Cleveland State University

2024 UNDERGRADUATE RESEARCH POSTER SESSION

Student Center Atrium

SEPTEMBER 19

NOON–3 P.M.

CSU | Office of Research

2024 Undergraduate Summer Research Award Poster Session

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*McNair Projects

Drivers of Dissolved Organic Matter in Reservoir Ecosystems

College of Arts and Sciences

Student Researcher: Alicia Stemberger

Faculty Advisor: Ruchi Bhattacharya

Abstract

Dissolved organic matter (DOM) is a major factor influencing the water quality and trophic status of inland lakes and reservoirs. However, DOM quantity and sources and its effect on reservoir water quality is largely understudied. Reservoirs are ubiquitous and widely used as a source of drinking water and recreation (e.g., fishing and swimming). The lack of information regarding DOM dynamics precludes the effective management of this critical water resource. To address this issue, we used a meta-analysis approach to collate existing DOM data from reservoirs across several states in USA and explored their key drivers. We collected data on dissolved organic carbon concentration (DOC), DOM quantity assessed via absorbance at 350 nm wavelength (a350) and, specific UV absorbance (SUVA254) as a measure of aromaticity. Watershed and reservoir characteristics, such as land use, watershed and reservoir area, and reservoir depth were assessed via geospatial datasets (e.g., NLCD, HydroLakes and HydroBasins). We found that DOC concentrations, humic (a350), and aromatic (SUVA254) DOM were highest in reservoirs with larger watersheds dominated by forests and wetland in North Carolina and lowest in agricultural reservoirs in Midwest USA. Within the agricultural reservoirs, % crop vs. pastures in watershed also drove DOM dynamics with lowest DOM values in most crop dominated reservoirs in Indiana. We show that there are big geographical areas where studies can be extended. Future research on the patterns and process driving reservoir DOM cycling will yield optimal water quality management that will support the growing demand for clean water supplies.

Sensitivity of the Lateral Line System of African Clawed Frogs (Xenopus laevis): Ability to Distinguish between Nearby, Paired Wave Sources

College of Arts and Sciences

Student Researchers: Logan Lundblad and Julia Rigaud

Faculty Advisor: Jeffrey Dean

Abstract

African Clawed Frogs remain in the water throughout their adult life; thus like many other aquatic amphibians they possess a lateral line system. The lateral line system allows them to sense water movements, like those produced by their prey. This study explores the acuity of the lateral line by comparing the response of the frogs to a single stimulus and to two simultaneous stimuli presented at different separations. Wave stimuli were produced by briefly dipping plastic rods into the water. Response parameters of interest were frequency and accuracy of turning. Initial observation suggested that when two stimuli were close together, frogs often swam between the two. In contrast when two stimuli were far apart frogs often accurately swam towards the direction of one stimulus. When they were very close double stimuli were often treated like a single stimulus. With somewhat greater separations frogs chose one or the other, but the presence of the second stimulus biased their turns. The limited data suggests for nearby double stimuli the frog's brain takes longer to process the stimuli and the neural coding of the two directions interact.

Assessing Water Quality Variability and Optical Gradients in Sandusky Bay and Lake Erie Through Remote Sensing

College of Arts and Sciences

Student Researcher: Madellein Lemieux

Faculty Advisor: Brice Grunert

Abstract

Sandusky Bay is formed at the mouth of the Sandusky River located on Lake Erie's western basin. Heavily influenced by human activity, Sandusky Bay is known for its eutrophic waters that lead to cyanobacterial blooms in the summer months. Similarly, the Western Basin of Lake Erie experiences cyanobacterial blooms due to excess nutrient loading into its waters. Complex biogeochemical processes occurring in these waters are analyzed through the use of remote sensing equipment such as aircrafts, satellites, or drones. Additionally, various optical parameters are collected along the water column using submersible equipment. Parameters of specific importance to this study include average chlorophyll (ug/L), turbidity, and backscattering. Defined as the amount of light of a particular wavelength reflected from the surface back to the observer or sensor, backscattering offers a closer look at the interactions between each of the parameters studied. It is assumed that backscattering spectra can be well described using a single mathematical model, a power law, though in many locations across Lake Erie, this has not been found. This limits our ability to accurately observe specific aquatic components that impact water quality from satellite sensors. Data describing the variability of backscattering signals related to average chlorophyll and turbidity are analyzed here to illustrate how single wavelength estimates are limited in their ability to describe biogeochemical variability, and how a deeper understanding of optical variability associated with specific optical constituents is needed to improve satellite observations of water quality in Lake Erie and beyond. Our findings also suggest that alternative backscattering models are likely needed to improve remote estimation of water quality and associated biogeochemical constituents in optically complex inland and coastal waters.

