formation of the part. The aim of this work is to model the laser powder bed fusion process to provide an effective way to understand the relationship between process parameters and temperature history. This process will be modeled in Abaqus with a user defined Fortran subroutine to simulate the laser with a moving heat flux. Last year's research will be expanded upon with the addition of layer generation using the model change feature in Abaqus. This will allow for element deactivation/activation to simulate new layers of powder.

Publications: None yet.

KENT STATE UNIVERSITY

Jacob M. Bradley

Master's 2, Geology
Advisor(s): Dr. Kuldeep Singh

How Pore-Scale Topology Of Sedimentary Rocks Control Transition Of Non-Fickian To Fickian Contaminant Transport And The Upscaling Of Dispersion Phenomenon

Biography: Jacob Bradley is a current graduate student pursuing a master's degree in Geology at Kent State University. He developed an interest in geology during his early adolescent years when he collected rocks on family vacations. Since, he has obtained a B.Sc. in Geology from Kent State University in 2017 and devoted a year in the oil and gas industry working as a mudlogger before furthering his education. During his master's tenure, Jacob has been passionate about modeling and field studies of groundwater/contaminant transport in geosystems. He has presented his research at the annual AGU and EWRI conferences. After the completion of his master's degree, Jacob plans to publish his research and obtain a position as a geologist or hydrogeologist in the environmental industry.

Abstract: Hydraulic heterogeneity in aquifers contributes to non-Fickian transport characteristics, i.e., which cannot be defined by the continuum-scale advection-dispersion equation (ADE). We investigate the role of first-order heterogeneity, i.e., pore geometry's effect on the dispersion phenomenon of porous media. The research questions addressed are; how can we determine dispersion coefficient and Dispersivity as a function of pore-scale geometry and various flow rate? In this computational study, a series of intra-pore geometries are designed and quantified by a dimensionless pore geometry factor (β), which captures a broad range of pores that likely exists due to diagenetic processes. Navier-Stokes and Advection-Diffusion equations are solved to examine the transport phenomenon via breakthrough curve (BTC) and residence time distribution (RTD). We determine a length-scale when non-Fickian features transition to the Fickian transport regime by sequentially extending the number of pores. Our results indicate that not only is the velocity distribution and its variance (σ2) are dependent on the pore geometry, but its impact is amplified with flow rate. Consequently, the magnitude of non-Fickian becomes significant for complex pore shapes and require a longer length-scale for the Fickian transport. Thus, a larger velocity variance due to the effect of intra-pore geometry and flow rate contributes to a larger dispersion where variations are found to be a function of β and flow rate. We determine various constitutive equations to predict the length-scale needed for Fickian dispersion, the magnitude of non-Fickian features, the Fickian dispersion and Dispersivity coefficients as a function of pore geometry factor (β) for various flow regimes bridging the gap between the pore-scale and the continuum-sale.

Publications:

1. Bradley J., Wang L., Chaudhary K., (2019). How pore geometry controls dispersion during transition from non-Fickian to Fickian solute transport with length at pore-scale, American Geophysical Union, December 9-13, San Francisco, California.
2. Bradley, J., and K. Chaudhary., (2019) Role of pore channel geometry on length scales for transition of non-Fickian to Fickian solute transport, World Environmental and Water Resources Congress (EWRI), May 19-23, Pittsburgh, Pennsylvania.

THE OHIO STATE UNIVERSITY

Noah A. Broski

Senior, Aerospace Engineering
Advisor(s): Dr. Jen-Ping Chen

Development of an Optimization Method for an Offset Jet Engine Inlet Utilizing Non-Linear Optimization Methods

Biography: Noah Broski grew up in Olmsted Falls, Ohio, where he attended Olmsted Falls High School. During his time in high school he excelled in math and science classes along with developing an interest for computer coding. While in high school, Noah was a part of his school's soccer, football, and wrestling teams, along with playing for a club rugby team in Avon, Ohio. He is currently a senior at The Ohio State University. During his undergraduate experience, Noah completed the Green Engineering Scholars Program, along with being a member and competing nationally with the Men's Rugby Club and the Racquetball Club. Noah is also a member of the Aerospace Honorary, Sigma Gamma Tau. He will be graduating with a Bachelor of Science in Aerospace Engineering in May.

Abstract: Inlets whose centerlines are offset of the aircraft's engine have been utilized in many applications across both the civilian and military aircraft. Some advantages of an offset inlet include but are not limited to: being able to place the engine along the centerline of the aircraft allowing for better propulsion integration, reducing heat signatures by having the engine insulated in the body of the aircraft, reducing radar detection by having a more compact cross-sectional area, and allowing for boundary layer ingestion to reduce overall drag on the aircraft. However, utilizing an offset inlet does not come without complications. Two of the main complications are having a large pressure loss in the inlet and having large flow distortion at the aerodynamic interface plane (AIP). Both of these complications can lead to large decrements in engine performance, in addition to the possible formation of dynamic stall cells, leading to catastrophic failure of compressor blades.

The goal of this research is to develop a tool which utilizes non-linear optimization methods in order to optimize the geometry of an offset inlet, resulting in reduced pressure loss and flow distortion. This tool will require the user to input geometric constraints for the desired inlet. Using these constraints, the tool will create an inlet using a MATLAB code which parameterizes the inlet into four fifth-order Bezier curves. With these curves defined, a SOLIDWORKS macro creates an inlet geometry to be sent into computational fluid dynamics software. Utilizing user-defined boundary conditions, the pressure loss and flow distortion at the AIP will be computed. These results are then used as the objective function for a non-linear optimization algorithm, which will output new control points for the inlet's four Bezier curves. This will then iterate until the inlet is optimized and the termination criteria is met.

Publications: None yet.

Elizabeth M. Bryson

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

The Role of cyp1b1 in the Development of Primary Congenital Glaucoma in *Danio rerio*

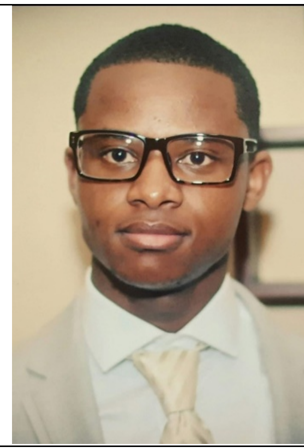
Biography: Elizabeth Bryson is a Senior at Baldwin Wallace University from Lyndhurst, Ohio. From a young age, Elizabeth has always been passionate about science and wanted to pursue a career in the sciences, mainly in the medical field. During her sophomore year of high school, she found her love for research which has led her to the path she is on now. After graduating from Baldwin Wallace, Elizabeth plans to pursue a Ph.D. in regenerative medicine. Participating in the Ohio Space Grant Consortium has allowed Elizabeth to collaborate with Dr. Jacqueline Morris on a project that has influenced her career path for the better and created a mentor/mentee relationship which will last beyond the scope of her undergraduate studies.

Abstract: Primary congenital glaucoma (PCG) is an autosomal recessive disorder of the eye due to a neural crest defect that results in increased ocular pressure. PCG is the most common neonatal and infantile glaucoma, affecting 1/10,000 babies in The United States. Retinoic acid (RA), a vitamin A metabolite necessary for the development of the optic nerve and ventral retina is metabolized by cyp1b1. A cyp1b1 knockdown creates the inability for neural crest cell migration, leading to trabecular meshwork malformation and elevated intraocular pressure. This study aimed to create a null deletion using the CRISPR/Cas9 system in Danio rerio in order to determine whether this method of knockdown could induce PCG as it would occur naturally. Three Danio rerio specific oligonucleotides were designed to target the cyp1b1 gene located on chromosome 13; each sequence is located in the first exon of the chromosome. The oligonucleotides were PCR amplified and purified before undergoing in vitro transcription. Completed gene transcripts were confirmed via electrophoresis. Danio rerio one cell stage embryos were injected with Cas9 protein and the three cyp1b1 specific gRNAs. DNA isolated from injected embryos was used to confirm mutagenesis.

Publications: None yet.

YOUNGSTOWN STATE UNIVERSITY

Joseph C. Castma



Junior, Mechanical Engineering
Advisor(s): Dr. Kevin J. Disotell

The Open-Jet Facility Testing

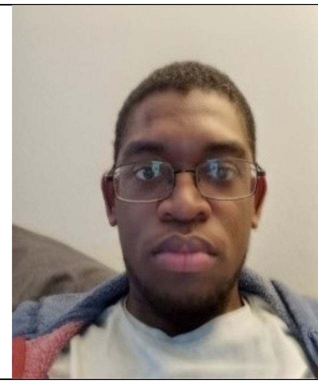
Biography: Joe Carson Castma is currently a Junior at Youngstown State University, majoring in Mechanical Engineering with a minor in Business. He was born in Haiti and moved to the United States when he was 11 years old. At the time, his parents were in Haiti, and he lived with his older sister. Since he was young, engineering has intrigued him because of his interest and strengths in all STEM disciplines. After graduating from high school, he attended Slippery Rock University to pursue his engineering degree. In Fall 2019, He transferred to Youngstown University to complete his degree. He is a member of the National Society of Black Engineers (NSBE). Upon graduation, his career goal is to work in the aerospace or automotive industry.

Abstract: A Shear Flow Wind Tunnel has been converted into an open-jet facility at Youngstown State University. The open-jet facility incorporates a test cell with a large fan that propelled air with a velocity of up to 35 m/s. My research consisted of using the following tools: A pitot-static tube, hot-wire anemometer, and an ultrasonic anemometer, to measure the modified test cell flow quality to test UAVs (drones) and associated components and provide documentation for futures tests.

Publications: None yet.

WILBERFORCE UNIVERSITY

Zackry D. Cephas



Junior, Computer Engineering
Advisor(s): Dr. Deok Hee Nam

Cyber Security For Distributed Energy Resources

Biography: I am a Computer Engineering student at Wilberforce University. My love for science fiction like Star Wars and marvel. That is the reason why I'm interested in engineering. Today, every story you hear is how someone got to or where they are from a there humble beginning in which they started.
My story starts here. Majoring in engineering is a challenging profession as an engineer often has to operate under immense pressure. But it can also be extremely rewarding. When I was young, as watching Star Wars using a lightsaber or seeing androids and spaceships, I feel like that it could happen one day or watch back to the future and marvels avengers in which that inspire great things to come in the future because there is some tech that is now real and their others that I wish to see it, in reality, one day. This biography is not about me. It is really about the amazing things that science fiction has done for the world by inspiring things, that got people into what business they are now.

Abstract: The purpose of the proposed project is to examine the cybersecurity resources that can help how people use energy resources to expanded networks inside energy frameworks and their parts and expanding the assault surface that a dangerous entertainer can target. A normalized method to survey distributed energy resources (DER) network as a method to utilize the online instrument for the greatest advantage is used for the safety planned to give an outline of a network safety hazard as it relates straightforwardly to filling in thorough reference concerning online protection controls for the direction on the most proficient. To address the difficulties of DER network safety, specialists at the National Renewable Energy Research facility built up a comprehensive DER online protection system that incorporates a device for assessing the network. Currently, most of the electric grid is transitioning through increased penetration of DER. Hence, the consumers or third party owned devices controlled by digital communication are getting increased and targeted by cyber-attacks. That causes the monitoring and control of DERs to require significant data-exchange and extensive communication networks. The proposed project explores the current industry's best practices related to DER cybersecurity and studies the possible recommended functionalities for improving the cybersecurity posture of DERs. In addition, for improving the cybersecurity posture of DERs, possible attack prevention, detection, and response measures specifically designed for DER integration across the cyber, physical device, and utility layers of the future smart grid are examined.

Publications: None yet.

Marietta College

Victoria L. Clarchick

Senior, Petroleum Engineering
Advisor(s): Ben Ebenhack

Water Purification and the Efficiency and Viability within the Mid-Ohio Valley

Biography: Victoria Clarchick is a Senior at Marietta College majoring in Petroleum Engineering with a minor in Computer Science and a certificate in Leadership. Originally from Pittsburgh, Pennsylvania, Victoria has immersed herself in her school and community. At Marietta College Victoria is a student athlete, engineering and math tutor, executive coordinator of the Marietta College Petroleum Engineering Mentoring Program, campus president for the Society of Women Engineers (SWE), as well as a member of the campus chapters of American Association of Drilling Engineers (AADE) and the Society of Petroleum Engineers (SPE). Victoria has also completed several internships where she has been able to learn about the industry from a hands-on perspective.

Abstract: The separation of oil, gas, and water in the Oil and Gas Industry is continuously changing. The creation of new processes occurs practically every day, yet there is still always a small percentage of water and smaller hydrocarbons still left in the hydrocarbon mixture at the end of the separation process on locations. The purpose of this experiment is to determine if a water purification plant could be implemented into the Mid-Ohio Valley to improve the quality of the surrounding environment. The current problem is that there is not a facility that will accept wastewater from oil and gas locations as well as draw in water from damaged waterways and treat both simultaneously. A water treatment plant has the potential to separate the impurities from wastewater and sulfur drainage. This will be important to environmental protection as well as efficient operations. Therefore, outlined in this experiment is the process for how to facilitate the implementation of a water purification treatment plant.

Publications: None yet.

THE UNIVERSITY OF TOLEDO

Jacob A. Connolly

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

Paraoxonase Regulation of Vascular Dementia

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

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

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

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

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

Kayla M. Covington

Senior, Chemical Engineering
Advisor(s): Dr. Bi-min Zhang Newby

Evaluation of the Adhesive Properties of Glycoproteins in of Snail Mucin

Biography: Kayla M. Covington is a 5th year undergraduate student at The University of Akron studying Chemical Engineering while specializing in biotechnology. She has always had a passion for the environment and nature and hopes to use her career as an engineer to further improve efforts to protect and restore the environment and promote a circular economy. While studying at the University of Akron, Kayla has used her free time to help promote sustainability on campus by joining Akron's chapter of Engineers for a Sustainable World, working her way to the role of chapter president in 2020. Kayla has a strong desire to further her education to reach her career goals.

Abstract: Strong adhesives in wet conditions could be highly beneficial for underwater and medical applications. Snail mucin is known to have excellent adhesion properties, and its main constituent is a mucin-like viscoelastic glycoprotein complex that is biocompatible, biodegradable and antimicrobial. Certain ions, both anions and cations, can lead to changes in protein solubility and crosslinking, resulting in mechanical property alterations. In the proposed project, the effects of some of these ions (e.g., sodium, calcium, thiocyanate, sulfate) on the extent of cross-linking, hence the viscoelastic properties and consequently the adhesion strength of snail mucin will be evaluated. The optimal goal is to provide some needed insights in generating strong snail mucus based adhesives for various underwater applications.

Publications: Al-Azzam, N.; Teegala, L.R.; Pokhrel, S.; Ghebreigziabher, S.; Chachkovskyy, T.; Thodeti, S.; Gavilanes, I.; Covington, K.; Thodeti, C.K.; Paruchuri, S. Transient Receptor Potential Vanilloid channel regulates fibroblast differentiation and airway remodeling by modulating redox signals through NADPH Oxidase 4. Sci Rep 10, 9827 (2020).

Alexis C. Cresanto

Junior, Chemical Engineering
Advisor(s): Dr. Pedro Cortes

Biochemical Research

Biography: Alexis is a Junior at Youngstown State University majoring in Chemical Engineering with a minor in Mathematics. She was born in Salem, Ohio, and graduated from Salem High school. Alexis is a member in the Chemistry Club, American Institute of Chemical Engineers and is the Vice President of Society of Women in Engineering at her university. She enjoys volunteering and spending time networking in these clubs. When she is not busy with school, she is traveling the world with her nonprofit, Hand in Hand Africa INC. Her future plans are to pursue research and development opportunities as a chemical engineer across the world.

Abstract: Society is threatened daily by potentially harmful chemical substances that may not be detectable by human sensing. It is essential that these chemicals can be detected accurately and immediately before lives are threatened. To accomplish this, carbon nanotubes are being used as the main detection material in sensor creation because of their electrochemical properties. These properties allow them to detect changes in conductivity in the presence of a foreign substance. The carbon nanotubes must be functionalized specifically for the chemical in testing so that the sensors will not detect incorrectly to similar substances. The production of small and integrated sensors is a beneficial feature for commodity on wearable structures. The answer to this requirement is the incorporation of additive manufacturing on the production of bio-chemical sensing platforms.

Publications: None yet.

Sabrina R. D'Alesandro

Junior, Materials Science & Engineering
Advisor(s): Dr. Joy Gockel

In-Situ Process Monitoring of Additive Manufacturing

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

Abstract: Additive Manufacturing (AM) is a manufacturing process in which a part is built in a layer by layer fashion. AM can suit a wide variety of materials and allows rapid prototyping, less waste production, and cost efficiency. These numerous benefits have made many AM processes popular among manufacturers in many fields. Despite these benefits, defects, such as porosity, continue to be a challenge that researchers are trying to mitigate. Porosity is a major challenge to the AM parts due to the rapid change in geometry in the parts structure. This leads to crack propagation and a shortening of the parts life span. In order to mitigate defects, in-situ monitoring can be used during the AM process to gather data pertaining to the creation of porosity. In-situ monitoring is the real time collection of data about the AM process with the use of sensors in the machines. In this project, multiple in-situ monitoring sensors were used to observe a type of AM process called Laser Powder Bed Fusion as the thermoelectric material, Bismuth Telluride was printed. The sensor data was then collected and processed using a variety of data and image processing techniques. The results from this research will provide addition insight into why defects appear in AM parts as well as what processing techniques can be used to better understand the data collected from in-situ monitoring sensors.

Publications: None yet.

Mark A. DeAngelis

Senior, Mechanical Engineering
Advisor(s): Dr. Jason Walker

Optimization of Lunar Rover Suspension

Biography: Mark DeAngelis is a Senior, Honors Mechanical Engineering student at Youngstown State University with a minor in Mathematics. His fascination for robotics started at Champion High School when he was a member of their FIRST Robotics team, where he was eventually the Team Captain and is now a mentor. This deep passion to learn more about robotics and the mechanics of the world led him to get involved with the YSU Robotics Club his junior year when it was founded, and he is now the President of the organization. Additionally, Mark is a member of three national honor societies (Tau Beta Pi, Phi Kappa Phi, and Pi Mu Epsilon); the Vice President of Mats for Mahoning, a group that crochets mats for the homeless in the Youngstown area out of plastic grocery bags; and a 13-year volunteer for LEAP (Life Enrichment Activities Program), where his family holds activities for handicapped young adults during the summer. Upon graduating with his Bachelor's degree this spring, he plans on attending graduate school to get a PhD in Mechanical Engineering with a focus in robotics and controls.