Kinetic Liver Metabolic Adaptations to Fasting

College of Arts and Sciences

Student Researchers: Kadaia Williams and Patrick Ebeigbe

Faculty Advisor: Roman Kondratov

Abstract

Hepatic steatosis is the abnormal accumulation of fats in the form of neutral lipids called triglyceride (TAG) in the liver. This can negatively affect the liver's structure and function, such as lipid droplets accumulating in non-alcoholic fatty liver disease (NAFLD). Fasting offers many metabolic benefits but interestingly induces hepatic steatosis via unclear mechanisms. We investigated the mechanisms contributing to this by evaluating the time-dependent changes in the mRNA expression of TAG metabolism enzymes. We found that 6 hours of fasting was sufficient to induce significant changes in the expression of several genes involved in TAG metabolism. These include liver fatty acid transport (*Slc27a2*), TAG synthesis (*Lpin1* and *Gpat4*), and lipid storage genes (*Plin2*). Gene expression by other TAG synthesis genes (*Dgat 1 and Agpat1*) were unchanged or decreased in response to fasting. TAG content was also evaluated by staining hepatocytes for lipid droplets. We observed increased accumulation of lipid droplets following the duration of fasting, with significant accumulation observed as early as 6 hours. Thus, we conclude that changes in the expression of several TAG metabolism genes directly correlate with liver lipid droplet accumulation. This lipid accumulation in the liver might contribute to fasting hepatic steatosis. We propose that targeting the expression of one or more TAG metabolism genes may prevent fasting hepatic steatosis.

**Supported by the McNair Scholars Program*

Using an ADCP in Reintroducing Freshwater Mussels (Unionidae) to the Cuyahoga River

College of Arts and Sciences

Student Researchers: Layla M. Seder and Rachel A. Elder

Faculty Advisor: Robert A. Krebs

Abstract

An Acoustic Doppler Current Profiler (ADCP) analyzes water currents, sediment movement, and stream depth by sending high-frequency sound pulses that reflect off moving particles. This study involved stationary and looping bed tests, as well as cross-stream transects, to gather detailed measurements at five river sites suspected to contain mussel habitat. Precision of GPS mapping geographical coordinates derived from a Leica Zeno GG04 rover. Results indicated that beyond its primary function, data derived from the ADCP can be utilized to effectively map flow velocity, bathymetry, and flow direction, thus aiding in identifying how rivers change over time, which should become a critical component of habitat models for mussel introduction. Notably, bathymetry and flow velocity graphs revealed that slower water flows, which are thought to provide more favorable conditions for mussels, do not always correspond with river depth, suggesting that flow models can improve the prediction of sustainable habitats.

Effects of Flow velocity on Sediment Type and Potential Mussel Habitats

College of Arts and Sciences

Student Researchers: Maxwell C. Potter, Leo A. Fasolo, and Layla Seder

Faculty Advisors: Nayte D. Senn*, Kyra J. Bassett*, and Robert A. Krebs

Abstract

Mussels have suffered significantly in the lower Cuyahoga River for a long time. As efforts are made for reintroduction, habitat viability must be assessed. Different mussel species require specific habitats based on stream flow velocity as well as substrate type. To identify the best locations for a viable introduction a connection between the flow velocity of the river and substrate type was sought. Using an Acoustic Doppler Current Profiler (ADCP) stream flow can be measured along given transects. It is then possible to collect substrate data along these transects by measuring the percentages of different sediment sizes at specific points. By comparing data on flow and substrate, suitable mussel habitats may be better predicted. So far, the results have been inconclusive in linking flow rate to a certain sediment size. Some minor trends have been seen connecting low flow to a siltier substrate however more data and analysis are needed to make a statistically significant claim.

**Cuyahoga Valley National Park*

Examination of TbRAP1 and TbCactin Interaction Interface

College of Arts and Sciences

Student Researchers: Tereze Vevere and Elaina Casteel

Faculty Advisor: Bibo Li

Abstract

Trypanosoma brucei is a protozoan parasite responsible for human African trypanosomiasis (HAT), or Human African Sleeping Sickness. Transmitted by the Tsetse fly in sub-Saharan Africa, this parasite evades host immunity through antigenic variation, periodically changing its major surface antigen, variant surface glycoprotein (*VSG*). This strategy allows *T. brucei* to persist in the host by avoiding immune detection. The parasite has over 2,500 *VSG* genes located near telomeres (chromosome ends), but only one *VSG* gene is expressed at a time, a process known as monoallelic expression, which is crucial for persistent infections.

Our lab has previously shown that *Tb*RAP1, a telomere-associated protein in *T. brucei*, is essential for regulating VSG expression and VSG switching. In earlier research conducted in Dr. Li's lab, a yeast two-hybrid (Y2H) screen using a *Tb*RAP1 fragment containing its Myb domain, linker region, and RRM domain as bait identified *Tb*Cactin as a *Tb*RAP1-interacting candidate. *Tb*Cactin has been implicated in RNA splicing, as it is a subunit of the *T. brucei* spliceosome. Although its precise functions are not fully understood, *Tb*Cactin's involvement in RNA splicing underscores its importance in parasite biology.

Understanding the interaction between *Tb*RAP1 and *Tb*Cactin is crucial for gaining insights into the mechanisms underlying antigenic variation. By investigating how these two proteins interact, we can better understand their roles in regulating *VSG* expression and potentially identify new targets for therapeutic strategies to combat African sleeping sickness.

Determining DNA recombination Pathways Responsible for Telomeric and subtelomeric Recombination events in T. brucei Cells Depleted of Telomere Proteins

College of Arts and Sciences

Student Researcher: Elaina Casteel

Faculty Advisor: Bibo Li

Abstract

Trypanosoma brucei is a protozoan parasite that can regularly change its major surface antigens (VSGs) through both transcriptional regulation and DNA recombination, thereby effectively evading the host's immune response. VSGs are expressed exclusively from subtelomeric VSG expression sites in a strictly monoallelic manner, and our lab has shown that telomere proteins are important regulators for VSG monoallelic expression and VSG switching. *T. brucei* cells depleted of *Tb*TRF or PolIE also exhibit elevated levels of telomeric C-circles, a hallmark of telomeric recombination. However, depletion of PolIE leads to longer telomere 3' overhang while *Tb*TRF depletion results in loss of telomere 3' overhang. Therefore, the underlying mechanisms of how *Tb*TRF and PolIE suppress telomeric DNA combination appears to be different, and we speculate that different recombination pathways may be involved in telomeric/subtelomeric recombination events in *Tb*TRF- and PolIE-depleted cells. While Homologous Recombination (HR) frequently mediates VSG switching, it is unknown whether Microhomology-Mediated End-Joining (MMEJ) is also an important pathway. In addition, whether HR and MMEJ are required for telomeric and subtelomeric recombination in *Tb*TRF- and PolIE-depleted cells is unknown. RAD51 and BRCA2 are key players of the HR pathway, while DNA Ligase I is required for MMEJ. We are generating *T. brucei* strains lacking these recombination factors and will examine whether depletion of *Tb*TRF and PolIE in these backgrounds leads to reduced level of telomere/subtelomeric recombination events.

Investigating the Interactions Between Trypanosoma brucei PolIE and TRF Through Yeast-2-Hybrid Analysis

College of Arts and Sciences

Student Researcher: Jillian Gady

Faculty Advisor: Bibo Li

Abstract

Trypanosoma brucei, a protozoan parasite, causes Human African Trypanosomiasis (HAT), a deadly disease transmitted by the Tsetse fly. *T. brucei*'s ability to evade the host immune system through antigenic variation—periodic changes in its major surface antigen, variant surface glycoproteins (VSGs)—makes it difficult to eliminate and complicates the development of vaccines and effective treatment. *VSG* genes are located at subtelomeric regions of *T. brucei* chromosomes. Telomere proteins suppress VSG switching and play essential roles in VSG monoallelic expression, two key aspects of antigenic variation in *T. brucei*. Understanding these processes could lead to new therapeutic strategies against HAT by targeting *T. brucei*'s antigenic variation mechanisms.