Abstract: The Youngstown State University Robotics Team will be competing in the 2020 NASA Lunabotics Competition with the task of designing, building, and programming a rover that must traverse a simulated lunar surface as autonomously as possible to mine icy regolith (gravel) at a secondary ground layer 30 cm below the surface. This rover must meet specified design constraints, including an initial volume of 1 m long, 0.5 m wide, and 0.5 m tall, and a maximum mass of 60 kg. The rover must also be capable of avoiding or crossing boulders and craters upwards of 50 cm in diameter and depth. As such, a small, lightweight suspension system capable of meeting these requirements was designed to potentially increase the performance of the team's rover. A wide variety of suspension systems have been utilized and proposed for planetary rovers – including the six-wheeled, rocker-bogie system on all of NASA's Martian rovers – but a novel solution had to be implemented for this rover which is substantially smaller in size.

Publications: None yet.

THE UNIVERSITY OF TOLEDO

Kevin H. Decato

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

Development of a UV-C Reactor

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

Abstract: UV Technology has been used in health care and water purification for over a century. UV Light "Deactivates" bacteria by fusing the DNA, preventing the bacteria from reproducing and essentially making it safe to drink. UV absorption occurs between a wavelength of 255-280 NM, and it can be enough to sanitize water with proper exposure. Originally, a fluorescent tube is used to produce this UV light, however they have many pitfalls and room for improvement. The purpose of this research is to switch from a fluorescent bulb to LED lights that produce a similar UV wavelength. The LED chips consume less energy, has a lifespan of 10 years instead of the 1 year of a fluorescent bulb, and also avoids the mercury in the fluorescent bulb. An AutoCAD drawing of the new prototype is currently being refined to eventually produce a working model.

Publications: None yet.

William A. Deisler

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

Calibration Procedure Development for Open Return Wind Tunnel at Ohio Northern University

Biography: I am an Ohio native from Paulding, Ohio. As far back as I can remember I have always wanted to be involved in the aerospace industry. As a kid I dreamed of being an astronaut, and as I grew older my passion for space exploration has not faded. My focus has now shifted to becoming an Aerospace Engineer for NASA and contributing to humanities exploration of the unknown. I currently work as a Pathways Intern for the Wind Tunnel Testing Division at the NASA Glenn Research Center, and plan to continue my career with NASA following graduation.

Abstract: Wind tunnel testing is used to predict how flight articles will respond to flight conditions during real world operations. Testing of this nature often involves very sensitive instrumentation and requires that the results reported be highly accurate. Ohio Northern University's wind tunnel has recently been disassembled, moved to a new building, and reassembled. The goal of this project is to develop a calibration procedure to verify operating conditions and instrumentation effectiveness within the facility.

Publications: 1. Deisler, William A., "Modeling Liquid Propellant Rocket Nozzle using MATLAB and SolidWorks", Ohio Space Grant Consortium Student Research Symposium XXVIII, Cleveland, Ohio, April, 2020, pages 69-70. Link: http://osgc.org/wp-content/uploads/2020/10/Final-Proceedings-2020-with-TOC-New.pdf

Brooke E. DeVriendt

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

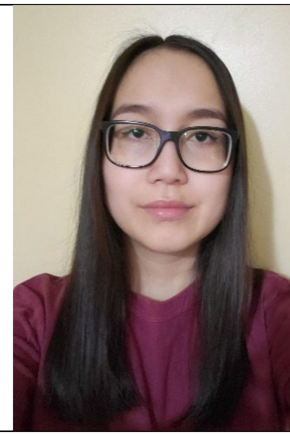
The Implementation of Biomedical Devices for Brain Injuries

Biography: I am currently a Junior at Ohio Northern University (ONU), with the intent of graduating in Spring, 2022. I grew up in Bowling Green, Ohio. During my time at ONU, I have been given the opportunity to be Treasurer for the American Society of Mechanical Engineers. I have also declared a concentration in bioengineering, with an interest in attending graduate school to further my knowledge in this area.

Abstract: Often times brain injuries can be fatal without the performance of an immediate high-risk surgery. The recent improvements in biomedical engineering have allowed for these processes to be less dependent on the surgeon and more focused on precision orientated robots. In addition to the surgery itself, the post-operation patient recovery varies greatly. There are also devices in development stages that help to measure and track the recovery process. This research is intended to summarize several of these medical devices and evaluate the practicality of their use in the future.

Publications: None yet.

Kristel H. Doong



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

Investigating Impact Tolerance of Sea Urchin for Aerospace Applications

Biography: Kristel is pursuing a major in Aerospace Systems Engineering and a minor in Mathematics from the University of Akron. Kristel chose Aerospace Systems Engineering because she always has a fascination with airplanes and space, and it is a great way to learn more about it. Engineers are constantly changing the world with inventions and solutions that affect everyone's lives, so this is a great opportunity to make some sort of impact to mankind. While attending the University of Akron, she is an active member of Tau Beta Pi and Asian American Student Organization (AASO). She plans to pursue graduate studies in the future.

Abstract: Biomimicry takes inspiration from nature to create more resilient and innovative sustainable solutions to complex human problems. Nature has both developed well adapted and evolved structures and materials that can advance human engineering. This paper investigates the impact tolerance of sea urchins. The structure of sea urchins can be used as a biological model to create lightweight, impact-resistant material that can be adapted to develop more structurally sound architecture in infrastructure. Sea urchins settle in different depth zones in the oceans and can be found in all climates from tropical to polar regions. Sea urchins are built to withstand the water pressure due to its dome shape and internal supports. The unique dome shape contributes to relieving the impact of the water pressure by distributing the force over a large area. The shell of a sea urchin is called a test that is composed of fused plates of calcium carbonate that is divided into five segments. Since these bioinspired structures can be used to tolerate harsh environments where impact protection is essential, they can be utilized for many applications like high pressure structures in deep sea exploration and landing gears for space exploration purposes. The purpose of this project is to examine the unique shell structure of the sea urchin through experimental testing and Finite Element Analysis.

Publications: None yet.

The University of Akron

Hiba El Rassi

Senior, Civil Engineering
Advisor(s): Dr. Anil Patnaik

Effects of Soy-Based Nutrients on the Properties of Self-Healing Concrete

Biography: Hiba EL Rassi is an undergraduate Civil Engineering student at The University of Akron. She will be rounding up her undergraduate program in May, 2021, and will be continuing her program to a Master's Degree in the same field of study. Hiba found her love for engineering during her senior year at Copley High School. She led her team to win the second place in the nation through "Source America Design Challenge". Recently, Hiba completed two internships: one at Donley Inc. and another at AECOM. By having an integral role in both companies, the internships provided her the hands-on experience to make her a better engineer where she has gained a vast knowledge and passion for civil engineering. To fulfill her thirst to knowledge, Hiba is part of a laboratory research group on campus at The University of Akron. Presently, she is conducting research on concrete to investigate the constituents' properties in order to have sustainable and longevity structure.

Abstract: Concrete consists of three basic components: water, aggregate and cement. It is considered a focal construction material in any infrastructure project and the second most used material on earth (after water). While concrete provides wide range of benefits, it is not always perfect. A major drawback of concrete is the crack nucleation affecting the structure aesthetics and most importantly its lifetime. Cracks initiate in a form of microcracks and merge to form a dominate crack that creates an easy path for moisture to penetrate into the bulk of the concrete structure and degrade the strength over time. A worldwide research has been conducted on this valuable material to enhance the durability against crack formation. Recently, the research focus has been directed towards the use of a biological agent containing bacteria that would seal concrete cracks as it forms. The process starts by adding suitable strains of bacteria "spores" to the concrete matrix during the making of wet concrete in the form of capsules. As crack initiates and propagates, the embedded bacteria capsules will rupture and chemically react with water to form calcium carbonate crystals and infiltrate into the existing cracks. This type of concrete with the ability to repair cracks is commonly known as self-healing concrete. Nutrients are an essential constituent in the proximity of the biological agents for the self-healing concrete and it is important to be effective. Nutrients enable spores to remain potent (alive) and germinate during crack progression. The primary goal of this research is to determine the effects of soy-based nutrients that will be used to encapsulate biological agents. This study will be conducted on both wet and hardened concrete properties. Moreover, this study will investigate and characterize various concrete properties such as compressive strength, setting time, heat of hydration, and unit weight of self-healing concrete when soy-based nutrients are added during the concrete wet mixing process.

Publications: None yet.

Grace N. Floring

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

Run-up Distance to Strong Flame Acceleration and Detonation Using Linear Eddy Model

Biography: Grace Floring grew up in Delaware, Ohio. She has been involved in scientific research since age 11, when she competed in her first science fair. Throughout high school she knew she wanted to contribute to space travel, which led her to Case Western Reserve University (CWRU) to study Mechanical and Aerospace Engineering. She is simultaneously pursuing her Master's Degree in Aerospace Engineering. During her time at CWRU, she has been heavily involved in Society of Women Engineers (SWE). She became Director of Public Relations her sophomore year, then Director of Membership and Director of Special Events in subsequent years. She loves making connections and networking with other female engineers on campus, and enjoys SWE's outreach work. This includes Engineer Explore, an annual event where Girl Scouts come to campus to participate in hands-on activities from different fields of engineering. This event is special to Grace because she was a Girl Scout for 13 years. Also at CWRU, Grace is an Undergraduate Teaching Assistant for the course Computers in Mechanical Engineering, where students apply numerical methods in Matlab for solving systems. She is also a member of Pi Beta Phi Fraternity for Women, and has been an Orientation Leader. Upon graduation in 2022 Grace hopes to find a research and development position in the Aerospace industry.

Abstract: Despite its hyper-relevance to explosion safety and next-generation detonation-based propulsion, the deflagration-to-detonation transition (DDT) in smooth ducts is a phenomenon not well understood. The expansion of product gases and formation of boundary layers at the duct walls can induce turbulence, making it hard to predict. The run-up distance, or the distance the flame travels until it reaches the speed of sound in the product, is a necessary critical value for DDT. At this condition, the flame becomes choked, and the mixture becomes sensitive to trigger detonation. The current correlation for predicting run-up distance is only $\pm$25% accurate when compared to experimental data, and the sufficient criteria for the transition to detonation have yet to be determined. This research hypothesizes that the run-up distance to strong flame acceleration can be more accurately predicted by incorporating turbulence statistics into a theoretical predictive model, which in turn will provide the means to determine the sufficient flow conditions for DDT. The key objectives can be broken into three parts: (1) revisit existing theory behind DDT in smooth channels and derive the run-up distance from a theoretical point of view, (2) perform numerical simulations with the compressible linear eddy model for large-eddy simulation (CLEM-LES) to measure turbulence statistics, and (3) compare these simulations to experimental data for validation.

The ability to predict DDT has extreme relevance for explosion safety, but can also be utilized to advance the pulse detonation engine (PDE) concept, which requires the ability to consistently initiate a detonation wave. This problem is also relevant to develop pre-detonators to ensure successful startup of rotating detonation rocket engines (RDREs).

Publications: None yet.

MIAMI UNIVERSITY

Jason T. Godawski

Senior, Mechanical Engineering
Advisor(s): Dr. James Moller

Chemical Signature of Fracture in Thermosetting Polymers

Biography: Jason Godawski is a fourth-year Mechanical Engineering student originally from Palatine, Illinois. He attended William Fremd Highschool where a wide selection of CAD and modeling classes were offered to students, thus leading him into the engineering field. All of his life, he spent most of his free time at his grandpa's farm where he learned to love big machinery and the implements they pull. This passion for agriculture lead Jason down the path of wanting to work on and design big equipment in the future. Pursuing a degree in mechanical engineering at Miami University was the best choice for him as he wanted a degree where he learned about different aspects about all kinds of different industries. Expanding his knowledge about any and all topics was a big priority during his college years which is why he decided to take on this research project. Epoxies and learning more about their weaknesses has much more to do with material science than mechanical engineering, but this was the perfect opportunity for Jason to learn something brand new his senior year. After graduation in the spring of 2021, he plans on pursuing a job in the agriculture industry.

Abstract: Epoxy resins are thermoset plastics that are widely used in many different applications that require surfaces to be bonded together. An epoxy is cured when a resin and a hardener are mixed together. The resin and hardener molecules react to form a cross-linked molecular network. The result is a substance that is hard and sticks to the pores of whatever selected materials are being bonded together. This bond created from epoxies are very durable and hard to disrupt, but chemical bond failure due to mechanical fracture in cured epoxy resins has not been thoroughly explored.

The goal of this research is to identify chemical end groups on fracture surfaces of cured epoxy. If these end groups can be identified, the covalent bond scission that occurs during the fracture of the epoxy will be able to be understood more. When a polymer chain is broken or opened, it is chemically reactive with the surrounding environment. By mechanically pulverizing cured epoxy samples in specific gas environments to prompt differing chemical reactions, these groups can be determined by diffuse reflectance infrared spectroscopy. Creating a method that provides insight into the weaknesses of epoxies will allow for safe and secure bonds to be created for any situations in which epoxy resins are utilized in the future.

Publications: None yet.

The University of Akron

Amy R. Gravenstein

Junior, Chemical & Biomolecular Engineering
Advisor(s): Dr. Edward Evans, Dr. Monty-Bromer

Liquid Hydrogen Implementation with Fuel Cells

Biography: Amy Gravenstein was raised in Akron, Ohio and attended Our Lady of the Elms high school where she was first introduced to engineering. She is passionate about renewable energy and the development of clean technology. She is in her third year at the University of Akron where she is pursuing a degree in Chemical and Biomolecular Engineering with a focus in biotechnology. At the University of Akron, Amy began working with Dr. Lu-Kwang Ju where she performed soy hull fermentations that yield a valuable enzyme mixture used in fatty acid production. She then worked at The Goodyear Tire and Rubber Company performing research on retread plies and non-pneumatic tires for both the aircraft and global metrology teams. Currently, Amy has spent the last year working with LTA Galactic, an aerospace R&D company, where she is performing hydrogen fuel cell research. This area of research closely aligns with her passion to develop an efficient and cost-effective source of renewable energy. Amy is looking to continue researching hydrogen fuel cells and technologies and plans on pursuing graduate school in electrochemical engineering.

Abstract: The potential of using liquid hydrogen for propulsion is often undermined due to its perilous nature. Hydrogen has a wide flammability range when mixed with air (4.0 - 75.0% hydrogen) and a low ignition energy (0.019 mJ). Liquid hydrogen adds to this high risk as a cryogenic fluid that is to be maintained below - 22 K. A liquid hydrogen model has been created in Matlab that can model various leak/spill scenarios from cryogenic liquid hydrogen containers. This model takes into consideration the spill rate, spill temperature, ambient air temperature, duration of spill, and air flow conditions to calculate the mass accumulation, pool temperature, pool radius, pool height, and evaporation rate as they change over time. The model can also predict a safe distance radius for users to abide by if a spill/leak is occurring. This model is verified through an in-depth analysis of each variable and a comparison to known trends of cryogenic liquid spills and leaks. The liquid hydrogen safety model can be used with standard operating procedures for hydrogen liquefaction systems to ensure safe practices. This model provides safety advantages to better prepare those operating hydrogen liquefaction systems and vessels that are used in line with hydrogen fuel cells and other hydrogen technologies.

Publications: None yet.

Delenn R. Hartswick

Senior, Neuroscience Psychology
Advisor(s): Dr. Clare Mathes

Exploring the Link between Prenatal Hormone Exposure and Sex-Specific Neuroanatomy in a Rat Model

Biography: I have always wanted to know about the world around me. I was lucky to have a family which encouraged not only questioning but finding the answers yourself. When I was young my mother went back to school to study child development, and ever since I have been interested in how we, as humans, become who we are. In high school, a combination of health problems which sent me to a neurologist, teachers who challenged and encouraged me to explore my personal interests, and my well-timed reading of a book about “the biology of belief” aggregated into my discovery of neuroscience. With very little knowledge of what neuroscience would entail beyond “brain” and “science” I decided to take that path and have never looked back. While exploring my identity and becoming more involved with the LGBTQ+ community I found a serious lack of scientific understanding surrounding LGBTQ+ issues as well as a lack of representation in the scientific community. I believe science has a social presence which is underutilized allowing confusion and falsities to reign in some situations. I wish to use science, accessible communication of science, and encourage minority representation in science to push past these issues and create a more informed world.

Abstract: Previous research supports a biological basis for transgender identity, but the data do not suggest that genetics, gonads, genitalia, or adult hormone levels are responsible. Instead, it is hypothesized that sexual differentiation of the brain prenatally, which happens due to hormone levels after the surge that promotes peripheral sexual differentiation, may follow a different pattern in transgender individuals than it does in cisgender individuals. The role of prenatal hormones on the development of sexually dimorphic brain nuclei can be modeled in rats. They possess similar neurological structures to humans in both function and volumetric differences between sexes. One such structure is the bed nucleus of the stria terminalis (BNST) which in both humans and rats is larger in volume in males compared to females. While research exists on prenatal testosterone exposure and its effects on BNST size in rats, more can still be done. I expanded on previous research by reducing the dose and number of doses of testosterone to avoid external genital effects on the rats, treating at the critical point of differentiation, and considering persistence of any effect throughout the lifetime. I hypothesize that prenatal exposure to testosterone will increase the size of the BNST in rats as compared to non-exposed rats of the same sex and this effect will persist into sexual maturity. The expected pattern is as follows: the BNST of testosterone exposed males are larger than control males which are larger than testosterone exposed females which are larger than control females. TP female rats possessing this intermediate BNST volume would be a model of transgender humans and offer a possible explanation for this phenomenon.

Publications: None yet.

UNIVERSITY OF Cincinnati

Daniel R. Heitmeyer

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

Fuzzy Logic Controller of Quadcopter Drone

Biography: Daniel is currently a Junior at the University of Cincinnati pursuing his bachelor's degree in Aerospace Engineering. He has co-oped at the UAV MASTER Lab at the University working on Collaborative Multi-UAV systems. Under the guidance of Dr. Kelly Cohen, Daniel has taken a passion to Fuzzy logic and genetic algorithms for aerospace applications. After obtaining his degree, he hopes to continue researching UAVs and Fuzzy Logic to obtain a master's degree at the University of Cincinnati.

Abstract: With the ever-increasing usage of UAV's in civil and military applications, a higher level of control and mobility of these UAV's is desired to increase stability and controllability. A Fuzzy Logic based flight controller will be developed and compared to a traditional PID controller found in a Pixhawk running PX4 flight control software. PX4 was chosen as the baseline model to be compared to because of its widespread usage in the community and its open-source nature. Fuzzy logic has been chosen for its proficiency with highly nonlinear systems in addition to offering explainable results through its rule base. The UAV Toolbox in Matlab will be used to simulate the quadcopter during testing to develop and train the fuzzy system and compare the results to the traditional controller. The scope of this project also hopes to include a slung load to introduce chaos into the system where a traditional controller and pilots would fail. Further, by using the UAV Toolbox, the Fuzzy Logic controller created will be flashed to the Pixhawk and used during actual test flight of a quadcopter to determine its worth in real applications.

Publications: None yet.

Cleveland State University

Brandon J. Heppe

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

Creating Fluorescent Quantum Defects in Chirality-Pure Carbon Nanotubes Using Small Molecules

Biography: Brandon Heppe is an undergraduate student at Cleveland State University (CSU) pursuing a bachelor's degree in chemical engineering. He intends to enroll in the 4+1 accelerated master's program in chemical engineering at CSU. Brandon currently works as an undergraduate researcher in the BioNano Materials Lab at CSU. His research primarily focuses on the separation of chirality-pure carbon nanotubes, creating fluorescent quantum defects via carbon nanotube photochemistry, and optical spectroscopy characterization of nanomaterials. Brandon has also participated in I-Corps@Ohio program in 2020 as an entrepreneurial lead of the team to evaluate critical market and commercialization associated with a specific technology developed in the BioNano Materials lab.

Abstract: Pure-chirality single-wall carbon nanotubes (SWCNTs) possess well-defined optical and electronic properties that can be functionalized covalently with molecular precision to develop applications, such as biochemical sensing and imaging and single photon sources via exciton trapping. Pure-chirality SWCNTs are isolated utilizing recognition DNA sequences in a polymer aqueous two-phase system. DNA coatings can further be displaced by surfactants, such as sodium dodecyl sulfate (SDS), due to their stronger binding affinities toward the surface of nanotubes compared to that of DNA in water. This provides an avenue to modulate the coating structures on the SWCNT sidewalls as needed for photochemical reactions of nanotubes. Diazonium salts and small molecules with phenyl azide groups will be utilized to create fluorescent quantum defects on pure-chirality (6,5) SWCNTs with UV irradiation. Optical properties of the functionalized SWCNTs will be compared to determine the efficiency of photochemical reactions of nanotubes with different molecules. Nanotube chemistry offers vast potential for creating carbon-based fluorescent probes with tunable photoluminescence in the near-infrared (NIR) region for developing novel applications.

Publications: None yet.

The University of Akron

Catherine E. Howell

Senior, Biomedical Engineering
Advisor(s): Dr. Ajay Mahajan, Dr. Catherine Konopka

Fractionation and Purification of Lettuce Cell Sub-compartments

Biography: Catherine Howell is a fifth-year biomedical engineering student hoping to continue onto medical school after graduating. In high school she decided to pursue biomedical engineering due to her interest in mathematics and medicine. Biomedical engineering was a major that combined these subjects. After successful completion of two engineering internships through her university, Catherine realized she wanted more direct patient interaction in her future career. This interest can be attributed to her part-time job working as an STNA, which involves daily interaction with patients. Due to this realization Catherine decided to pursue medical school, which will allow her to utilize her major and interact with patients. In addition to research, Catherine is involved in Phi Delta Epsilon on campus. She also volunteers in her community on the weekends in addition to working part-time.

Abstract: Currently, there are three main methods used to produce vaccines: egg-based, cell-based, and investigational manufacturing systems. Investigational manufacturing systems refers to the use of biological systems such as plants, insect cells, or bacterial culture to manufacture vaccines. Recently, plant-based vaccines have been suggested as an alternative to egg-based and cell-based vaccines. Using a plant-based production system offers an economical advantage over other approaches, due to the low production costs of plant biomass and the scalability of production. By utilizing a gene delivery system, particle bombardment can be used to transform the genome of a biological cell. This approach allows the antigenic protein responsible for stimulating an immune response in vaccines to be produced in plants. Protein production is expected to be localized to a specific sub-compartment in cells, making it necessary to fractionate and purify them. By utilizing past methods performed on Arabidopsis, lettuce cells can be fractionated and purified using centrifugation and various gradients, such as Percoll and sucrose. The obtained sub-fractions are then able to be assessed for purity using immunoblotting. Successful fractionation and purification of these sub-compartments gives an approach that can be used to obtain the antigenic protein once it is produced due to transformation of the cell genome. Obtainment of this protein is a vital step in producing a plant-based vaccine.

Publications: None yet.

Allayah C. Hughes

Junior, Computer Engineering
Advisor(s): Dr. Deok Hee Nam

Sixth Generation(6G) Technology for Future Cognitive Satellite Communication

Biography: I am a Junior majoring in Computer Engineer at Wilberforce University, the First Private Historic Black College/University, continuing to obtain a bachelor's degree. To be a student of Computer Engineer is a spontaneous relationship, I never know what to do or what to expect. It excites me that there is always something new or intriguing for me to learn. This spontaneous relationship enhanced my drive and goals of becoming better. It eagers me to be precise about my grades and academic goals. I was born in a small city called Mansfield but raised in Columbus, Ohio. I am the second oldest child with a lot of determination of being better than I was yesterday. Coming to Wilberforce helped me realize how much the world brings to the table for anyone willing to stride for their goal. Being a bulldog is something I hold with great pride and poise. I took the initiative on becoming the 2019-2020 Miss. Sophomore my sophomore year and it was a phenomenal experience. It made me look at my school with such love and gratitude. Not only was I representing my sophomore class but I also played a big leadership role on the Wilberforce Women's basketball team. It is a blessing being on the basketball team traveling and meeting other HBCU's and learning about their experiences. Something I would never take for granted.

Abstract: The standardization and commercial deployment of the fifth-generation (5G) communication technologies have finished and an arrangement has been initiated all around the world. To support the serious edge of remote satellite communication, the mechanically and scholarly world collaboration have started to conceptualize the up-and-coming age of remote correspondence frameworks such as the 6th generation (6G) satellite communication. To satisfy the necessities of different upcoming applications, the future 6G versatile satellite communication will be relied upon to be a naturally smart, exceptionally unique, ultra-dense heterogeneous communication network that interconnects everything with low-idleness and quick information transmission. Hence, man-made reasoning like Artificial Intelligence (AI) will be the most creative strategy that can accomplish smart mechanized organization tasks, the board, and upkeep in future complex 6G satellite communication. Driven by AI methods, satellite communication with localized node to node correspondence will be one of the bits of the 6G satellite communication structure. Through the proposed project, the comprehensive review of the 6G satellite communication will be discussed including the vision and key highlights, difficulties and possible arrangements, and research exercises in terms of the connection to the inspiration of their different sub-spaces to accomplish an exact, concrete, and compact end.

Publications: None yet.

UNIVERSITY OF Cincinnati

Sebastian J. Lemieux

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

Quadcopter Arm Dihedral and Motor Twist Angle: The Impact on Stability

Biography: Sebastian Lemieux is a 3rd year Aerospace Engineering student at the University of Cincinnati. With parents in the United States Air Force, Sebastian is well traveled as a military child and has previously lived across the east coast and Europe. In high school, he developed an interest in engineering through Project Lead the Way (PLTW) program. This is when he began to grow a personal interest in RC model aircraft and First-Person View (FPV) flight. He has been involved in many RC projects since to include a world record event for the largest number of RC aircraft flown simultaneously.

Sebastian splits his time at UC across his aerospace engineering degree, AFROTC, and working in the Co-op education program. Through UC, Sebastian has had cooperative education experiences at Barnes Aerospace, working on the repair processes for turbine aircraft engines. More recently he assisted in undergraduate research at UAV Master Labs working on unmanned systems under Dr. Cohen. Sebastian's work at the lab has included obtaining his Part 107 unmanned civil license, flight testing small unmanned aerial vehicles, and work on large scale multirotor and fixed wing platforms under 55 lbs.

Abstract: The goal of this project is to evaluate the effects that arm angle and motor twist have on the flight stability of a multirotor. Many commercially available Unmanned Aerial Systems (UASs) that are multirotors incorporate some amount of dihedral or anhedral angle to improve stability while filming and carrying payloads. In an effort to improve yaw authority and stability, this research seeks to make discrete changes in the twist of a multirotor's motors by changing each motor's angle relative to vertical on each arm. This gives each motor a degree of horizontal thrust to control yaw rather than conventionally relying on changing the total torque of the system through motor rpm. The small UAS used in this research will utilize a custom arm mount design that allows for increasing changes to the angle of the platform's tube arms accompanied with motors that may rotate to any desired twist angle. The effects of these factors on flight will be analyzed by first using ardupilot's autotune in each configuration to obtain optimal PIDs. Next an evaluation flight is flown autonomously where a flight log is made. Gyro data, accelerometer data, and desired versus actual rates are then compared from each flight log and used to quantify both the stability of the small UAS as well as the level of controllability. The results of this research may hopefully be implement on future UAS platforms to create improved multirotor arm designs that provide better stability and controllability during flights for various operations.

Publications: None yet.

Naja T. Long

Junior, Biology
Advisor(s): Mark Nielsen

How nutritious is Space Food for Astronauts?

Biography: Originally from Dayton, Ohio. I am currently attending the University of Dayton getting my undergrad in Biology. I chose to major in Biology because of my passion for helping people through the medical field and Biology offers me a broad opportunity. After receiving my undergrad, I will be applying for accelerated nursing programs. Although my degrees will be medical focus, I also run two businesses while in college while being a student-athlete as well on the university's Track and Field team. Being a student-athlete has made me become more disciplined and driven focused towards any goals I have set for myself and helped with time management. I have worked in the research lab on campus with my advisor studying the bodies of fruit flies and how their bodies can mimic the human reproductive system.

Abstract: Nutritional studies have been performed to insure healthy space food. But one thing that has not been studied is long-term, generational effects on health and reproduction. This could be important if we are to travel to new planets, is the food sufficiently nutritious for long flights in space that may involve multiple generations? Here we propose to test the generational quality of space food in a fruit fly model to see if it supports healthy children, grandchildren, and great-grandchildren. Given their short generation time, fruit flies can be used to study the generational effect of space food. More generally, fruit flies have served as an important system for research into human health, over 70% of human diseases can be modeled in a fruit fly.

Publications: None yet.

WRIGHT STATE UNIVERSITY

Elizabeth C. Malek

Junior, Materials Science & Engineering
Advisor(s): Dr. Joy Gockel

Spatial Modification of Microstructure and Properties through Additive Manufacturing

Biography: Elizabeth Malek is a Junior at Wright State University earning a Bachelor's Degree in Materials Science and Engineering with a minor in Renewable and Clean Energy. Elizabeth was born in Cincinnati, Ohio, but has lived out most of her life in the Dayton area. She graduated from Beavercreek High School with honors. She has been placed on the Dean's List so far in her college career and participated in clubs like Engineers Without Borders. Currently, she has an internship through SOCHE at AFRL Materials and Manufacturing Directorate in the Ceramics and Composites department, which focuses on additive manufacturing of ceramic matrix composites. She has a strong passion for engineering research and plans on continuing her education after graduation by pursuing a Ph.D.

Abstract: Manufacturing of functionally graded metals using additive manufacturing (AM) provides an opportunity to change the material composition and processing parameters at different regions within a component. This research is focused on the exploration of the properties of multilayered graded materials using laser powder bed fusion AM through the measurement of Vickers hardness. There are six different regions within a single sample with compositions varying from 100% titanium (Ti) to 100% tantalum (Ta) and the processing parameters are changed within each region to account for differences in the thermal properties of the composition mixtures. Changing the processing parameters and material composition changes the microstructure along the transition regions. The hardness is measured across the sample to show how the change in microstructure will affect the properties in the regions of different compositions. An understanding of the changes in hardness leads toward the ability to modify properties at different regions within a part for location specific functionality.

Publications: 1. Kemp, J. W., Diaz A., Malek, E., et al. Direct Ink Writing of Ultra-High Temperature Ceramic Matrix Composites. 2020; In Review.
2. King, D. S., Key, T. S., Malek, E. C., Kazmierski, P., Cinibulk, M. K. X-ray Computed Tomography Analysis of a Plain Weave CMC Laminate, Part I: Segmentation and Bulk Porosity Analysis. 2020; In Review.

THE OHIO STATE UNIVERSITY

David K. Marshall

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

Ability of Localized Arc -Filament Plasma Actuators to Deflect Primary Jet of Subsonic Jet Engine

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

Abstract: Thrust vectoring (the ability to modify the angle of thrust generated by the exhaust nozzle on an aircraft) is of great interest to the military as it could be used in fixed wing unmanned aerial vehicles (UAVs) to increase hyper-maneuverability and short or vertical take-off/landing capabilities. Therefore, proposed experiments are to be conducted using localized arc -filament plasma actuators (LAFPAs) coupled with a Coanda-based thrust vectoring (CTV) inspired reaction surface to deflect the primary jet of a subsonic, axisymmetric jet engine. The LAFPA's are believed to be a more efficient way of deflecting a jet over other previously tested methods such as CTV since CTV requires a significant amount of bleed air (up to 15 % of the primary jet) whereas LAFPA's exploit natural instabilities in shear flows to control the mixing and entrainment characteristics of the flow. Thus, LAFPA's are more efficient active flow control concept (AFCC) since it requires less power and zero mass flow. The proposed experiments involve documenting experimental sweeps of excitation frequencies and other excitation parameters of the LAFPAs using schlieren and pressure measurements for the purpose of determining the ability of the AFCC to deflect the jet. The focus of the past year's research efforts have been on researching CTV and using results of previous CTV experiments to inform the design and implementation of similar experiments instead using the proposed LAFPA's as the AFCC. Based upon the findings of this literature review a nozzle made of boron-nitride (a ceramic capable of withstanding the high-temperature, high-voltage LAFPAs) has been designed for use in the proposed experiments.

Publications: None yet.

Maxwell R. McLain

Senior, Mechanical Engineering
Advisor(s): Dr. Roger Quinn

Cam Driven Peristaltic Robot with Reduced Stiffness, Weight, and Design Complexity

Biography: Max is a senior at Case Western Reserve University currently working on completing both a Bachelor's and Master's degree in Mechanical Engineering. Max grew up in Centerville, Ohio where he found his passion for engineering through involvement on his high school's Science Olympiad team. At Case Western, he has remained involved in numerous activities such as Case Men's Glee Club, vice president for Sigma Nu fraternity, Tau Beta Pi, and undergraduate research in the Biologically Inspired Robotics Lab. During this time, he has earned recognition on the Dean's High Honor List every semester. After completing his degrees in the next two semesters, Max hopes to continue exploring research and design in engineering, with particular interest in robotics.

Abstract: Earthworm-like robots have shown promise in exploring constrained spaces that can be difficult for other robots to reach such as subterranean tunnels and pipe systems. Earthworm like locomotion, or peristalsis, does not require complex actuators or control systems to navigate these terrains due to the periodic nature of the motion and the ability of the soft body to conform to the irregular environment. This research details the development of an earthworm-like robot that achieves peristaltic motion through the use of a single degree of freedom motor-driven cam which contracts the body of the robot in a longitudinal wave pattern. The robot builds off of the work of Softworm, another earthworm-like robot that is currently the fastest moving peristaltic robot. This new robot aims to update the previous Softworm design by reducing weight, using fewer components, and reducing friction between moving parts. First, we detail the construction process and design considerations. Upon completion of the robot, measurements of the robot's speed, weight, and stiffness will be compared to other similar robots. With the improvements to the weight, friction, and reliability of our robot, we can begin to develop more reliable control mechanisms and explore the possibility of controlled locomotion in two dimensions.

Publications: None yet.

Marietta College

Sarah K. McNeer

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

Investigation of Dinitroparaben-Induced Apoptotic Death in M624 Melanoma Cells

Biography: Sarah McNeer is a Senior at Marietta College majoring in biochemistry with minors in Biology, English, and Leadership Studies. She enjoys sharing her passion for the sciences with other students as president of the Biology Club and Chemistry Club. Additionally, she mentors underclassmen in the research lab and has served as a teaching assistant and lab assistant. She has enjoyed her undergraduate research experiences and intends to further her education through a graduate school program in the biomedical sciences.

Abstract: Parabens are organic compounds commonly used in cosmetic and food products due to their antimicrobial properties. Recent studies suggest that parabens accumulate in the body and have the potential to cause harm to healthy cells. Therefore, parabens could possibly be utilized to target cancer cells. M624 human melanoma cells were treated with dinitroparaben, a novel paraben. Cell viability was determined using clonogenic assay, which showed that dinitroparaben induced cell death. Western blot was used to detect and quantify the cleaved form of poly(ADP-ribose) polymerase, which indicates that apoptosis is occurring. Results showed that PARP was cleaved in the treated cells, suggesting that the melanoma cells underwent apoptosis. In the signaling pathway for apoptosis, PARP is cleaved by caspase-3. The current project will employ an enzyme activity assay to measure the activation of caspase-3 in M624 cells treated with dinitroparaben. Activation would verify that apoptosis is the method of cell death. A possible direction for further investigation would be to study the role of cytochrome c in triggering apoptosis in the treated cells, which would indicate involvement of the mitochondria and also serve as further verification that apoptosis is occurring.

Publications: None yet.

CEDARVILLE UNIVERSITY

Kristina G. Mills

Senior, Molecular Biology
Advisor(s): Dr. Sharon Cooper

Dissecting the interaction between PCDH19 and NCAD and its Relationship to Neural Development

Biography: Kristina Mills is a current Senior at Cedarville University majoring in Molecular Biology with a minor in Bible. Growing up in Saratoga, New York, Kristina has always been a hands-on, kinesthetic learner and has enjoyed "seeing how things work", including taking apart and rebuilding computers and coffee makers, and making things such as an amplifier, stereo speaker, and a beautiful Shaker table. Her love of all things hands-on has also included learning to rewire the electrical outlets in her home and dissecting a fish to investigate the internal organs. Kristina has enjoyed many aspects of her education at Cedarville but has found the most excitement when participating in labs. During her four years at Cedarville, she has had opportunities to job shadow X-ray technicians, mammographers, occupational therapists, and a pathologist. These job shadowing experiences led Kristina to realize that she is most passionate about the hands-on work of running lab experiments. In the fall of 2020, Kristina was selected for an appointment to the Research Participation Program at the U. S. Department of Defense. Kristina is assisting with the evaluation of biological contaminants present in water systems using modern microbiological techniques such as bioaerosol and adsorption experiments. Kristina has an opportunity to continue working at the Air Force Institute of Technology as a research assistant in bio-contaminants after graduating in 2021.

Abstract: Adhesion proteins are a group of proteins that play a role in connecting neurons during brain development. One group of adhesion proteins, the cadherin family, and specifically protocadherin 19 (PCDH19) and neural cadherin (NCAD) play an important role in this development. Mutations in PCDH19 have been shown to cause a specific form of epilepsy. Children with this epilepsy syndrome begin experiencing seizures around six months of age. Sometimes the seizures will subside around puberty, whereas others continue experiencing seizures throughout adulthood; even when seizures end in childhood, cognitive impairment still exists. In some of the PCDH19 mutations, it is clear how protein function is disrupted, but the mechanisms for others are unclear. Structural studies suggest that a cluster of mutations in extracellular domain 6 (EC6) of PCDH19 may disrupt interactions with other proteins. In this study, we test which regions of PCDH19 and NCAD may interact with one another and whether mutations (D618N, R625G, P567L) in this cluster impact their interaction. Wild-type or mutant versions of PCDH19 were expressed in HeLa cells along with wild-type NCAD. Co-immunoprecipitations with these proteins indicated the D618N, R625G, and P567L mutations disrupt the interaction between PCDH19 and NCAD. This disruption could be the molecular mechanism of epilepsy in patients with these specific mutations.

Publications: None yet.