T. brucei PolIE and TRF are telomere proteins that have been shown to suppress VSG switching by maintaining telomere and subtelomere stability and integrity. In this experiment, the interaction between these two proteins are being investigated. It is already known that these proteins are part of the same protein complex, but their specific protein-protein interface is unknown. This is being tested using a yeast-2-hybrid analysis with *Tb*PolIE as the prey protein and *Tb*TRF as bait protein. After cloning *Tb*TRF and *Tb*PolIE into yeast expression vectors, they are transformed into a yeast reporter strain and a western blot and liquid assay are used to investigate *Tb*TRF and *Tb*PolIE expression and interaction, respectively.

Associations between street-level greenness and firearm violence in Cleveland, Ohio

College of Arts and Sciences

Student Researcher: Emily Leininger

Faculty Advisor: Zihan Lin

Abstract

Gun violence is a serious security issue in the United States. Cleveland experiences particularly high incident rate. This study investigates the relationship between street-level greenery and firearm violence in Cleveland from 2017 to 2023. We analyzed Google Street View (GSV) images and Gun Violence Archive (GVA) data to assess how different types of street vegetation—tall (e.g., trees) and short (e.g., grass, shrubs)—affect the occurrence firearm violence. Socioeconomic factors such as poverty rate, unemployment rate, low education rate, house vacancy rate, and population density were also included, using data from the 2022 American Community Survey (ACS) at block group level.

We performed a case-control analysis, identifying firearm incidents as cases and establishing control locations within 1 km buffers around these cases. The ENet deep learning algorithm was employed to classify tall and short vegetation in the GSV images. Conditional logistic regression (CLR) was applied to examine the impact of street greeneries on firearm violence, accounting for socio-demographic factors.

Our analysis revealed significant findings: a 1-SD increase in tall vegetation was associated with a 43% reduction in the odds of firearm incidents, while a 1-SD increase in short vegetation was linked to a 56% reduction. This study underscores the potential of both tall and short street greenery in reducing gun violence and offers valuable insights into how urban green spaces can be utilized to mitigate firearm violence in urban areas.

Restoration of Native Plant Communities in Meadows

College of Arts and Sciences

Student Researchers: Olivia Pira and Keri Plevnaik

Faculty Advisor: Emily Rauschert

Abstract

Ecological restoration is the rehabilitation of a previously degraded piece of land commonly destroyed through urbanization, agriculture or industry. Meadows are beneficial to our ecosystem through the services they provide such as creating a rich habitat for plants, animals, pollinators, and they help with water regulation and nutrient retention. My research is the continued work of Keri Plevniak, who previously studied the initial restoration of Observatory Park in 2016 and the post-restoration survey in 2017 and 2018. The meadow at Observatory Park was once a monoculture soybean field, which was later purchased seeded and restored by Geauga Park District. The North Carolina Vegetation Survey Protocol was used to resurvey the meadow and monitor the progression of native plant growth for both the broadcast-seeded and drill-seeded plots. Our hypothesis was that the meadow's biological richness will improve over time with more native species from the seed mix appearing since its initial restoration. Overall, it was observed that the meadow restoration was successful, and there were significant improvements in both the biological richness (Shannon index of 4.0 compared to previous research Shannon Index of 2.3) of the meadow and the appearance of new species from the seed mix. These findings coincide with other restoration projects that have been conducted regionally, where some of these benefits develop over time and results are not evident in the first year of restoration.

Purification of Methanococcus jannaschii Dihydroorotase and Co-crystallization with Ligands

College of Arts and Sciences

Student Researchers: Ella Bair and Allison Wintz

Faculty Advisor: Jacqueline Vitali

Abstract

During the de novo pyrimidine nucleotide biosynthesis, a reversible reaction takes place, in which N-carbamoyl-L-aspartate is converted to L-dihydroorotate and vice versa. The enzyme which catalyzes the reaction is Dihydroorotase (DHOase). The conversion of N-carbamoyl-L-aspartate to L-dihydroorotate is important for biological metabolism. Therefore, it plays a role in metabolic diseases in humans. In this experiment, DHOase from the archaeon *Methanococcus jannaschii*, was purified and co-crystallized with ligands, in order to understand its mechanism of catalysis. The archaeal model was used because it shares multiple cellular characteristics with eukaryotes, including the presence of DHOase. The crystals of the complexes will allow for the structures to be determined by X-ray crystallography. The purification experiments included an ammonium sulfate precipitation, a heat step and chromatography. The crystallizations were performed with the hanging drop method. Five, 24 reservoir, crystallization trays were used to test different conditions of pH and chemical concentrations in a gradient. The reservoirs were prepared and a small amount of protein, ligand, and reservoir solution were placed on a coverslip and placed upside down on top of each of the corresponding reservoir wells. The crystallization trays were evaluated the following weeks and crystals were observed under various conditions. The crystals will be used to determine the structures of the complexes. The structures will provide insight on both the mechanism of catalysis and how the inhibitor binds to the protein. Dihydroorotase is an enzyme used to develop cancer treating chemotherapy drugs. The structure of this protein with ligands will help with further investigations in human studies and treatments for cancer.