CEDARVILLE UNIVERSITY

Sara A. Mitchell

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

Preparation and Description of a Sauropod Fossil from the Morrison Formation at Skull Creek, CO

Biography: Sara Mitchell grew up in Atlantic Beach, Florida. She has always loved the ocean and the outdoors and spent many hours at the shore meticulously looking for fossil shark teeth. She discovered Cedarville University and met her advisor at a high school summer camp and has enjoyed studying geology ever since. Sara loves teaching labs and tutoring her peers, and hopes to go to grad school after her undergraduate years. In addition to active involvement in her department, Sara also participates in Cedarville's Honors organization and enjoys hiking and exploring Ohio's parks as she finishes her education at Cedarville.

Abstract: The purpose of this research is to prepare and describe a sauropod femur that is approximately 1.8 meters in length. The sample to be studied was collected from the Morrison Formation near Massadona, CO in the Skull Creek area. The fossil is poorly preserved in a loosely consolidated sandy conglomerate matrix. The research will also focus on understanding the taphonomy of the fossil and its depositional environment. This study has potential implications for the dinosaur fossils of the Morrison Formation and how this site compares to other localities, and this will be explored during this project.

Publications: Sara A. Mitchell, Investigations of Radiohalos from the Galway Batholith in Ireland. OSGC Symposium 2020.

THE OHIO STATE UNIVERSITY

William A. Mullin

Senior, Aeronautical/Astronautical Engineering
Advisor(s): Dr. Mo Samimy & Dr. Nathan Webb

Active Flow Control in an Aggressively Offset Inlet

Biography: William Mullin is from Cincinnati, Ohio, where he attended Walnut Hills High School. A knack for math and science partnered with a lifelong passion for air and space vehicles led him to the Ohio State University to pursue a BS degree in Aeronautical and Astronautical Engineering. Currently a senior at Ohio State, William is an undergraduate research assistant at the Aerospace Research Center, where he is studying active flow control through an offset inlet. Outside of academics and research, William is a member of Beta Theta Pi fraternity and is the Vice President of Sigma Gamma Tau, the aerospace engineering honorary. In the summer of 2020, he completed an internship working on structural Loads and Dynamics for the Space Launch System at Boeing, and he plans on moving to Huntsville, AL upon graduation to join Boeing as a full-time structural analyst. He is also the computational lead in his senior capstone group, in which he is studying implementing additively manufactured coolant channels to a Nuclear Thermal rocket.

Abstract: Aggressively offset inlet systems are becoming increasingly important in the field of aerospace engineering, with many potential military and flight applications. Prospective advantages include reducing the radar cross-section of an aircraft and improving the integration of the propulsion and aerodynamic systems. However, due to the curved S-shape of the duct, an adverse pressure gradient forms around the inside of the turns in the inlet. This adverse pressure gradient causes flow separation and the formation of streamwise vortices which result in significant flow distortion and pressure loss at the aerodynamic interface plane. These flow characteristics are very undesirable; they can cause decreased aircraft performance and the high-cycle fatigue reduces the structural life cycle of the engine components. To counteract the unsteady flow, specialized plasma actuators may be used to reduce the effect of the streamwise vortices and crossflows throughout the duct through flow excitation. Many different types of plasma-based actuators have been proposed to excite the flow: localized arc-filament plasma actuators (LAFPAs), pulsed DC plasma actuators, and plasma synthetic jets are under consideration. The goals of this project are to investigate the effect of active flow control configurations on the aerodynamic performance throughout the duct and to gain a better understanding of the flow physics and dominant instability features of flow through an aggressively offset inlet.

Publications: None yet.

Zane R. Myers

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

CFD Analysis of Effects of Inlet Velocity on Outlet Frequency for a Fluid Oscillator

Biography: I am a Senior at Ohio Northern University and will graduate in May, 2021, with a B.S. in Mechanical Engineering and a minor in Business Administration. I am originally from Bluffton, Ohio. I have my private pilot's licence and I like to fly airplanes. I also like the outdoors. During my time at Ohio Northern, I have had the opportunity to participate in the Las Vegas Design Experience as well as an EPICS service-learning design program. I served as the Chair of our AIAA Student Branch and was the Project Lead for the 2020 SAE Aero Design East Competition. I currently serve as the President of our Engineering Leadership Council which is a member of NAESC. In the Summer of 2019, I became a Pathways Intern in Facilities Project Management at NASA Glenn Research Center. Once I finish my degree, I intend to convert to full-time employment at NASA and continue my education on a part-time basis.

Abstract: The goal of my OSGC project is to perform a CFD analysis to help explain the relationship between inlet fluid velocity and outlet frequency for a fluid oscillator. Fluid Oscillators are mechanical devices that have no moving parts but through their unique geometry are capable of redirecting linear fluid flow into steady oscillating flow. The basis of operation is the Coanda effect, which is a fluid's tendency to attach to a wall. This is what allows flow to be directed into the feedback channel and for oscillation to begin. Applications of fluid oscillators include turbine vane cooling, microbubble aeration, airfoil boundary layer control, and many others. Ansys Fluent will be used as the meshing, solving, and post processing software for the analysis.

Publications: None yet.

Maja F. Paar

Senior, Mechanical Engineering
Advisor(s): Dr. Roger Quinn

Design of the Trunk and Torso of a Lower Body Exoskeleton

Biography: Maja Paar is a fifth year Mechanical Engineering Major pursuing both a Bachelor's and Master's Degree at Case Western Reserve University. She grew up partly in Northampton, MA, and partly in Cologne, Germany. Due to her love of math and physics and her participation in Robotics Club in high school, she decided to pursue engineering. After she graduates, Maja hopes to work in the Biomedical field and use technology to help improve the lives of others.

Abstract: Lower-limb exoskeletons are used attached to a person's lower body, extending from the back to the feet. The motorized hip, knee, and ankle joints allow paraplegic patients to simulate able-bodied walking. Many exoskeletons on the market and in development are not being chosen over wheelchairs because they lack comfort, require a lot of energy to use, and need to be custom manufactured. Due to these limitations, I am working on making changes to the trunk and torso portions of the exoskeleton. This includes adding extra degrees of freedom to the hip joints so it more realistically mimics walking and therefore makes movement easier. Currently, the hips only move forward and backward, leaving the abduction and adduction joint at zero degrees. In addition to the existing forward and backward motion of the hip joints, there is now the ability to adjust the angle of abduction and adduction. There is added adjustability to the torso so that it can be worn by a wider range of people and does not have to be custom-manufactured for each user. Simple adjustments can be made in a matter of minutes to expand or contract for different users. The hip joints can also be moved forward and backward so that the center of rotation of the device lines up with the user's hip's center of rotation, which is crucial to a realistic, comfortable gait. These improvements should aid in making the device more comfortable and less strenuous to use as well as easing the testing process.

Publications: None yet.

Hannah J. Pineault

Senior, Chemical Engineering
Advisor(s): Dr. Bi-min Zhang Newby

Wetting Transition and Liquid Uptake of 3D-printed Featured Surface

Biography: My inclination towards math and science resulted in my decision to major in chemical engineering, and I landed myself at UA which I've enjoyed ever since! I'll be graduating this coming May in 2021 with the co-op degree along with the polymer engineering specialization certificate. Some of my favorite undergraduate experiences have included being an officer in the Tau Beta Pi Engineering Honor Society and a member of Engineers for a Sustainable World. I began undergraduate research with Dr. Newby before my entering my junior year. My first project dealt with studying the effect of Hofmeister Ions on protein-based hydrogel properties to generate more affordable, mechanically strong hydrogels. Building upon that, I'm very excited to be conducting research on 3D printed models in partnership with OSGC. Following graduation, I'm pursing my PhD in chemical engineering and I hope to focus on sustainability related research.
I was born and raised in the wild and wonderful state of West Virginia, where I grew up with my older sister. From middle school to high school to college I ran cross country and track, which I still enjoy in my free time. I love reading as well as spending time outdoors, especially with my dogs!

Abstract: Surface features play an important role on the wettability of a surface. Depending on the geometries of the features, a surface can be made more hydrophobic or more hydrophilic. A surface retaining hydrophobic, or in extreme cases super hydrophobic, characteristics will always repel water, hence mitigating or even eliminating corrosion. In contrast, a surface made to be hydrophilic or super hydrophilic can be used to trap water even in extreme conditions (e.g., in a desert). The goal of this project is to gain insight on how to fabricate 3D-printed featured surfaces with different geometries and surface treatments to achieve the various wettability. The surface treatment methods for tuning wettability of these featured surfaces include plasma oxidation and depositing a silane layer. Specifically, cylindrical pillars in both square and hexagonal arrays will be studied with varying pillar spacing, height, and diameter.

Water sitting on these surfaces will be monitored via optical microscopy to determine whether and/or how fast the transition from the non-wetting state (i.e., Cassie-Baxter's state, when air fills the grooves/cavities) to the wetting state (i.e., Wenzel's state, when water penetrates the grooves) occurs. The liquid uptake rate will be measured with an analytical balance to determine the amount of liquid rising in the model. The knowledge gained from this project may be useful in applications such as self-cleaning surfaces, oil and water separation, corrosion prevention, water harvesting in hazardous environments, anti-fogging and anti-fouling.

Publications: None yet.

Christina D. Praprost

Senior, Mechanical/Manufacturing Engineering
Advisor(s): Dr. Muhammad Jahan, Dr. Jiafeng Ma

Internal Structure, Mechanical Properties and Machinability of 3D Printed Carbon Fiber Reinforced Polymer Composites

Biography: Christina Praprost is a senior at Miami University, double majoring in Mechanical and Manufacturing Engineering. Beginning in high school, Christina participated in a local business internship program, through which she spent two summers in manufacturing and quality engineering roles. This experience solidified her decision to pursue engineering in college. College internships with Honda of America Manufacturing further fueled her love of manufacturing. At Miami University, Christina is in the Honors and Grand Challenge Scholars Programs, conducts materials research for the Mechanical and Manufacturing Engineering department, serves as a teaching assistant, and is a United States Powerlifting Association Athlete. After college, she hopes to apply her skills in the automotive, aerospace, or manufacturing engineering fields.

Abstract: The research objective of this project is to investigate the effect of internal structures and fiber orientations on the mechanical properties and machinability of 3D printed carbon fiber reinforced polymer (CFRP) composites. Throughout the past semester, my research has been focused on learning the ABAQUS simulation software to validate tensile and compression testing results from the additive manufactured polymer composite samples. I aimed to gain knowledge on internal structures, composition and orientations of carbon fiber reinforcements to determine how those can influence the mechanical properties of CFRP composites. Studies involving carbon fiber reinforcement planes at various angles and frequencies across the specimen were explored to determine the combinations resulting in the best mechanical properties. A variety of preparation methods for CFRP composites were also studied as a part of literature review, including drawing and fabrication methods, drawing ratios, ultrasonic and plasma treatments, and electrophoretic deposition. However, very little research has been carried out on investigating the effect of fiber orientations and internal structure of 3D printed CFRPs on their mechanical properties and machinability. This research is focused on carbon fiber reinforcements experimented with thin, connected layers containing fiber strands at different angles and densities, intending to find the optimum combination and orientation of fiber and matrix for improved compression and tensile strengths. Some studies investigated adding foreign materials like glass and steel into the polymer mixtures to impede breakage, increasing strength and rigidity of samples. Other important papers focused less on the polymer and more on various shapes of the test specimen in order to see where breakage occurs during tension and compression. However, very few papers have focused on investigating how the machinability is influenced by fiber orientations and internal structures of the CFRP samples. Much of the Fall 2020 semester was spent creating models and simulations of samples with various ASTM standard shapes, composite materials, and forces to ensure experimental results can be confirmed in the Spring 2021 semester.

In the upcoming semester, I intend to take the information learned from literature and apply it by creating and printing samples using additive manufacturing, carrying out mechanical properties and machinability testing, and running simulations to show the influence of fiber orientation and internal structures on mechanical properties. I will use Autodesk Inventor to create models and ABAQUS to simulate and confirm the results of tensile and compression testing of the additive manufactured samples.

Publications: None yet.

Markus R. Puckett

Senior, Manufacturing Engineering
Advisor(s): Augustus Morris, Jr., Ph.D., P.E.

Investigating Technology Leading to the Design of a High Altitude Ballooning Platform

Biography: Markus Puckett was born and raised in Minneapolis, MN. His mother started to introduce STEM to him once he reached his junior year of High School and he took a large interest in the programs. He is currently majoring in Manufacturing Engineering, with a minor in Nuclear Engineering and plans of designing and leading teams to new innovations. He is a member of the National Society of Black Engineers (NSBE), and a member of Kappa Alpha Psi Incorporated. His free times he takes the interest of playing a variety of games on different consoles, researching components for Computers, and being a mentor to his niece and nephew.

Abstract: Exploration of the upper atmosphere and near space became has become increasingly affordable for students at all levels over the last 20 years. Thanks to modern technology, instrumentation and communications needed to support scientific ballooning missions have become miniaturized, reliable, and affordable. Dubbed by some as the poor man's space program, it is now possible to conduct real science at near space altitudes for less than $1000. Central State University is revisiting high altitude ballooning as a means to attract students toward, and choose careers in, the STEM fields. Working toward this goal, understanding the basic instrumentation necessary to measure key atmospheric variables is required if custom payloads are designed with such instrumentation. Knowing the range of environmental conditions encountered during a flight at altitudes up to 100,000 feet is necessary in order to protect the instrumentation on such missions.

Publications: None yet.

Joseph R. Rathkamp

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

Magnus Effect over Multiple Rotating Cylinders

Biography: I am currently a Senior at Ohio Northern University and will be graduating in May of 2021 with a B.S. in Mechanical Engineering with a concentration in Aerospace Engineering and a minor in Applied Mathematics. I am originally from Franklin, WI and my hobbies include football, basketball, playing video games with friends, and reading. During my time at Ohio Northern, I have had the opportunity to be a student coordinator of the engineering mentorship program and am currently the Senior class representative of the Joint Engineering Council. I also am currently a member of the football team.

Abstract: The purpose of this project was to analyze the magnus effect over multiple, in-line, rotating cylinders and their potential use on commercial aircraft. Using various processing and post-processing software, the goal was to first imitate existing research on a single rotating cylinder and afterwards, proceed to add an additional cylinder directly behind it. The distances between the two cylinders were varied in order to observe the amount of lift produced at each distance.

Publications: None yet.

Cleveland State University

Kristen M. Reyes

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

Catalytic Gasification of Polyethylene as an In-Situ Resource Utilization Alternative

Biography: I am an undergraduate senior Chemical Engineering student at Cleveland State University. I was born and raised in the Cleveland area. After taking an environmental engineering course during my senior year of highschool, I knew I wanted to pursue chemical engineering in college. I was thrilled to find a research topic at Cleveland State University pertaining to sustainable living environments for space exploration.

Since starting my academic career I have made myself an active member of the student life at Cleveland State University. I serve as the President for the college's Society of Hispanic Professional Engineers student organization. My passion for diversity and inclusion initiatives has given me the opportunity to assume the role as a student representative for the hispanic community on the Engineering Dean's Diversity Counsel.

Abstract: Dealing with solid waste is a major issue. In space exploration, solid waste requires waste management alternatives that lead to in-situ resource utilization strategies. Ground-based waste management alternatives, on the other hand, include alternatives such as landfill. Gasification is a process that can be used to convert waste into a valuable fuel, rather than resorting to landfills for waste management. Similarly, gasification integrated as in-situ resource utilization alternatives, can generate fuel while preserving living environments in space exploration. In this research, mid-density polyethylene was used as the model substrate to study gasification as a waste management alternative. The gasification proceeds through a complex reaction mechanism consisting of four reactions that are a combination of in series and parallel. Experiments were run in a 100 mL pressurized batch reactor. The use of 5 wt.% Ruthenium on Alumina catalyst allowed for the reaction to take place at temperatures below 350 oC . After the reaction ended, solid residuals and gas products were analyzed via gas chromatography (GC) and thermal characterization Gas products showed a linear trend of increasing percent gasification with longer reaction times and higher temperatures. Kinetic characterization of mid-density polyethylene gasification experiments is presented. The potential of catalytic waste gasification as in-situ resource utilization alternative is examined.

Publications: None yet.

William L. Rickman

Senior, Mechanical Engineering & Mathematics
Advisor(s): David Munday

Thin Film Cooling in Gas Turbines

Biography: William Rickman is a third year Mechanical Engineering and Mathematics student enrolled in Miami University's Honors Program and Combined BS/MS program. He has a passion for learning and hopes to someday pursue a PhD or a career in R&D. Currently, he works on-campus for the Physics Department at Miami, designing and manufacturing a variety of hardware for the faculty there. Additionally, he has just completed his first Co-Op with Tark Inc., a Dayton engineering firm that designs cooling pumps for CT scanners. When in his hometown of Perrysburg, Ohio he enjoys spreading his love for learning as a math and science tutor for Tutor Doctor. Aside from his coursework, research, and job, William is heavily involved in Miami's student branch of AIAA and serves as its Secretary. Miami's AIAA branch is also hoping to compete in this year's Spaceport America Cup Collegiate Rocketry competition. He is also associated with the Outdoor Adventure Club and is the cofounder and treasurer of a gaming organization on campus. In his ever-shrinking spare time, he enjoys the great outdoors, playing guitar, and reading.

Abstract: The performance, efficiency, and carbon emissions of a gas turbine are directly related to its operating temperature, with higher temperatures yielding more favorable results. In modern systems, the temperatures at which a turbine can be run have surpassed the temperatures that the blades themselves can withstand. Thus, in order to further increase performance and run time, the blades of the turbine must be cooled in some manner. One method of achieving this is through thin film cooling, which integrates rows of small cooling holes along the blade of the turbine. These rows pump coolant to the surface of the blade, producing a thin film of cool gas that acts as a buffer between the blade and the hot flow. This allows for higher operating temperatures, and thus gains in efficiency and performance, as well as a decrease in carbon emissions. While the use of these holes is prevalent, further increasing their effectiveness is highly desirable. This study aims to produce a modular test section to further explore how the effectiveness of cooling holes changes under different conditions. This test section will include a variety of interchangeable components, allowing for control over the boundary layer conditions, coolant supply, and the pressure gradient over the cooling holes, among other parameters. This new test section, whose manufacturing has been delayed due to the ongoing Covid-19 pandemic, will support the testing of new, compound angle, shaped cooling hole geometries. The test section will also be used to support the research of other future graduate students.

Publications: None yet.

KENT STATE UNIVERSITY

Sara J. Roman

Junior, Mechatronics Engineering
Advisor(s): Irvin Cardenas

Augmented Reality Overlay System

Biography: Sara Roman is going into her senior year as a Mechatronics student at Kent State University and has since started a minor in Sustainability. Born in Norwalk, Ohio she stayed in state to pursue her degree in engineering and has plans to further her education with graduate studies. She is heavily involved with the battlebots club on campus as well as The American Foundry Society (AFS) where she has been an active member since 2017. Her first internship was with students from across the nation at NASA Glenn Research Center working on two projects. Her primary project was High Data Rate Architecture (HiDRA) and designing the chassis and heat sink for the motherboard and data processing chips. The second project was working with one of the many rovers and putting together the tread system for operation. Recently she began working in the Advanced Telerobotic Research Lab on Kent's campus and was assigned to design a robot for the World Robot Summit in Japan. Alongside working in the ATR Lab she also spends her time with Technology House operating their HP Jet Fusion 5200 nylon printers alongside two other interns from Kent State.

Abstract: The Augmented Reality Overlay System came about during a hackathon hosted at Kent State University. When observing airports across the country there was a noted struggle with constantly fluctuating weather that interferes with landing planes. Nantucket being an example as it had unpredictable heavy fog that grounds flights frequently. Taking advantage of Augmented Reality allowed me to form the concept for a projection of the runway to appear on the windshield (or pair of AR goggles for trial runs) that would aid the pilots in landing even when visibility is low.
The idea is for 'beacons' to be placed in distinct markers along a runway that will communicate to the AR system to help pilots visualize their orientation to land. Future developments being considered is to further develop this into a general guidance to even allow for routs to specified terminals though there are legal restrictions that may inhibit its implementation into commercial airlines.
Research and prototyping has been restricted due to the pandemic though I plan to do what I can from home. Over the past semester I've been able to design the concept for the Augmented Reality Overlay System around the guidelines for flight and in the coming semester I hope to have a visual layout prepared with the beginnings of a prototype in the works.

Publications: None yet.

THE OHIO STATE UNIVERSITY

Andrew J. Sais

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

Visualization of Flow Structures in Actively Controlled Supersonic Jets

Biography: Born and raised in Columbus, Ohio, Andrew graduated with a music performance degree in Jazz Studies from Capital University in 2012. In 2016 he decided to pursue his passion for science by enrolling in the engineering department at The Ohio State University. Currently, Andrew is finishing his senior year in the aerospace department at The Ohio State University. Over the past year Andrew has held a position as an undergraduate assistant researcher studying flow physics of supersonic jets at the university's Aerospace Research Center. While gaining experience in all manner of analysis in flow physics, he has focused on visual data and analysis, gaining experience in Schlieren imaging and numerical analysis tools such as Spectral Partial Orthogonal Decomposition. With a desire to work in the space industry, Andrew is currently applying to graduate programs with a focus on astronautical engineering.

Abstract: Supersonic twin rectangular jets contain a myriad of unique physical and acoustic properties including flow coupling, screech frequencies, and near-field and far-field noise signatures. The control of these behaviors, such as high amplitude screech tones and other far-field noise, is of interest to parties looking to reduce the overall ground noise of supersonic aircraft. A variety of different methodologies and techniques have been developed to analyze and modify the flow physics of the twin jet system. The use of Local Arc Filament Plasma Flow Actuators, or LAFPAs, is one way of modifying the flow in supersonic jets. Using a supersonic nozzle inside an anechoic chamber, actuators are placed around the inside of two twin rectangular nozzles with an aspect ratio of 2. These actuators produce short duration plasma arcs to create disturbances in the supersonic flow, which develop into larger structures as they convect downstream in the flow. Over several varying actuation regimes, microphone arrays collect near-field and far-field pressure signatures to determine how the new structural regimes introduced by the LAFPAs have affected the behavior of the jets flow. Numerical analysis of visual data is another component used in this analysis. Schlieren imaging is a method that allows for the visualization of density gradients in fluids. From a series of schlieren images of the flow, Spectral Orthogonal Decomposition, or SPOD, is performed. This numerical technique allows for a visualization of energy contained in the flow at various frequencies. SPOD analysis and data is currently being used, in conjunction with data collected form the microphone arrays, to determine how the acoustic and hydrodynamic properties of the flow can be modified with different excitation modes through LAFPA actuation.

Publications: None yet.

KENT STATE UNIVERSITY

Hayley D. Shasteen

Senior, Psychology/Molecular-Cellular Biology
Advisor(s): Dr. Rachael Blasiman

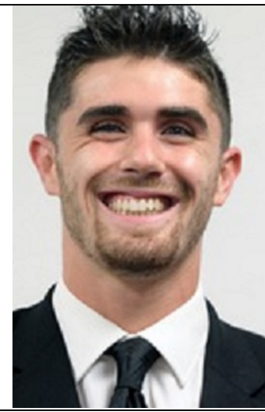
Impacts of Shift Work on People with Chronic Conditions

Biography: Hayley Shasteen is a senior at Kent State University who will be graduating this spring with a BS in Psychology with a concentration in molecular/cellular biology. Expressly interested in 'brain fog', a cognitive symptom experienced by many people with chronic illness, most of Hayley's undergraduate work has focused on cognition in people with systemic lupus erythematosus (SLE), an autoimmune disease. She has worked alongside Dr. Rachael Blasiman completing several projects that emphasize longitudinal designs examining fluctuations in cognition related to environmental variables in people with SLE. Working on this particular problem has led Hayley to become interested in circadian rhythms and how sunlight and variations in circadian rhythms may impact disease progression of SLE and other chronic illnesses, as well as the presentation of physical and cognitive symptoms. In addition to quantitative work, Hayley is currently completing a qualitative study aimed at defining 'brain fog' across many different chronic conditions. Hayley also works alongside Dr. Eric Mintz working on projects pertaining to circadian rhythm function. After graduating this spring, Hayley intends to pursue a PhD in clinical neuropsychology and continue working towards defining and alleviating cognitive dysfunction in chronic illnesses as well as investigating the role of circadian rhythms in cognitive dysfunction. Hayley was named a 2019 Goldwater Scholar for her work regarding cognition in SLE.

Abstract: In this project, we aim to understand how shift work impacts people with chronic conditions, such as systemic lupus erythematosus or multiple sclerosis, as compared to people without chronic conditions. Current research efforts have revealed that shift work is a risk factor for developing numerous chronic conditions and that shift work in general leads to dysfunction in cognition as well as an increase in physiological maladies. However, there remains a lack of research regarding how shift work impacts those who already have a chronic condition. We examine differences in objective and subjective cognition, physical symptoms, sleep, and sleep-wake activities between shift workers with chronic conditions and those without.

Publications: Shasteen, H.D. & Blasiman, R.N. (2020). The role of sunlight exposure in tasks of inhibition in patients with systemic lupus erythematosus. NASA/Ohio Space Grant Consortium 2019-2020 Annual Student Research Symposium Proceedings XXVIII, 261-265.
Shasteen, H.D. & Blasiman, R.N. (submitted 2020). A longitudinal investigation in cognitive function in systemic lupus erythematosus.

Branden S. Stoeffler



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

Thrust Generation Due to Turbofan Fan Blade

Biography: My name is Branden Stoeffler, and I am a Senior at Ohio Northern University. I am pursuing a Bachelor of Science Degree in Mechanical Engineering. In addition, I am pursuing a minor in Applied Mathematics. I am a three-time letter recipient on the Ohio Northern Men's Lacrosse Team. I also have three summers worth of industrial experience where I interned as a Quality and Purchasing Intern at Rocore Holdings in Indianapolis, a Test Vehicle Engineer Intern at Rolls-Royce in Indianapolis, and as a Program Engineer Intern at Raytheon Technologies in Indianapolis. Upon graduation, I have accepted a role as a Program Engineer at Raytheon Technologies and will begin employment there in the beginning of the summer. In addition to my internship experience, I have worked as a summer travel lacrosse coach for the previous two summers coaching a 12U team and will act as a 14U coach this upcoming summer.

Abstract: Turbofan engines are an extremely common technology nowadays. The vast majority of commercial aircraft utilize a turbofan engine. A turbofan engine works by using a fan to draw air into the engine. From there, the air is compressed by using an axial-flow compressor. Next, the compressed air is passed into the combustion chamber where it is mixed with jet fuel and combusted. After that, the exhaust from the combustion is then passed through the turbine which therefore makes the turbine capable of rotating which rotates the compressor and the fan. Finally, the exhaust is passed out through the nozzle in the rear of the engine. This process allows the turbofan engine to create thrust which propels the aircraft through the sky. This project will examine how much trust is created by the fan portion of the turbofan engine. In order to do so, a CFD analysis will be performed which will calculate the thrust created by the fan. This operation can be performed by subtracting the product of the mass flowrate of the air moving through the fan and the free-stream velocity of the air going into the fan by the mass-flow rate of the air moving through the fan and the exit velocity of the air as it passes through the fan.

Publications: None yet.

Cleveland State University

Kevin C. Stropki

Junior, Electrical Engineering
Advisor(s): Dr. Zhiqiang Gao

Tornado Simulator with Airflow Control System

Biography: I am a Junior at Cleveland State University studying Electrical Engineering with a minor in Mathematics. I obtained my first Bachelor's Degree in Psychology from The University of Akron. After graduating, I quickly realized that I was not passionate about psychology and decided to pivot in a direction where I would be objectively challenged. Having experience as a musician, I applied for a job at Stratosphere Sound, a recording studio located in New York City, where I was hired as an intern and eventually worked my way up to a position as an assistant engineer. During my time at Stratosphere Sound, I developed a passion for electronics and was tasked with making minor repairs to the recording equipment. As the projects got more complex, I quickly realized that a more in-depth knowledge of electronics would be required to pursue my passion safely. After five years in New York City, I decided it was time to move back home to Cleveland, Ohio, and pursue a degree in Electrical Engineering.

Abstract: Each year, tornado-induced aerodynamic loads cause billions of dollars in damages throughout the United States. To help engineers better understand turbulent wind flow patterns, a tornado simulator capable of producing radial and tangential velocities similar to that found in full-scale tornado research is being designed. The simulator will include a closed-loop airflow control system that allows users to change the swirl ratio of the tornado-like vortex without compromising airflow rate. The airflow control system will maintain a constant airflow rate; this will be achieved by positioning airflow sensors within the downflow ducts of the simulator. The output of the sensors will be part of a negative feedback loop that sends a signal to an airflow proportion integral derivative controller, which in turn will output a control signal that will drive the error between the setpoint and the output to zero.

Publications: None yet.

Jennifer A. Swabb

Junior, Electrical Engineering
Advisor(s): Dr. Saiyu Ren

Analysis of Proposed Improved Lidar Detector Design for use in Space Using MATLAB

Biography: Jennifer Swabb is a Junior at Wright State University studying Electrical Engineering with a focus in software. Growing up, her fascination with space exploration led to an interest in robotics. Jennifer hopes to use her degree to apply her knowledge to projects which will make it safer for humans to explore the unknown. Light Detection and Ranging (LIDAR) is particularly interesting to her because it has applications in both robotics and space exploration. She will begin an avionics engineering internship at Wright-Patterson Air Force Base this summer.

Abstract: This project will expand upon research suggesting integration of the last two detected pixels into a LIDAR scan using a detector with an integrated focal plane, examining potential uses of the improved system in deep space. This integrated detector design can be used to detect objects even more accurately behind reflective or obscured surfaces than standard LIDAR techniques, meaning that it may be ideal for space exploration as the enhanced detector can be used to see more clearly through thick or reflective atmospheres. The new chip design is compact and uses very little power in its base form. The detector itself is designed in 90nm CMOS and can be added to an existing LIDAR chip inside a focal plane array. Analog outputs are used to minimize interference from other digital components with the analog input signal and CFD is used to minimize range walk. While the detector is designed to require as little space and power as possible, it can be expanded to detect additional surfaces if desired, meaning that a large-scale version could be built in space. The primary focus of this project will be to explore how this proposed improved LIDAR detector can be used to map distant targets, whether by constructing a larger version for enhanced accuracy or for use over great distances, or by attaching a standard sized detector to an exploratory probe.

Publications: None yet.

Clarence M. Toney

Junior, Computer Engineering
Advisor(s): Dr. Deok Hee Nam

Cybersecurity and power system communications in a smart grid environment

Biography: I am a junior computer engineering student attending Wilberforce University and will be completing my bachelor’s degree in May 2021. I am from Cincinnati, Ohio. I am the oldest out of 4 siblings, and a first-generation college student.

Growing up I've always been fascinated with computers, my mother used to call me her personal computer technician when I was younger because I would always learn to work her new phones and computers before her, and whenever there was something wrong with the computer, she would always get me to fix it. I knew early on in my life that I wanted to pursue engineering, but was unsure about what kind of engineer I wanted to be until I got into high school which is where I took my first programming class. After that, I fell in love with programming.

Abstract: For the development of the smart grid, more technologies on the power grid are used for the enhancement of the system reliability. Since the smart grid is for increasing the capability of the automation through computer-based remote control, the higher connectivity and cybersecurity can be a potential threat to the cyber-physical systems (CPSs). Even though the purpose of the smart grid is eventually to enable efficient energy usage of the future network performance, cybersecurity and information privacy issues are always concerned due to the demand of large-scale communication networks requiring the connection of numerous devices from geographically dispersed sites to a control center. In this proposed project, a survey on cybersecurity of the power grid concerning issues is performed by examining the most relevant cybersecurity studies in power systems. It also reviews researches that demonstrate cybersecurity risks and construct solutions to enhance the security of a power grid by reviewing smart grid technologies, power industry practices and standards, solutions that address cybersecurity issues, a review of existing CPS testbeds for cybersecurity research, and unsolved cybersecurity problems.

Publications: None yet.

THE OHIO STATE UNIVERSITY

Jack C. Tyskiewicz

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

Active Control of Jet Noise from Supersonic Rectangular Nozzles

Biography: Jack Tyszkiewicz, a Cincinnati native, gained a B.S. from Ohio State University in Engineering Physics with an Aerospace Concentration in May 2021. Now graduated, Jack plans to pursue an advanced degree in quantum physics as he works towards becoming involved in the up-and-coming quantum computing sector. During his junior and senior years, he researched the active control of jet noise from supersonic rectangular nozzles using localized arc filament plasma actuators (LAFPAs) under the guidance of Dr. Samimy. Jack's interests include artificial intelligence, quantum mechanics and quantum computing, spacecraft and orbital mechanics, aerospace vehicle propulsion, aerodynamics, aeroacoustics, music, and all things physics.

Abstract: Jet noise and methods of its mitigation have been the target of active research and development efforts since the advent of jet-powered flight. The impact of jet noise on communities adjacent to airbases and on service members exposed to it on the ground or onboard carrier decks has spurred the efforts by the military and industry to investigate methods of reducing jet noise to alleviate noise-induced hearing loss.

Investigating the noise signature of rectangular nozzles and implementing active control to abate noise is of great interest to the military since incorporating rectangular nozzles in tactical aircraft brings about a host of advantages compared to traditional circular nozzles including better integration with airframe and therefore lower installation drag, lower nozzle weight, potential for implementing thrust vector control and reduced signature for low observable aircraft.

Noise reduction using active flow and noise control by localized arc filament plasma actuators (LAFPAs) installed on low-aspect ratio, rectangular convergent-divergent nozzles were investigated in this project. While methods of noise control for subsonic flows have had a host of research, active noise control of supersonic flow required simultaneously high amplitude and high bandwidth perturbations that were not previously possible.

LAFPA's are unique in that they offer the ability to produce simultaneously high amplitude and high bandwidth thermal perturbations that allow active flow and noise control of supersonic nozzles by excitation of perturbations in the Kelvin-Helmholtz instability. Large-scale flow structures are primary components in aeroacoustic noise generation models, particularly through interaction with shock-cells in the jet plume. By controlling the generation and shaping of large-scale structures in the extended shear layer of the exit flow, a model of noise control through firing of LAFPAs in various modes may be developed to allow active control of supersonic jet noise.

Publications: None yet.

Christopher P. Vadala

Senior, Molecular/Cellular Biology
Advisor(s): Dr. Heather Caldwell

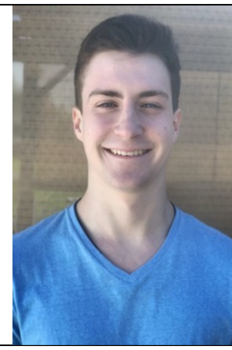
Disruptions of the Oxytocin System Impacts Social Discrimination Behavior in Adult Mice

Biography: Christopher Vadala has always had a passion for space and biology, something that drew him to AP biology in high school. It was this class where he discovered his love for neuroscience and decision to study biology in college. Upon graduating as valedictorian, Christopher started attending Kent State University (KSU) to study biology; he has since added a minor in Psychology. He has been a member and twice a mentor in KSU's Provost Leadership Academy for first-year students. He has performed research in Dr. Heather Caldwell's Lab of Neuroendocrinology for three years and is currently performing an honors thesis. Following graduation, he plans to attend graduate school to earn a PhD in neuroscience and later become a professor.
This summer, Christopher participated in the Summer Undergraduate Research Experience (S.U.R.E.) at KSU, where he performed research examining the behavioral differences in mice lacking their oxytocin receptors. This research won first place in the S.U.R.E. three-minute thesis competition and the undergraduate abstract award at the KSU Neuroscience Symposium. He has also been awarded the Dr. Gary B. Larkin Endowed Undergraduate Scholarship in Biological Sciences and a KSU Honors Thesis Fellowship. He will be presenting his research at the Society for Neuroscience Global Connectome Event in January 2021.

Abstract: Oxytocin (Oxt) and the oxytocin receptor (Oxtr) impact a variety of behaviors that are important to social living. The goal of this experiment was to examine the impact that a disruption of the Oxt or the Oxtr would have on social discrimination in adult mice. Social discrimination is an important behavior as it requires the formation of a memory of individuals the mouse has met before. A two-trial social discrimination test was performed using male and female mice with disruptions to the Oxt system (Oxt —/—) and wildtype controls (Oxt +/+) as well as Oxtr knockout (Oxtr —/—) and their wildtype controls (Oxtr +/+). The brains were taken, cut, and stained for the immediate early gene, c-fos, which is used as a measure of neuronal activation. Within several brain regions the number of c-fos positive cells will be counted and analyzed in order to compare across genotypes and sexes. The videos of the trials will be analyzed in order to determine if there are any behavioral differences between genotypes and sexes.

Publications: None yet.

Cleveland State University



Jacob C. Vitale

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

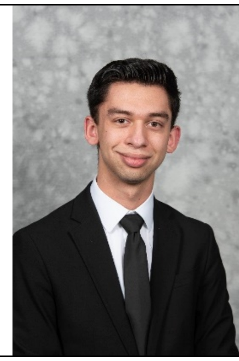
Noncovalent Complexation and Assembly of Boron Nitride Nanotubes using Biomolecules

Biography: My name is Jacob Vitale, I am a Senior at Cleveland State University (CSU) majoring in Chemical Engineering. I am a member of the honors college at CSU and enrolled in the accelerated master's program which will allow me to get my masters in one year. I also serve as the Vice President of the student chapter of Tau Beta Pi, an engineering honors society at CSU. I decided to study chemical engineering because of the love of chemistry that I developed in high school; I have always been fascinated with nanomaterials and the way chemical reactions work, and I wanted to learn even more about them in college. I was invited by Dr. Geyou Ao to join the bio-nano materials lab at the end of my sophomore year. For the past year and a half, I have been researching boron nitride nanotubes and their interactions with biomolecules with the goal of fabricating strong, biocompatible films for applications, such as thermal management of medical devices and protective coatings.. A manuscript on this topic is being prepared for a journal publication. I have also had the opportunity to be a part of the I-Corps@Ohio program as an entrepreneurial lead of our team where we looked at the commercial viability of the technology we are developing in our lab for processing nanomaterials.