Understanding the evaporative enrichment of stable carbon isotopes in natural waters

College of Arts and Sciences

Student Researcher: Rushi R. Viradiya

Faculty Advisor: Fasong Yuan

Abstract

The research focuses on understanding the mechanisms behind the evaporative enrichment of carbon-13 in dissolved inorganic carbon (DIC) within natural waters, specifically in the Lake Erie watershed. It is well-known that water in hydrologically closed basins tends to become more saline due to evaporation, which also leads to an enrichment of oxygen-18. However, the relationship between carbon-13 enrichment and evaporation remains unclear, particularly whether it is driven by atmospheric CO_2 exchange or CO_2 degassing. This study proposes a series of controlled evaporation experiments under both natural and artificial atmospheric conditions to investigate this phenomenon. By analyzing changes in water chemistry and stable isotopes, the research aims to determine whether carbon-13 enrichment is primarily due to CO_2 degassing. The results are expected to enhance our understanding of carbon cycling in Lake Erie and other aquatic ecosystems, providing insights into broader hydrological and environmental processes. This research will also engage an undergraduate student in fieldwork, data analysis, and scientific communication, contributing to their hands-on learning experience.

Development and Characterization of a Small Molecule Agonist Targeting Epha2 Receptor to Suppress Glioblastoma Cell Proliferation

College of Arts and Sciences

Student Researchers: Tyler Roeper, Andrew Martin, Jamie Shuster, and Fatma M. Salem

Faculty Advisor: Bin Su

Abstract

Glioblastoma multiforme (GBM) is the most common and aggressive malignant primary brain tumor, accounting for 60% of adult brain tumors. Despite treatments like surgical resection, radiation, and chemotherapy, the prognosis for GBM, especially grade III or IV, remains poor, with a mean overall survival (OS) of 4–6 months.[1] Therefore, identifying new therapeutic targets is crucial. EphA2, a receptor tyrosine kinase, has emerged as a potential target due to its role in cancer cell migration and its overexpression in many cancers, which is linked to malignant progression and poor prognosis. Activation of EphA2 by its ligand, ephrin-A1, has been shown to suppress tumor progression by inducing apoptosis, inhibiting cell proliferation, and suppressing cell migration.[2,3] However, ephrin-A1 cannot effectively cross the blood-brain barrier (BBB), limiting its use for glioblastoma treatment.[4] This has led to the hypothesis that a small molecule agonist for EphA2 could serve as a novel therapeutic approach for high-grade gliomas.

Profiling Sialidase Expression in Macrophages upon LPS Stimulation

College of Arts and Sciences

Student Researchers: Morgan Pychowycz and Majdi Aljohani

Faculty Advisor: Xue-Long Sun

Abstract

Sialylation is a post-translational modification process that occurs on glycosylated proteins. Desialylation is the process of removing the sialic acid from the terminal end of the glycoprotein. Lipopolysaccharide (LPS) is a glycolipid produced by most Gram-negative bacteria. Previous studies confirmed that LPS induces sialidase expression in human monocyte, indicating sialidase plays important role in bacterial infection. Neu1, Neu2, Neu3, and Neu4 are the four isozymes of mammalian sialidase, which differ in subcellular localization and substrate specificity. In this study, we investigated the effect of LPS on the THP-1 macrophages and found a higher expression of Neu1, which cleaves terminal sialic acid residues from host glycoproteins (desialylation). Through lectin blotting and flow cytometry, it was determined that bacterial and viral neuraminidase and LPS can cause desialylation of glycoproteins and THP-1 macrophages since there were increased binding interactions with PNA lectin to the treated groups compared to the untreated groups. Through ELISA, it was determined that THP-1 macrophages treated with LPS released significantly more proinflammatory cytokines (TNF-α and IL-1β) compared to untreated THP-1 macrophages. Overall, the complex interactions that occur on the cell's surface and the many roles of sialidase were explored utilizing lectin-blotting, flow cytometry, and ELISA, which strengthens the understanding of sialidase's role in immunochemistry-related research for future development of sialidase inhibitors.