Abstract: Boron nitride nanotubes (BNNTs) are one-dimensional (1D) nanostructures with a cylindrical shape similar to that of carbon nanotubes. BNNTs are mechanically robust, stable under air oxidation up to 1173K, and absorb ultraviolet light. These features make BNNTs an ideal material for potential applications, such as thermal coatings for medical devices. Establishing stable dispersions of the synthetic BNNT material is a prerequisite to translating distinct properties of individual nanotubes into assembled structures via liquid phase processing. In this work, aqueous dispersions of BNNTs will be prepared by probe tip ultrasonication utilizing various biomolecules including single-stranded DNA, lysozyme, bovine serum albumin, and acylase, respectively. The biomolecule:BNNT mass ratio will be varied for a broad range from 0.5:1 up to 20:1 to determine the optimal ratio for each dispersion. BNNT dispersions will be characterized by UV-vis absorption spectroscopy and zeta-potential measurement. A least squares regression method will be applied to determine the absorbance value of BNNTs at 205 nm peak. Furthermore, stable dispersions of biomolecule-BNNTs will be utilized to create thin films using a layer-by-layer assembly method. UV-vis absorbance measurement and scanning electron microscope imaging will be utilized to characterize BNNT films. Research findings of this work will enable the development of new technologies utilizing BNNTs in biological applications. Potentially, techniques learned from BNNT processing will be used to process stable dispersions of 2D boron nitride nanosheets and emulsions.

Publications: None yet.

Micah A. Walden



Senior, Mechanical Engineering
Advisor(s): Dr. Thomas Ward; Dr. Jeff Shortt

Autonomous Orbital Debris Remediation Initiative (AODRI) - Cost Effective Technology Demonstrator CubeSat Design for the Remediation of Small Orbital Debris in LEO

Biography: Micah Walden in a fourth-year Mechanical Engineering student from Huntingtown, Maryland. He will be graduating from Cedarville University in May 2021 with a Bachelor of Science degree in Mechanical Engineering and a Minor in Mathematics. As the child of two engineers, Micah gained an early appreciation for the field of engineering, fueled further by his obsession with Legos, robotics, and spaceships. As a homeschool educated student, he actively participated in a variety of robotics competitions, including FIRST Lego League, FIRST Tech Challenge, and SeaPerch. Post-high school, the robotic skills he attained were readily transferred during his freshmen and sophomore years at Cedarville University where he participated on the university's ASEE robotics team. During his junior year, his fascination with spacecraft led him to propose the Autonomous Orbital Debris Remediation Initiative to combat the ever-increasing threat of orbital debris collisions. This work is supported by four fellow mechanical engineering students, Cyle Adams, Joshua Gazica, Matthew Peel, and Michael Winter, with mentoring provided by Dr. Thomas Ward and Dr. Jeff Shortt. In his spare time, you can find Micah tinkering with computer components, reading and discussing various thought-provoking topics, and playing vehicle-based simulation games. After graduation, Micah seeks to obtain employment in the aerospace industry, where he can utilize his talents in the design, development, and operation of new spacecraft and spacecraft subsystems, with the goal of creating manned spacecraft capable of spaceflight beyond our Solar System.

Abstract: The Autonomous Orbital Debris Remediation Initiative (often referred to as Project AODRI) is a 3-year senior design engineering program focused on the development of a CubeSat solution to combat the increased risk of orbital debris collisions in LEO. AODRI is intended to provide a debris remediation system capable of working cooperatively with manned systems or independent, autonomous operations.

As various commercial interests pursue the large-scale deployment of CubeSat satellite constellations, such as SpaceX's Starlink program, already crowded orbits will become further congested by a large influx of new spacecraft increasing the potential for spacecraft conjunctions and debris collisions. Realization of these outcomes will result in the proliferation of debris into multiple orbital altitudes and drastically increase the already vast space debris population, putting billions of dollars in spacecraft at risk. Historical events, such as the collision of the active communication satellite Iridium-33 with the defunct military satellite Cosmos-2251 and the anti-satellite weapons tests performed by China, the United States, and most recently India, already show the long term and long-lasting implications of orbital debris field expansions with orbital decay periods exceeding upwards of 100 years or more.

To address the need for orbital debris remediation, AODRI seeks to develop a technology demonstrator satellite system capable of the capture and removal of debris objects in an economically viable manner. AODRI develops a debris retrieval system that can be integrated into a CubeSat platform and explores approaches for debris recovery, retention, and removal. In addition, AODRI also considers the mission flight plan that addresses and adapts to changing debris orbits and types.

Publications: None Yet.

Ryan T. Watts

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

Truncation Analysis of an Aerospike Nozzle

Biography: Ryan Watts is a Senior at Ohio Northern University pursuing his bachelor's degree in Mechanical Engineering. Ryan is originally from Geneva, Ohio, and enjoys running, playing guitar, snowboarding, and going on adventures. During his time at Ohio Northern, Ryan has had the opportunity to participate in an Immersive Design Experience at Yellowstone National Park and participated in the university's chapter of the American Society of Mechanical Engineers as the Joint Engineering Counsel Representative. Ryan has also participated in the SAE Baja team where he was the head of the vehicle's brake system subsection during his sophomore year. Ryan was also recently given the opportunity to be a fluid mechanics tutor at Ohio Northern.

Abstract: In spacecraft, bell nozzles are typically used to control the flow exiting the rocket's engines. Bell nozzles have a major flaw, however, when compared to other nozzles like the aerospike nozzle. Bell nozzles are only optimally efficient at one altitude, whereas aerospike nozzles are nearly optimal for all altitudes. One major drawback of aerospike nozzles is the added weight due to the design of the nozzle. One way to decrease some of the weight of the nozzle is to truncate the spike. For this study, an aerospike nozzle will be looked at, using CFD software, with different lengths of the spike truncated to determine the weight loss compared to the associated thrust lost with the truncation.

Publications: None yet.

Madison M. Wood

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

Lead in Urban Soils

Biography: Madison is a Junior at Kent State University studying Geology. She is president of two student organizations; Sigma Gamma Epsilon (Gamma Zeta Chapter) which is a nationally recognized honorary society of earth sciences and the Kent State Geological Society (KSGS). She is also a member of the American Association of Petroleum Geologists (AAPG) and is a Research Ambassador at Kent State where she works to educate students about how they can be involved in research within their major. Madison has been working in a geology lab since her second semester of freshman year and plans to continue her education in geology by pursuing graduate school after completing Her Bachelor's Degree.

Abstract: Lead (Pb), a versatile metal, is commonly found in urban soils because of its wide range of industrial uses and its resistance to degradation. Pb has been used over the past few centuries, primarily in gasoline and paint in the 20th century, and can have long-lasting negative health effects following exposure, particularly for children. This caused the USEPA to set a standard of 400 parts per million for bare soils to limit human exposure. The risk of Pb exposure is based on its speciation (chemical form) in soils, which can be determined by Scanning Electron Microscopy with Electron Dispersive Spectroscopy (SEM-EDS). SEM can be used as an initial identifier for Pb in soils because of its ease of sampling and quick analysis processes. The combination of SEM imaging and EDS element mapping can be used to identify Pb and other elements present, which can assist in understanding the phases that Pb is associated with. This is important because speciation is directly related to the potential bioaccessibility of Pb. Thus far, 16 of the samples collected from Akron (n=82) are above USEPA acceptable range. These samples contain Pb in insoluble phases that are galena like or lead aggregates with clays and iron phases. The analysis of these soils is being done, in part, through a collaboration between KSU and Akron Public Schools system. This information may also be used to streamline future Pb soil analysis by reducing the number of steps taken to prove if Pb is present within soils.

Publications: None yet.

KENT STATE UNIVERSITY

Sarah N. Worrell

Senior, Geology
Advisor(s): Dr. Daniel K. Holm

The Early Earth: Cool and Clement or Hot and Hadean? An Investigation into the Geology and Surface Environments on Ancient Earth

Biography: Sarah Worrell is a currently a senior at Kent State University and pursuing a Bachelor of Arts in Geology. She has previously worked as a geology tutor for Kent State at the Tuscarawas campus, where she began her schooling. She has also participated in the Undergraduate Student Research Colloquium in the Spring of 2017, where she conducted experiments to determine chemical equilibrium constants using digital camera spectroscopy, advised by Dr. Christopher Fenk. Sarah currently lives in Kent, Ohio and works as a Starbucks barista while she finishes her degree. She is set to graduate in December 2021, after which she wants to pursue a career as an environmental geologist/scientist in the northern Appalachian region. She is passionate about animals and the environment, and in her free time enjoys hiking, cooking, crafting, and spending time at home with her birds.

Abstract: The current research on Earth's modern-day geology and surface environments has coincided with a renewed interest about Earth's initial early environment – from 4.4 to 3.6 billion years ago, during Earth's first gigayear. The long-held view of a hot and "hell-like" (Hadean) early Earth with molten magma oceans maintained by heat released from inside the Earth has been challenged by recent geological evidence, which favors a calmer early Earth cool enough to support liquid water, proto-continental crust, and possibly even life. This paper synthesizes the evidence that earth materials have provided for a cool, clement early Earth, with an emphasis on the evolution of the mineral, rock, and isotopic record. These evidences taken from the research literature have important implications for the formation of ancient continental crust, the onset of plate tectonics, the existence of liquid water, and the origin of life on Earth. A major part of this evidence comes from the discovery of 4.4 billion-year-old zircons determined to have formed from a granitic magma in the presence of liquid water. Water-deposited sedimentary rocks in Greenland have further supported the existence of a hydrosphere by 3.85 Ga. Carbon isotopes in metacherts from this same region in Greenland suggest that primitive life may have also existed by this time. There is also discussion of the nature and composition of the first proto-continental crust and the beginning of plate tectonics.

Publications: None yet.

KENT STATE UNIVERSITY

Matthew J. Zirckel

Junior, Aerospace Engineering
Advisor(s): Dr. D. Blake Stringer

A Hybrid Fuel Cell/Battery/Capacitor Power Source for UAS

Biography: Matthew is a Junior at Kent State University pursuing a Bachelor of Science in Aerospace Engineering. He was born and raised in Pittsburgh, Pennsylvania. At a young age, he was fascinated with the engineering discipline. Aviation was always an interest of his and by combining these two interests, Aerospace Engineering was an obvious choice. He is involved in several extracurricular activities related to the STEM field. He currently holds the position of Safety Officer for Kent State's High Power Rocket Team and is involved in restarting Kent State's AIAA Student Chapter, along with fellow students.

Abstract: The current investigation is a continuation of research done by previous Kent State students concerning the scalability of UAS technology. With collaboration from Kent State Associate Professor, Dr. Yanhai Du, the project seeks to find alternate power sources for Unmanned Aircraft Systems (UAS). With the increase in size of UAS technology, several developments have surfaced. Thermal runaway was recorded in previous investigations, which stems from the heat generated from electric motors. The alternate power device, provided by Dr. Du, is connected to Kent State's UAS Static Thrust Test Bench as a replacement for the battery bank. A series of tests will be conducted on a commercial electric motor and propellor combination using this device. The investigation will conclude with a 12-hour endurance test and a one-hour demonstration flight in an airframe provided by Event 38, an Akron based UAS company. The temperature of the system, as well as aircraft performance characteristics will be recorded by this investigation.

Publications: None yet.

Community College

Muhammed Z. Ali

Freshman, Associate of Science
Advisor(s): Dr. Regan Silvestri & Dr. Harry Kestler

Building a Plasma Reactor Chamber

Biography: I was born and raised in Ohio. I graduated in 2015 with a dual high school and Associate's Degree. I completed a Bachelor's in Business in 2018 and was pursuing a nursing degree in 2020, but circumstances are forcing me to rethink that decision. Because I enjoy building things I am leaning towards software development as this is something I can teach myself quickly. I've already started learning C++ and will be attempting Python to use arduino and raspberry pi respectively. I hope to design a market trading bot that will trade my money for me in the stock market by the end of next year. I've also figured out how to plate various metals and even made my own conductive ink.
Electrical engineering has been a passion of mine since I was a kid so I've kept up with some personal experiments on the side. One of my more difficult projects is to build a chamber to generate plasma and then modify it to create a PVD machine to attempt to create a carbon supercapacitor. If I am successful I can combine this with lithium ion batteries and have a battery pack that can charge itself in just a few seconds. This could revolutionize the way electricity is used in a variety of industries.

Abstract: Physical vapor deposition is an essential process for manufacturing modern electronic components. The relatively high cost of these machines makes it a barrier for people who want to experiment with this type of technology. To solve this problem a cheaper solution will be investigated and a small plasma reactor chamber would be the first step necessary to build a PVD machine.

Publications: None yet.

COLUMBUS STATE COMMUNITY COLLEGE

Grace A. Ciminillo Delamotte

Sophomore, Construction Management
Advisor(s): Dr. Jen-Ping Chen

Comparative Study of Resilient and Green Building Practices and Applications

Biography: Grace is pursuing both her Associate in Applied Science in Construction Management and Associate of Science at Columbus State Community College. Upon graduation, she will continue her studies pursuing a BS in Construction Systems Management and Surveying Engineering. She will continue to work in the built environment studying sustainable construction and universal design principles that address the health, safety, and well-being of all. Grace believes the construction field is being asked to solve more problems and feels those that represent the field must be diverse in experience, expertise, and in thinking. She hopes to combine the best practices of sustainability, design, and construction management to work with great teams of dedicated people committed to remarkable builds for all.

Abstract: Conduct a comparative study through a literature review examining resilient and green building practices and applications within the built environment.

Publications: Ciminillo Delamotte, G. A. (2020). 28th Annual OSGC Student Research Symposium Proceedings,56–57.https://doi.org/http://osgc.org/wp-content/uploads/2020/10/Final-Proceedings-2020-with-TOC-New.pdf

Cincinnati State

Tyler J. Dorsey

Sophomore, Mechanical Engineering
Advisor(s): Professor Abigail Yee

Superconductors; From One Extreme to Another

Biography: I am currently studying Mechanical Engineering & Manufacturing as well as working towards earning my Associate Degree in Applied Sciences at Cincinnati State. I will be graduating in the Summer of 2021 and plan on trasnfering to Clarkson University where I will persue a Bachelor's in Mechanical Engineering. During the first year of my time at Cincinnati State I have earned a certificate in CAD and CNC Manufacturing, as well as joined Phi Theta Kappa Honor Society. I recently accepted an intership with a security company to do some work as a drafter. I look forward to gaining some experience in the field, and for the years to follow. I hope to one day become a PE.

Abstract: Last year a team of physicists in New York created the first material to be classified as a superconductor at room temperature (59ºF). This was a major break through as the previous record was more than 50º cooler. The biggest downfall of this however was the pressure needed to maitain the superconductive properties. The pressure needed is close to 2.5 million times atmosopheric pressure. The biggest issue with implementing superconductors into practical uses before this breakthrough was the fact they were only found to be superconductive at very low temperatures. While we could take advatage of the bizzare properties superconductors exert, there was no practical to keep the temperature low enough to make it a reality.

If there was a feasible way to implent the new discovered room tempertaure superconductors the world would benefit greatly. Frictionless high speed trains, more efficient powerlines, a much greener world, and the countless innovations that would follow. While going from one extreme to the other may not seem like a breakthrough, this will allow scientists to get a better understanding of why superconductors behave the way they do. This will shed some much needed light on the subject and sets the next big goal in superconductivity, creating a material with superconducitve properies at room temperature, while under atmopheric pressure. People are already hard at work working towards the next goal taking a look at adding carbon compounds into the new forumla. Since carbon has strong covalent bonds the belief is it will be able to hold the compound together at much lower pressures.

While this new discovery may not be the final breakthrough before superconductors are used worldwide for everyday use, it is still a major breakthrough in the right direction.

Publications: None yet.

THE OHIO STATE UNIVERSITY

Brandon L. Dunson

Sophomore, Cyber Technician Associates of Applied Science
Advisor(s): Dr. Derek Petrey

Oasis in the Food Desert: Using the Internet of Things to Support Community-Organized Groceries

Biography: Brandon Lamar Dunson was born and raised on the West side of Dayton Ohio in a situation of extreme poverty and many challenges. He overcame them to graduate from Trotwood-Madison High School in 2013. He is the first in my family to go straight into college. At Sinclair Community College, he became Electronic Engineering student. He took an international service-learning trip to Guatemala in 2017 and made strong connections with my fellow Sinclair classmates and faculty, realizing how similar the situation of the rural Guatemalans was to his own.

He will graduate Spring, 2021, with Associate Degrees in both Computer Engineering and Electronic Engineering, and then transfer to a four-year institution for a B.S. Degree in Computer Engineering. His mid-term career goal is to work in an aerospace company in the Dayton or Cincinnati area. He desires to mentor others as he was mentored, inspiring them to learn and to study abroad.

Abstract: This project is intended for the capstone project in the Internet of Things (IoT) Cyber Technician Associates of Applied Science (CETT.S.AAS), which includes the recognition of professional, ethical and societal responsibilities, diversity, and design, document and implement of computer software solutions to solve technical challenges.

Dayton, Ohio has been recognized both a place for innovation and invention as well as suffering from food deserts in under-served areas of the city. As a solution, the Gem City Market, is being built through a community project to create a “vibrant, community-centered grocery store with well-trained, friendly workers who know the value of providing exceptional service. The Market will restore grocery service to Northwest Dayton for the first time in over a decade.” (https://gemcitymarket.com/about-us/)

This project will examine the technological needs of the market in its supply chain management, inventory, sales and other operational challenges and design a software and firmware infrastructure in a comprehensive plan that will meet the needs of this community-owned non-profit.

Publications: Consortium 2019-2020 Scholar Fellow Student Symposium, April 2020. URL: http://osgc.org/wp-content/uploads/2020/10/Final-Proceedings-2020-with-TOC-New.pdf

COLUMBUS STATE
COMMUNITY COLLEGE

Kyle H. Frith

Freshman, Mechanical Engineering Technology
Advisor(s): Dr. Adele Wright

Microstructure, Heat Treatment, and Applications of Inconel 718 in Aerospace

Biography: Kyle is currently enrolled as a first year student at Columbus State Community College working towards an A.S. in Mechanical Engineering Technologies with plans for a B.S. in Electro-Mechanical Engineering Technology through Miami University. Originally from Dayton, OH, Kyle grew up surrounded by Aviation landmarks and aspires to work in aerospace. He has previously obtained a B.A. of Music from Miami University, is certified for professional video calibration through the Imaging Science Foundation (ISF), a member of the National Association of Rocketry (NAR), and a member of the American Institute of Aeronautics and Astronautics (AIAA).

Abstract: Inconel 718 is a superalloy that has been in use for over 70 years. There are currently more than a dozen designated Inconel alloys produced by metal manufacturers with applications including furnaces, gas turbines, rocketry, and nuclear facilities. Heat treatment has been critical to the success of this alloy, as has an understanding of the microstructure evolution that occurs by altering the heat treatment. With the advent of additive manufacturing Inconel 718 has found continued viability into the future. This project will serve as an examination through existing research of various heat treatments and their applications in aerospace of Inconel 718.

Publications: None yet.

Lorain County Community College

Mystal E. Jackson

Junior, Chemistry
Advisor(s): Dr. Regan Silvestri

Uncovering the Recipe for Synthetic Mineral Water

Biography: Mystal Jackson has completed an Associate of Arts Degree at Lorain County Community College and will graduate in May 2020. She is currently pursuing an Associate's of Science degree at LCCC which she will complete in August 2020. Upon completion of her second Associate's degree, Mystal will continue her studies at Cleveland State University in pursuit of a Bachelor's of Science in Chemistry. Since 2017, Mystal has been conducting independent research at LCCC on the science of the flavor of whiskey under the direction of Professor Regan Silvestri. Her current research is in deformulation of mineral waters, which aims at formulating a recipe for synthetically produced mineral water. Mystal's goal is to work in Research and Development. Mystal is also an Artist and an independent business owner of Mysstyle Customs LLC.

Abstract: Mineral waters may contain various salts including sodium chloride, potassium chloride, calcium chloride and magnesium chloride. Furthermore, mineral waters may contain various sulfates and bicarbonates. Atomic Absorption (AA) spectroscopy and Inductively Coupled Plasma (ICP) spectroscopy are being used to identify and quantify the various minerals in selected commercially available mineral waters. Further, blind taste tests are being conducted on the mineral waters to identify user preference for flavor. Ultimately, a statistical correlation will be drawn between the analytical data and user preference, identifying what minerals are preferred for taste and in what quantities. Deformulation of the recipe for the best tasting mineral water will allow us to create our own synthetically formulated mineral water.

Publications: "Uncovering the Recipe for Synthetic Mineral Water", Mystal Jackson and Regan Silvestri, Proceeding from the N.A.S.A/Ohio Space Grant Consortium (OSGC) Annual Student Research Symposium, Volume XXVIII, April 3, 2020.

Cody C. Nackerud

Junior, Animal Science
Advisor(s): Dr. Regan Silvestri

Fractions of Flavors

Biography: Cody Nackerud grew up in Avon, Ohio. During high school he had started early college credit through Lorain County Community College. Achieved his Associate of Arts during his junior year of high school. Also, received his Associates of Science upon the year of graduation of high school in 2018. Cody started research with the Biology department in 2018. In 2019 he joined the research with the chemistry department being overseen by Dr. Regan Silvestri. He is currently working on many projects in both departments while being dull enrolled at Lorain County Community College and Ohio State University. He strives towards a Bachelor's Degree of Animals Science in Biology. Always looking to learn and further his degree with his end goal becoming a specialized surgeon in veterinarian medicine.

Abstract: Our research is focused on different alcohols that are flavored, such as cherrywood whiskey, moonshine made with bananas, and smoked whiskey. The flavor comes from the wood that the alcohol is aged in and the banana peels used in the moonshine. Once distilled above a certain proof, the alcohol, unfortunately, loses these important flavors as it becomes purified. The endeavor here is to capture the flavor in the end product distilled spirit. The discarded distillate portions will be collected and analyzed by a gas chromatography-mass spectrometer to identify the flavor compounds within each of the discarded distillate portions. The flavor compounds thus identified could then be reintroduced back into the finished distilled spirit, yielding a high purity distilled spirit that still has the desired flavors intact.

Publications: None yet.

Lorain County Community College

Ryan M. Palmer

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

Reduction of Voiding in Pb-Free Solder Joints on PCBs Processed in Varying Thermal Profiles of a Solder Reflow Oven

Biography: Ryan Palmer is currently finishing his Associate degree in Applied Electronics and working towards a Bachelor's degree in Micro Electro-Mechanical Systems. In the years leading up to college, he participated in the Brookside High school robotics program, where he worked with other students in a team to create many high-performance competition robots. Ryan entered college as a College Credit Plus (CCP) student knowing what profession he wanted to pursue. He had spent the last 6 years self-educating himself on electronic assembly and design with the help of online forums, youtube, and electronic project websites. With this prior knowledge, he has been able to better complete his college classes and work on many complex and fun projects. Last year, Professor David Astorino was impressed with his performance in his class and gave him the opportunity to work as a lab assistant in the electronics labs at LCCC. As he learns more about electronics fabrication and its many nuances, he views this project as an amazing learning experience.

Abstract: Lead Free (RoHS) solder is a common solder material used for the electrical and mechanical connection of components to a Printed Circuit Board (PCB) commonly found in consumer electronic equipment. This solder replaces the use of Lead (Pb) solder which is known to be carcinogenic and hazardous to the environment. Pb-free solder has several increased difficulties in the processing and manufacturability when compared to Pb based solder; primarily the dependency of a thermal profile for a solder reflow oven to reduce voiding in the Pb-free solder joints. Voids in solder joints are trapped chemicals and/or gasses that can cause the joint to become mechanically unstable after several thermal cycles and/or humidity cycles. The goal of this project is to study the effects of varying solder reflow temperature and time profiles when compared to the amount of voiding for a reflowed Pb-free solder joint.

Publications: None yet.

Blaine C. Thompson

Sophomore, Biology
Advisor(s): Dr. Kathryn Durham, Michelle Nudeck

Neutralizing Agent Against Cyanobacterium Toxin Microcystin

Biography: Blaine Thompson was born and raised in northeast Ohio. His father first introduced him into STEM whereby his older brother Corey furthered that interest by allowing Blaine to visit some of the laboratories that he worked in. Upon graduation from high school, Blaine then decided to attend Lorain County Community College and further participate in the Bowling Green State University Partnership working towards a B.S. in Biology. At LCCC, Blaine currently participates in the biotechnology lab under the guidance of advisors Dr. Kathryn Durham and Michelle Nudeck.

Abstract: Algal blooms have become a major public health concern within the past several decades. Although algal blooms are seen universally, our research is focused on the blooms in Lake Erie and the Sandusky Bay. These blooms are driven by two types of cyanobacteria: Microcystis aeruginosa and Planktothrix agardhii respectively. The underlying cause is excess runoff of nutrients from nearby farm fields post-fertilization. During bloom periods, these cyanobacteria release toxic amounts of the hepatotoxin, microcystin, which can cause permanent liver damage in living organisms exposed to the contaminated water.

Once ingested, microcystin binds and inhibits protein phosphatases 1 and 2A that are found within liver cells. These phosphatases are important for maintaining the cytoskeleton and when inhibited causes collapse and ultimate death of the cells. In response to microcystin exposure, the liver produces a molecule called glutathione which can also bind microcystin. Once bound by glutathione, the microcystin is converted into a nontoxic substance called mercapturic acid and renally eliminated from the body. Unfortunately, with exposure to high amounts of microcystin, the liver cannot produce adequate amounts of glutathione to neutralize the toxin.

At Lorain County Community College, the focus of our research is to create an antitoxin that will potentially treat individuals exposed to the toxin. In this study, human liver cells will be exposed to microcystin, and then treated with varying concentrations of glutathione along with other enzymes. This will determine the concentration of glutathione required to neutralize a set amount of microcystin entirely.

Publications: None yet.

Cincinnati State

Erin M. Weygandt

Sophomore, Mechanical Engineering Technology
Advisor(s): Dr. Michael Devore

Utilizing Nano-Technology for the Prevention of Fracture Caused by the Loss of Bone Density

Biography: Erin Weygandt is currently a freshman at Cincinnati State majoring in Mechanical Engineering Technology. She has restarted her educational pursuits after spending many years supporting her spouse through his active duty career in the Air Force while focusing on providing her children the skills needed to be successful in their own lives. During this time, Erin worked for the school systems in the cities her husband was stationed. She worked primarily with gifted students, students needing alternative settings, and as a substitute teacher. Erin believes that she learned more from her students than she could have ever taught them.

Most recently, Erin started a hobby business as an artistic blacksmith creating home décor out of a variety of metals and reclaimed wood.

A love of creating and working with different materials led to an interest in seeking her degree in Mechanical Engineering Technology with a focus on design. When a research assignment for one of her classes introduced her to the need for mechanical engineering in medical research and development Erin knew she had found a real passion.

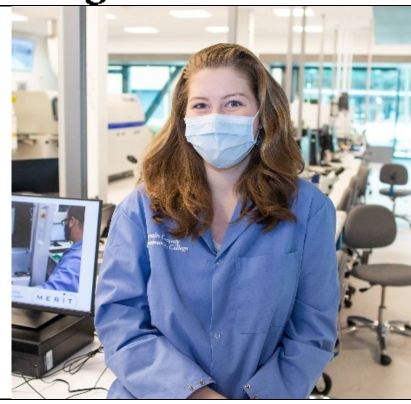
After graduating from Cincinnati State, Erin will be pursuing a position in research and development for orthopedic devices. She also hopes to continue her education by pursuing a bachelor degree in Bio-Mechanical Engineering.

Abstract: The loss of bone density increases the risk of bone fracture with the most common fractures occurring in the hip, wrist, and vertebrae. According to the International Osteoporosis Foundation studies show that a 10% loss of bone mass can double the chance of a fracture in the vertebrae and increase the risk of a fractured hip by 2.5 times. Utilizing Nano-Biomaterials and 3-D printing technology therapeutic medications can be directly deployed to locations at high risk of fracture. I will be researching the different types of modalities being used and the efficacy of these treatments.

Publications: None yet.

Lorain County Community College

Emily T. Williams



Junior, Microelectro Mechanical Systems
Advisor(s): Johnny Vanderford and Courtney Tenhover

A Study of Pb-Based Solder Fumes Effects on Exposed Manufacturing Workforce and Prevention Methods

Biography: Emily Williams is a second year Engineering Technologies student pursuing her Associate of Applied Science in Mechatronics Technology - Microelectro Mechanical Systems (MEMS) at Lorain County Community College. Growing up in Northeast Ohio, while enjoying long walks in the forest and along the beaches of Lake Erie, Emily became invested in the environmental impacts of daily life revolving around the health and sustainability of local ecosystems. With this in mind, she took advantage of Project Lead The Way (PLTW) classes and other computer science and engineering courses provided at Midview Highschool. Her love of technology was cultivated by teachers, such as Mr. Brian Wanosky and Mr. Paul Roby, who continue to encourage her path as a STEM student today. To continue to invest in the health and sustainability of the local ecosystem, as a freshman at Midview, Emily created the club 'Hats for Humanity' with the help of another influential teacher and advisor, Mrs. Courtney Miller, to create hats and scarves to those in need at local churches and soup kitchens. With her drive for helping others and her desire to create and conceptualize new ideas, Emily was drawn to the path of STEM, specifically microelectronics; where she is able to utilize her creativity and love for art in a field that can appreciate a creative approach to a more technical problem.
Working closely with the staff at LCCC, Emily continues to pursue Work-Based Learning opportunities at local manufacturing companies to gain experience in the MEMS field and grow a better appreciation of the industry and make a positive impact on the world around her.

Abstract: Lead (Pb) solder processing is a metallurgical process of electrically and mechanically connecting components to a printed circuit board (PCB) with the use of applied heat. Pb solder is a common metal alloy found in a variety of electronic applications. The Pb soldering process involves a phase change from solid to liquid at temperatures commonly exceeding 180 degrees C. Other materials processed with solder at elevated temperatures can include fluxing agents containing resin acids or ammonium chloride, fiberglass commonly found in FR-4 PCB laminate, and other chemicals that increase the solder's shelf life, tackiness, and thixotropic printability. Solder processing also involves the control and mitigation of fumes caused by the solder being in an energized liquid state, activated fluxing agents in an acidic state, as well as other heated chemicals. Common equipment used for this mitigation included ventilated hoods, fans with charcoal filters, and fume extractors with internal replaceable filters. This equipment prevents harmful effects to humans exposed to Pb fumes and other chemicals at processing temperatures. The goal of this project is to research the reported effects of not using solder fume preventative equipment by both quantifying and qualifying the effects as recorded in official documentation.

Publications: None yet.

Lorain County Community College

Andrea L. Zirkle

Junior, Associate of Science
Advisor(s): Dr. Regan Silvestri

Flavor Profile of Moonshine Homemade from Apples and Double Distilled

Biography: Mystal Jackson has completed an Associate of Arts Degree at Lorain County Community College and will graduate in May 2020. She is currently pursuing an Associate's of Science degree at LCCC which she will complete in August 2020. Upon completion of her second Associate's degree, Mystal will continue her studies at Cleveland State University in pursuit of a Bachelor's of Science in Chemistry. Since 2017, Mystal has been conducting independent research at LCCC on the science of the flavor of whiskey under the direction of Professor Regan Silvestri. Her current research is in deformulation of mineral waters, which aims at formulating a recipe for synthetically produced mineral water. Mystal's goal is to work in Research and Development. Mystal is also an Artist and an independent business owner of Mysstyle Customs LLC.

Abstract: Homemade moonshine prepared from fermented apples and double distilled was analyzed by gas chromatography-mass spectroscopy (GC-MS). The volatile compounds thus identified serve as a flavor profile of the spirit. As the moonshine has been fermented from apples, it was anticipated a-priori that the flavor profile would contain a wealth of pleasant aroma fruity esters. However, it was found that the flavor profile of the apple moonshine consists mainly of longer chain alcohols, butanols, pentanols and hexanols, which serve as off-flavors. Overall, it was found that the flavor of the apple moonshine is dominated by 3-methyl-1-butanol which imparts a fusel, alcoholic, and fermented flavor often described as pungent. It is hypothesized that the fruity ester flavors were unfortunately removed during the double distillation process, which brought the spirit to 170 proof.

Publications: 1."Flavor Profile of Moonshine Homemade from Apples and Double Distilled", Proceeding from Society for Applied Spectroscopy 63th Annual May Conference, May 22, 2019
2. "Flavor Profile of Moonshine Homemade from Apples and Double Distilled", The Ohio Journal of Science, Volume 120, No. 1, April 2020

Education Scholars

KENT STATE UNIVERSITY

Natalie T. Alfano

Senior, Adolescent to Young Adult (AYA) Math
Advisor(s): Dr. Joanne Caniglia

Temperature Changes & Slope

Biography: Natalie Alfano grew up in Brunswick, Ohio. She is currently a Senior studying Integrated Mathematics at Kent State University. While at Kent State University, Natalie enjoys being active in many organizations. She is the Co-President of Kent State Council of Teachers of Mathematics, has served on the Kent Student Education Association board, is a recipient of the Choose Ohio First scholarship program, and has worked as a Certified Math Tutor for many semesters. Her work as a math tutor has given her valuable insights into how students perceive math and how to reach struggling students. Natalie has always had a passion for education and mathematics. She hopes to share her love of mathematics with her students and help them to become excited about how math relates to the world around them.

Abstract: This lesson is designed to support the understanding of slope in the context of a real-world problem. This lesson plan is geared towards middle school students as they are being introduced to slope for the first time. However, this lesson could easily be adapted to other algebra courses. Students will learn about climate change and how the global annual mean temperature has changed by watching videos and using data from NASA. They will apply their knowledge about slope to determine the rate of temperature change during two different time periods and use this information to predict what the temperature will be like in future years. This lesson will be supported through the use of Desmos, as students can interact with the graph and use the line of best fit to determine the slopes. Using this program will allow for easy adaption to virtual or in-person learning. By the end of the lesson, students should understand how they can use the mathematical concept of slope to make conclusions about the global annual mean temperate and its changes.

Publications: None yet.

Trevor E. Bodine

Senior, Adolescent to Young Adult (AYA), Physics
Advisor(s): Dr. Todd France and Dr. William Theisen

Rocket Cars

Biography: At Ohio Northern University, I am a Physics major with an Applied Physics concentration, as well as a licensure for AYA Physics. I am currently a member of Colleges Against Cancer, Sigma Pi Sigma, and Phi Mu Alpha Sinfonia. I am the current treasurer for the Society of Physics Students and the current Vice President of Service for Kappa Kappa Psi. I am also the current operations, music, and production manager for WONB, Ohio Northern's own broadcasting service.

After graduation, I hope to remain near my hometown of Lima, Ohio, and find a physics teaching position. It would be my goal to have students interested in Physics every day and to increase enrollment in Physics classes at the school.

Abstract: My project is designed to go in tandem with learning about Newton's Third Law of Motion, but is flexible and simple enough to include into younger age groups. Students are tasked with making a "rocket car", consisting of cardboard, tape, a straw, and a balloon. These cars are to be oriented properly to travel across the classroom floor. Students will learn that the object would move in the opposite direction the wind is blowing, showing them a force pair.

Publications: None yet.

Lillian C. Brautigam

Junior, Mathematics (AYA certification) & Music Education
Advisor(s): Dr. Todd France & Dr. Tena Roepke

The Mathematics of Our Solar System

Biography: Lillian C. Brautigam is a Junior at Ohio Northern University where she studies both Mathematics with a concentration in an education certification of AYA Mathematics and Music Education (Multi-Age). Lillian is a member of the Ohio Collegiate Music Education Association where she serves as President, Tau Beta Sigma where she serves as the Vice President of Membership, and the Getty College of Arts and Sciences Student Advisory Board where she serves as an At-Large Representative and Secretary. She is also an active member of Kappa Mu Epsilon, President's Club, and many music ensembles on campus. Lillian also enjoys working in the ONU Mathematics and Statistics office, tutoring local students, and teaching private flute lessons. After graduation, Lillian plans to teach junior high or high school math near her hometown, New Bremen, Ohio.

Abstract: This lesson is geared toward seventh grade math students. This math lesson incorporates activities from the NASA lessons "How Big is Our Solar System?" and "Exploring Your Weight Across the Solar System." A key part of the seventh-grade math standards is learning and applying ratios and proportional relationships. Students will learn how to form a proportion in order to convert different measurements and weights from Earth to different planets in our solar system. Students will convert different measurements to different units, find their weights on different planets, and create scale drawings of the planets. Incorporating the NASA lessons into these state learning objectives allows the students to apply their new knowledge in a real-world situation. This lesson is geared to spark interest in the mathematics of space and our solar system.

Publications: None yet.

NORTHERN

Savannah E. Carter

Senior, Physics & Secondary Education
Advisor(s): Dr. William Theisen

Density as a Representation of Layers of the Earth

Biography: I am a Senior at Ohio Northern University, studying Physics as well as secondary education. Upon graduating in the Spring of 2021, I will be certified in Grades 7-12 in Physics, Chemistry, and Physical Science. Having always been skilled in the realm of science, I knew I wanted to help other people develop their skills in the field as well. I quickly found a laboratory research setting would not be where I saw myself in my future career. I have always had such a strong passion for being around people as an extrovert, which drew me to the classroom and working with students. I knew if there was any way I could help students further understand unique and complex topics, then I wanted to be a source of inspiration and encouragement. I am thankful to the Ohio Space Grant Consortium and Ohio Northern University for allowing me to explore science in the classroom, and further develop my teaching planning skills.