Synthesis and Characterization of Sialidase Inhibitors

College of Arts and Sciences

Student Researchers: Sophie J. McIntyre and Isaac Turan

Faculty Advisor: Xue-Long Sun

Abstract

Sialic acids are a family of monosaccharides found on the terminal ends of many glycoconjugates and are involved in numerous cellular processes. Sialidases play an important role in various cell processes by cleaving sialic acid residues from their parent glycoconjugates. They are found in almost all cells, in mammals existing in four known isoforms, Neu1, Neu2, Neu3, and Neu4. Each isoform performs several cellular functions, some of which vary even within the same isoform based on the specific subcellular locations in which they are found. Of particular interest is Neu1 due to its predominance in human cells and its implication in several important cellular processes, such as signal transduction, apoptosis, and immune functioning, among other cellular tasks which are not fully understood. Currently available inhibitors fail to allow effective research into the functions of each isoform due to their lack of locational specificity. In this study, we propose a prodrug which are protected with particular protective groups, chiefly acetyl groups, are able to more effectively permeate the cell membrane, thereby increasing the cytosolic concentration versus nonprotected inhibitors at equal concentrations. These inhibitors are specifically designed to allow us to better understand the various functions of Neu1 in distinct subcellular locations by imparting a level of specificity. Creating both protected and nonprotected Neu1-specific inhibitors to target inside and at the cell surface respectively. Neu5Ac2en-9-NBut-OAc-COOH, Neu5Ac2en-9-NBut-OAc-OMe, and Neu5Ac2en-9-NBut-COOH among other precursor drugs were successfully synthesised from sialic acid and other commercially available chemical reagents and were characterized *via* NMR spectrum.

The Role of RNase L in EGF Homeostasis

College of Arts and Sciences

Student Researchers: Isabel Paulesc, Xiaotong Zhao, Guanmin Chen, and Norah Alghamdi

Faculty Advisor: Aimin Zhou

Abstract

RNase L is a critical enzyme involved in the regulation of cellular RNA integrity and the immune response to viral infections. This study investigates the role of RNase L in the homeostasis of Epidermal Growth Factor (EGF) and its downstream signaling pathways. Using both in vitro cell culture systems and Western blot analysis, we explored how the absence of RNase L affects EGF- mediated signaling in mammalian cells. Our findings reveal that RNase L modulates the EGF pathway which is influencing cell proliferation and survival. The results provide novel insights into the broader regulatory functions of RNase L beyond its traditional role in antiviral defense, suggesting its potential involvement in growth factor signaling pathways and cellular homeostasis.

The Origin of ISIS and its Founding Father

College of Arts and Sciences

Student Researcher: Nadia Cruz

Faculty Advisor: Stephen Cory

Abstract

This project examines the life of Abu Musab al-Zarqawi, the founder of the terrorist organization ISIS (Islamic State of Iraq and Syria), and the events that led up to him becoming a terrorist. United States officials have implicated al-Zarqawi in over 700 deaths during the invasion of Iraq in 2004. While the violent nature of his acts of terror must be condemned, it is important to examine his personal history and the events that led to his rise to infamy to have a better understanding of his path to radicalism. For this purpose, existing literature and media was examined, including books, articles, scholarly journals, and watching multiple documentaries. Emerging themes that contributed to al-Zarqawi's radicalization include the political instability in the region and being raised in war zones under oppressive governments.

**Supported by the McNair Scholars Program*

The Examination of the Forbidden Fruit

College of Arts and Sciences

Student Researcher: Dominique Ryder

Faculty Advisor: Linda Goodall-Martin[1]

Abstract

The dominant subculture in each region significantly influences long-term behavioral changes. Strict social norms can result in deeply internalized punishment. Since enculturation and acculturation play a significant role in shaping established and accepted social norms, a complex interplay of sociocultural phenomena can be held accountable. Anthropology, sociology, and religious studies provide an interdisciplinary framework that can help explain how religion influences systemic discrimination. This study utilized interview techniques, short-term ethnography, and grounded theory methodology to collect data for an innovative framework and form a coherent theory to support this framework. The study focused on transgender and non-binary individuals in Northeast Ohio and their perspectives on how their religion, the religious views of the dominant culture, and their upbringing influence different aspects of their lives and identities. These findings will be analyzed in the context of a local case study on the legislative process affecting historically marginalized populations, specifically those surrounding the HB 68 issue. This research aims to promote interdisciplinary perspectives, establish an innovative framework with a cohesive, unifying theory for future research, and emphasize the relationship between social norms and systemic discrimination.