Abstract: Density is a basic concept of science which in which students must understand the relationship between mass and volume. Science and mathematics are often concepts which students fail to see the purpose or "bigger picture". They wonder why phenomena such as density impact their life or why they should care about them. In this middle school lesson, students combine the mathematical basis of the density formula with an understanding of how density resembles the layers of the Earth. Students will solve the density formula for several household liquids such as honey, dish soap, vegetable oil, etc. They will then predict which substances are most dense based on their calculations. The students can then test their predictions by putting all the substances in a graduated cylinder and watching them settle based on density. After students analyze their data and observations, they can draw conclusions and compare their finding to the layers of the Earth and how the layers differentiate based on density. In gaining a further understanding of the layers of the Earth, students can more fully grasp the characteristics of their home planet. Further studies could be completed with students to compare the density and composition of Earth with other planets to greater understand outer space as well. In combining mathematics, hands-on demonstrations, and real-world applications, the goal is for students to develop a more complete understanding of a complex scientific topics both here on Earth and beyond.

Publications: None yet.

Marietta College

Emma N. Christman

Junior, Biochemistry and AYA Education
Advisor(s): Dr. Tanya Judd-Pucella and Dr. Jim Jeitler

Exploration of the Elements and Space Craft

Biography: Emma Christman is a Junior at Marietta College majoring in Biochemistry and Adolescent Young Adult Education as well as pursuing a Teacher Leadership Certificate through the McDonough Leadership Program. In addition to pursing her academics, she is also very active on campus as president of the Marietta College Teacher Education Association, vice president of the Marietta College Chemistry Club, CRU leader, and active member of the Kappa Delta Pi, Alpha Lambda Delta, and Omicron Delta Kappa honor societies on campus. Emma has worked with a number of local schools and organizations, such as GoPacks4Kids which provides food on the weekends to elementary and middle school children, and is continuously seeking out new opportunities to learn more about the fields of science and education.

Abstract: Students learn in a variety of different ways including hands on experience, observation, self-exploration, auditory, visual, collaborative projects, as well as much more. It can be difficult for students to fully comprehend and apply information until experienced and encountered in multiple different ways. The purpose of this project is to make meaningful connections between the periodic table of elements and rocket fuel used in space craft. Students will be introduced to the following: the history of different combustible elements (such as hydrogen seen in the Hindenburg Disaster of 1937), real world application of elements in the rocket fuel of spacecraft, and some of the women who helped pave the way for space exploration. By making connections between spacecraft and the periodic table of elements, students will be able to better understand chemistry by changing their perception of the elements from purely abstract to more concrete thought.

Publications: None yet.

Craig A. Jenkins

Senior, Early Childhood Education

Advisor(s): Dr. Chad Malcolm, Dr. Rochelle Berndt

Rocket Races

Biography: Craig Jenkins is an Early Childhood Education major at Baldwin Wallace University. Currently completing his Clinical Practice teaching 4th grade, Craig is a non-traditional student who returned to complete his degree in education after a 20-year hiatus from college course work. The husband and father-of-3 finished a successful 15-year career in restaurant management in 2018 to pursue his lifelong desire to become a teacher. He attributes the inspiration for his career change to being an active participant in his own children's educational journeys. His academic endeavors have been fruitful since his return to the academic world. Craig earned an Associate of Arts degree from Cuyahoga Community College in May 2019, graduating summa cum laude and a member of Phi Theta Kappa honor society. At Baldwin Wallace University, he holds a GPA of 3.952 and was inducted to the international honor society in education, Kappa Delta Pi, in October 2020.

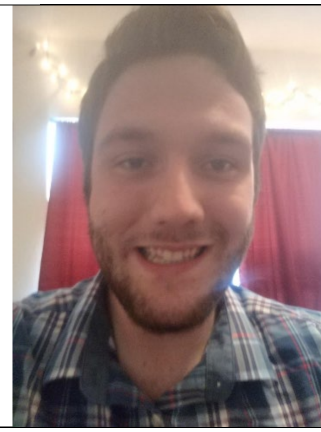
Craig also serves as the Director of Children and Youth Ministry at St. Barnabas Church in Bay Village, Ohio. Additionally, over the past decade, he has served the students of Bay Village in numerous volunteer leadership positions, including Westerly Elementary PTA President, PTA Council Student Advocacy Chair, STEM Fest Event Coordinator and 8 years of various executive board positions.

Personally, he enjoys spending time with his family, recreation on Lake Erie, and is an avid coffee drinker.

Abstract: An extracurricular activity will be formed in cooperation with Westerly Elementary School in Bay Village, Ohio for up to 20 students in third or fourth grade. Students will engage in the Rocket Races activity found in the NASA Rockets Educator Guide (pp. 56-62). Through the activity, students will investigate Newton's third law, while developing abilities of technological design and skills necessary to do scientific inquiry.
Students will meet for three sessions:
Meeting 1) - Initial instruction and construction of vehicles
Meeting 2) - Practice races, data tracking, and vehicle modification
Meeting 3) - Series of competitive races and sharing of best practices
It is hoped that this introduction to rocket power spurs further interest in the school district's science program. Bay High School is represented by a rocket mascot, and the high school science club mentors the younger students at Westerly each year for the elementary school's science fair (STEM Fest). Participation in that program will be encouraged to allow students to further develop their understanding of the concept or explore other areas of interest.

Publications: None yet.

Derek G. Joy



Senior, Integrated Science Education AYA
Advisor(s): Karen Henning, Kathleen Cripe

A Picture is Worth a Thousand Words: NASA's Database on the Planets

Biography: Derek is a Senior Integrated Science Education major completing his education at Youngstown State University. He is from Lisbon, Ohio. He wants to teach any discipline of the physical sciences at the high school level and coach football. He is a member of Youngstown State's Honors College, the College of Education's Dean's Dozen, and is a Choose Ohio First Research Scholar. He works as a tutor on campus for all varieties of STEM courses and loves the challenge science education in todays' classroom presents.

Abstract: Students will use the information collected by NASA and other stellar databases to determine conclusions about planets in our solar system and celestial objects beyond. This includes diagram reading, analysis of surface conditions, environmental factors, and chemical makeup. Students will use this information form conclusions about the viability of travel to those planets and in the solar system, and if object beyond it could theoretically support life even if they currently do not. The goal of the lessons is to have students create data-driven conclusions based on their reading and analysis.

Publications: 1. 3-D Printing Us: Humans of Tomorrow (YSU CROW)
2. Diffusion Performance of a 3D Printed Renal Dialysis Filter (Choose Ohio First)
3. Development of 3-D Printed Plastics and Fibers to Create Ballistic Protection (Choose Ohio First)
4. Removal of Bacteria Using Modified Chitosan Beads (Choose Ohio First)

KENT STATE UNIVERSITY

Margaret M. Kaminski

Senior, Integrated Science
Advisor(s): Julie Wilcox

We Are Going On A Road Trip

Biography: I am a senior at Kent State University in Adolescent and Adult education with a concentration in Integrated Science or just a fancy name for high school science teacher. I have always had a love for science even from a young age. I come from a long line of nurses and scientists. My grandma was a dietician, and my grandpa was a microbiologist. My mom became a nurse and my sister quickly followed in her footsteps. So, science has always been something that has been in my house. I wasn't a huge fan of medical things, so I chose to go a different route. I thought for a while I may want to become an astronaut, but I couldn't give up my love for teaching. Space Grant Consortium gave me both my loves in one place. It has been so fun to take my passion space and work it into my classroom. I have a deep passion for finding cool and exciting ways to engage my students in classes where they may normally struggle. It has been such an honor working with people at NASA and having this scholarship.

Abstract: In the future we may have to leave our planet and find a new Earth to inhabit. Exoplanets are our best bet for finding an inhabitable planet for humans. In this project I ask my students to find an exoplanet that may be suitable for life, design a space craft for travel to said exoplanet and discuss what life in space will be like. Using the NASA website, I will have each group of students choose an exoplanet and calculate how long it will take us to get there. After they have chosen a planet, they can begin designing their space crafts for their journey. I ask students to either draw or represent their crafts in a certain for a final presentation. There are many different parts to designing the space craft. We as a class are going to discuss artificial gravity and other outer space myths. Finally, my students will get to choose certain things on their crafts like, freeze dried food or farmed food each having a clean positive and negative with them. This entire project will end with a class presentation of their research.

Publications: None yet.

Marietta College

Kaitlyn D. Lafferty

Junior, Mathematics AYA Education
Advisor(s): Dr. Cathy Mowrer

Hidden Figures, John Glenn, and How the Math We Learn in High School is the Foundation for Modern Marvels

Biography: Kaitlyn Lafferty grew up in New Concord, Ohio, which also happens to be the hometown of the astronaut John Glenn. Because of this, most of Kaitlyn's childhood revolved around learning about space and science. Kaitlyn always knew she wanted to be an educator, but it wasn't until college that she realized that other students did not see science and space as an attainable goal like it was presented to her. Thus, a passion was born. She is currently a senior projected to graduate in May, 2021. Her goal is to teach High School Math, and eventually go into Math Coaching.

Abstract: Hidden Figures brought to light the many mathematical wonders that were accomplished by the women of color behind the John Glenn Mission. Since the anniversary falls in February, this lesson will be a combination of Black History and the mathematical feats. While the vast majority of the math computed was above a high school level math class, this lesson will focus on the fundamental skills that students learn in high school, and how that can lead to great scientific accomplishments. Students will be able to learn about why math can be such an important skill, but most of my students are females, several of which who are considering stem related college majors. The overall hope of the lesson is to not only educate students on some amazing people, but show them that no matter who they are, they can be in a stem field. As briefly mentioned in the bio above, my hometown shaped my confidence in being able to be a math major as a woman, and I hope that this can spark some of that confidence in my students.

Publications: None yet.

Grace S. Lockwood

Junior, Middle Childhood Education Math and Science
Advisor(s): Dr. William Jones

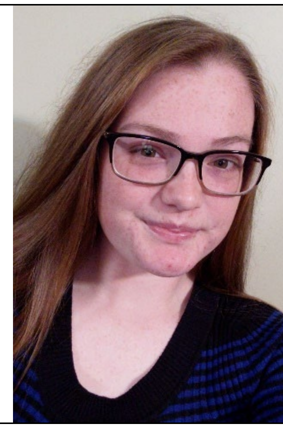
Gravity and its Relation to Planets Orbits

Biography: Grace Lockwood grew up in Southern Africa as a missionary kid. Her family moved to Zimbabwe when she was 1 and lived there for six years before moving to South Africa. Throughout this time her mom volunteered in different underprivileged schools in the area as a teacher. This inspired Grace to want to use teaching as a means to care for people around her. Currently, Grace is a Junior Middle Childhood Education major at Cedarville University with concentrations in Math and Science. After all of Grace's experiences overseas she sees the immense value in education and its ability to remove you from the poverty trap. Grace is looking to combine her love for Math and her passion for youth to become a Middle School Algebra teacher. Grace is looking to make a difference in the lives of her students by inspiring them to never give up, pushing them to try their best, and encouraging them in their out of school lives. Passing on knowledge is only a part of what it means to be a teacher, for Grace, it is much more about the students and with that she is hoping to leave a positive lasting impact on each of her students.

Abstract: This lesson is designed for Middle school students helping them to better understand the basics of physics and how they relate to the planetary systems. Students will use water balloons and a string to do a hands-on experiment enabling them to better understand gravity and the orbits of planets. They will have the opportunity to simulate planetary motion with themselves as the planet. This will allow them to grasp an understanding of the gravitational pull between two objects and how orbit of planets relates to gravity. In this lesson students will practice their experimental method through collecting data and determining a specific escape velocity.

Publications: None yet.

Josephine M. Palmer



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

Incorporating the Engineering Design Process in the Classroom

Biography: Josephine Palmer is currently a Junior at Ohio Northern University majoring in Engineering Education while minoring in Mathematics. During her time attending Ohio Northern University, she has been involved in the American Society for Engineering Education (ASEE), Marching Band, and Campus Scouts. She has spent time tutoring local Middle School students and is active in her local community. Ever since she was young, she was involved in Scouting, namely Girl Scouts and Venture Crew, where she has received her Girl Scout Gold Award, worked at a Cub Scout day camp for six years, and worked at two different Boy Scout summer camps in which she held a supervisor role at both camps.

This passion and drive for teaching and inspiring the younger generations is a large factor into Josephine's decision to pursue a career in Engineering Education. It is her belief that the younger generations need that inspiration and influence starting from a young age to build that motivation to learn and find creativity to explore deeper and aspire to do great things in the world.

Abstract: Within this activity, the students will use the engineering design process to think through how to build a makeshift rocket. The students will be given a wide variety of materials that are able to be used, and they will have to work together to brainstorm, sketch, design, and create a solution. Their final product will be tested, results calculated, revised, and then tested again. They will be determining how position, velocity, acceleration, and time are all related to each other and how they all can affect one another. The overall arching purpose of this activity is to get the students to use all six steps of the engineering design process and see, in practice, how they can implement the process into any problem or task they are working on.

Publications: None yet.

Emily A. Sukalac

Post Baccalaureate, Master of Arts Education (Mathematics)
Advisor(s): Jacqueline Morris Ph.D.

Finding Math in Every Space

Biography: Emily Sukalac is a Graduate student at Baldwin Wallace University obtaining her Master of Arts in Education with a concentration in Mathematics. She grew up in Jefferson, Ohio in Ashtabula County. Throughout her undergraduate years, Emily was very involved on campus and would volunteer whenever she could. Some organizations that she was involved in include Rotaract (the collegiate version of Rotary), STEM Scholars, BW Orientation Leader Staff, Alpha Gamma Delta where she served as Chapter President, and the Boys and Girls Club of Cleveland. It was through the Boys and Girls Club that she found her love of being in the classroom and helping kids, which pushed her to pursue a master's in education.

Her passion to help and influence children is one of the main reasons that she has decide to pursue education. The two reasons that Emily loves math are, its importance in many different aspects of life and that it is an universal language that everyone can understand. She wants to create safe spaces for each of her students and stress the importance that not every student learns in the same way. Emily hopes to pave a pathway that excites students about math and the endless possibilities that it can take them to.

Abstract: This lesson is based on Ohio's Learning Standards for a high school mathematics class. Students will learn how to convert different measurements that take place in space, such as miles to lightyears, the weight of something on Earth compared to its weight on the moon, the temperature of the sun in Celsius and Kelvins, etc. Each student will be assigned a packet of problems in which each answer will match to a corresponding letter. At the end of the packet there will be a spot where the students will need to use the letters they found and place them in the correct spot. When the students finish this, it will then reveal the name(s) of the women who helped with the mathematics of John Glenn's flight. After, we will go over the history of these women and what they did.

Publications: None yet.

Jenna L. Vollmar

Senior, Early Childhood Education
Advisor(s): Laura Dell, Ed. D

The Defense Mechanism Of Animals

Biography: Jenna Vollmar grew up in Liberty Center, Ohio. Currently, she is a senior at the University of Cincinnati. In addition to majoring in Early Childhood Education, she is a member of the Arabic Language and Culture club, Early Childhood Education club, she leads a small group at her church and she volunteers weekly at the church children's ministry. While at the University of Cincinnati, Jenna enjoys spending time working at a local school as an aide. Jenna's interest in early childhood education began in early high school but was pursued sophomore year of college. Jenna is passionate about being an advocate and helping all children. In the classroom, she strives to make learning fun and exciting!

Abstract: This lesson is designed for grades second and third. The focus is why animals have defense mechanisms and how that is important for survival. Part one of this lesson focuses on student's understanding as to what defense mechanisms are. Students will read a book and watch a video about this. The second part of this will include a presentation and an instructional activity. This is fun and exciting for grades second and third to learn about animals and their defense mechanisms. By the end of the lesson(s), the students will be able to understand the common defense mechanisms and they will be able to create one of their own to show to the class.

Publications: None yet.

Alexa E. Wallbrown

Senior, Early Childhood Education
Advisor(s): Shannon Logsdon

Race to the Moon

Biography: Alexa Wallbrown is a Senior at Kent State University studying Early Childhood Education. Wallbrown grew up in Akron, Ohio, and grew a love for learning and teaching at a young age. She began teaching her junior year of high school and has continued on into student teaching through her studies. Since attending Kent State University, Wallbrown has obtained leadership roles for the Kent Student Education Association and has become an active volunteer for many education-based organizations. Alexa believes her teaching philosophy will help her future students find a love for learning. Her philosophy is centered around classroom community which is the perfect foundation and environment for learning. Outside of the classroom, Wallbrown enjoys the great outdoors as she loves to hike, camp, and travel.

Abstract: For my lesson plan, I will be teaching in a 3rd grade classroom. Some of the students will be remote so during this lesson there will be accommodations. The lesson starts out putting ourselves back in time during the Space Race. Our goal is to get to the moon and we need to build a rocket to get there. Each student will build their own rocket since they are unable to work in groups due to the global pandemic. After the construction, the students will have the chance to blast off their rockets. We will discuss the space race, the properties of their rockets, and the moon landing during this lesson. For the assessment, we will need to get back home and share the news. The students will create a news article about their experience making the rocket, what they saw in space, and what they learned.

Publications: None yet.

Adison M. Wright

Senior, Middle Childhood Education, English Language Arts & Social Studies
Advisor(s): Dr. Romena M. Holbert

Effects on the Body During Space Exploration

Biography: Adison Wright is an undergraduate student majoring in Middle Childhood Education at Wright State University. She was raised in Winchester, Ohio, and graduated from high school at North Adams High School in Adams County, Ohio. She continued her education at Wright State University, where she is earning a Bachelor of Science in Education and will graduate in May 2020. Throughout her undergraduate years at Wright State, Adison has been active member of the Wright State Chapter of Habitat for Humanity and Wright State's Honors Program, along with earning a spot on the Dean's List every semester. Alongside her studies, Adison has been an active member of the College of Education and Human Services Dean's Student advisory board since the spring of her freshman year. Since then, Adison has been elected as vice president of the Dean's Student Advisory Board and is responsible for student engagement and retention. After she completes her Bachelor's Degree this spring, Adison plans on pursuing a Master's in Middle Childhood Education at Wright State University.

Abstract: Cross-curricular education is essential for student comprehension for more complex topics. When discussing space exploration, the effects of microgravity and space radiation on the human body can be hard to understand. Therefore, this project integrates both scientific research and creative writing to provide a more holistic educational experience for middle grade students. Students will perform in-depth research on space exploration and its effects on the human body. After the research is conducted, students will write a series of mock journal entries from the perspective of an astronaut experiencing these side effects. Writing from a mock first-person perspective allows the students to more closely relate to their scientific research and develop their research and narrative writing abilities. This project is designed to be utilized in both science and English language arts classrooms for middle grade students.

Publications: None yet.