**Supported by the McNair Scholars Program*

[1]Ursuline College

The Effect of the Pandemic on Developmental Mathematics: A Comparison of Fall 2019 and Fall 2023 Student Success

College of Arts and Sciences

Student Researcher: Ian LeSage

Faculty Advisor: Sandra Chincholkar

Abstract

It is well documented the pandemic caused drops in mathematics skills and "student" skills. During and after the pandemic, MTH 87 – Basic Algebra attendance and pass rates decreased. In F23, several initiatives were implemented. We compared pre-pandemic F19 student success with F23 student success focusing on: GPA, credit completion, and enrollment. F19 and F23 students who passed MTH 87 were in good academic standing (cumulative GPA $\geq$ 2.0 and credit completion $\geq$ 67%) for both GPA and credit completion. Second semester F19 students who passed MTH 87 remained in good academic standing, while F23 students did not. Although we have made progress rebounding from the pandemic, we are still not at the pre-pandemic averages for GPA, credit completion, or retention.

PAA Decay Modeling at Different Steps of Poultry Processing

College of Arts and Sciences

Student Researchers: Jason Simon and Vyshnavi Ciluveru

Faculty Advisors: Daniel Munther, Shawn Ryan, and Chandra Kothapalli

Abstract

Contamination in food processing is a continuing issue in the United States. Bacterial infections from Salmonella and Campylobacter are especially problematic in poultry processing. Funded by the USDA, this research develops a model to predict PAA decay during the chilling phase of processing, which is critical for ensuring food safety. A second-order decay rate is found using data from experiments to examine decay at lab and industrial scales. Comparisons show that total dissolved solids are a more consistent predictor of PAA decay than chemical oxygen demand. Results from various lab and industrial experiments demonstrate that consistent decay rates can reduce the need for repetitive testing and give better control of PAA levels to limit pathogen outbreaks.

Engineering a Reproducible Au(111) Flame Annealing Procedure

College of Arts and Sciences

Student Researchers: Jaxon S. Riley and Sahil Vachher[1]

Faculty Advisor: Jessica E. Bickel

Abstract

Silicon, the most common semiconductor today, has a production method that is expensive and bad for the environment. Organic electronics can not only be more cost-effective and eco-friendly, but can also be mechanically flexible and have lower processing temperatures and natural abundance. Despite this, organic semiconductors are not currently used due to their low conductivity. Films of organic molecules typically have an amorphous structure that makes it difficult for a current to tunnel between molecules. However, organic molecules can be crystallized, which has been shown to improve their conductivity and can make them more competitive. One way to crystallize is with directed self-assembly via a surface reconstruction (an atomically smooth repeating surface pattern that can drive how other materials incorporate). This research seeks to reproducibly create atomically smooth Au(111) surfaces by flame annealing to drive self-assembly crystallization of pentacene. Pentacene is a well-studied organic molecule already widely used in organic electronics such as OLED displays making it a perfect candidate. We hypothesize that, when evaporated, pentacene will deposit in the valleys of the rippled surface reconstruction, Au(111). By isolating a sub-monolayer growth, we will be able to see if the Au(111) is driving the self-assembly. This poster focuses on the creation of atomically smooth Au(111) and examines sample care, annealing setups (flame, hot plate, and crucible), characterizing the surfaces via scanning tunnelling microscopy (STM), and analyzing the effects of time and temperature on the Au anneal.

[1]*University of Texas at Austin*

Effects of Shear on Turbulence Kinetic Energy Distributions Around Shallow Cumulus Clouds

College of Arts and Sciences

Student Researcher: Jacob Forester

Faculty Advisor: Thijs Heus

Abstract

Clouds and their feedback into large circulation models are one of the greatest sources of uncertainty in climate science today. In this study, we use the MicroHH LES code to explore the relationship between windshear and the distribution of Turbulence Kinetic Energy (TKE) around a cloud. Performing data analysis in Python, we examine datasets from the Barbados Oceanographic and Meteorological Experiment (BOMEX) case, The Rain in Cumulus Clouds over the Ocean (RICO) case, and the Southern Great Plains (SGP) case. Using a decay function, we model the distance from a cloud boundary (where clouds are defined as a cell with nonzero liquid water content) to the environmental value of TKE. The distance from the cloud boundary to this norm is called the length scale. We use this model for every elevation an4\7]d time step, and, using image processing techniques, rotate the cloud field so that we can see the length scale at every angle around the cloud. We then compare the angle of wind shear, defined as the difference in wind magnitude at an elevation within the cloud from that at cloud base, to direction of the maximum length scale. What we find is that in the steady state cases (sea-air interaction) BOMEX and RICO there is a strong correlation between the direction of windshear and the maximum length scale; however, in the case of the SGP case (land-air) interaction, while the relationship still exists, it is not always guaranteed.

Characterizing the Dielectric Properties of Biomolecules through Molecular Dynamics Simulations

College of Arts and Sciences

Student Researcher: Colin Lathwell

Faculty Advisors: Wolfgang Pfeifer[1], Carlos Castro[1], and Sebastian Sensale Rodriguez

Abstract

Terahertz (THz) spectroscopy is emerging as a promising, cost-effective, and non-invasive tool for analyzing both inorganic and organic materials. Recent advancements have made it possible to integrate THz sensors with microfluidic chips, opening new opportunities for point-of-care diagnostics. While THz spectroscopy has been well-established for examining the dielectric properties of inorganic substances, there is growing interest in its use for the fast, sensitive, and reliable quality control of drugs and biomaterials, especially in commercial, industrial, and clinical settings.

Our research aims to study the properties of various biomolecules through atomistic molecular dynamics simulations to evaluate the performance of THz sensing platforms for biomolecular characterization. Specifically, we aim to determine:

1. Whether THz fingerprints can differentiate between DNA origami molecules of different shapes.
2. If THz fingerprints can distinguish between full and empty nanocarriers used in drug delivery.

We began by developing and validating our simulation methods within the simulation software. This process included replicating previous in-silico experiments that had been compared to lab-experimental results. Once verified, these methods were adapted to simulate and analyze small water-DNA systems with varying ionic strength. These smaller simulation runs will serve as a benchmark for systems including larger biomolecules, primarily DNA origami due to the wide range of available structures. Some of these DNA origami molecules were also set up for simulation but require larger computing resources, which have limited availability due to high demand.

[1]*Ohio State University*

Analyzing Polymer-Grafted Gold Nanorods using Depolarized Dynamic Light Scattering (DDLS)

College of Arts and Sciences

Student Researchers: Patrick Barrett, David Amirsadri[1], Haasini Sanisetty[2], and Nehal Nupnar[3]

Faculty Advisors: Mike Hore[3] and Kiril A. Streletzky

Abstract

Polymer-grafted gold nanoparticles (AuNPs) are a class of materials that combine the structural and optical properties of colloidal AuNPs with the stability of a polymer canopy. This unique combination allows for an array of potential biomedical applications such as drug delivery and catalysis. Unlike spherical grafted AuNPs, which are well-studied, grafted anisotropic AuNPs are not fully understood. Our goal is to study the effects of grafting thiolated Polyethylene Glycol (PEG) polymer to gold nanorods (AuNRs) on diffusive properties of the grafted AuNRs. The Depolarized Dynamic Light Scattering (DDLS) on two different setups (with two different wavelengths) was used to deduce the size of both bare and grafted AuNRs from their measured translational and rotational diffusion. This approach requires a multiangle DDLS experiment with critical analysis of the measured VV and VH correlation functions to yield the measured VV and VH decay rates of each system. The scattering theory for shorter ($qL<3$) cylinders allows to deduce nanorod translational and rotational diffusion coefficients from the measured angular dependencies of the decay rates. To obtain the apparent dimensions of the particles de La Torre's straight cylinder (SC) model was used. It was found that the bare nanorods had dimensions consistent with SEM results while the polymer grafted nanorods were as expected larger in diameter and largely unchanged in length. While two DDLS systems in general produced consistent results an unexpected difference in measured correlation functions were encountered. One DDLS setup produced an additional mode of the VV correlation function. While the origin of this mode is not well understood, a reasonable approach to data analysis was found to get consistent results from both systems.

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Examining the Relationship Between Intimate Partner Violence, Trauma, Attachment, and Help-seeking Self-Efficacy

College of Arts and Sciences

Student Researcher: Dalton C. Hundt

Faculty Advisor: Elizabeth Goncy

Abstract

Intimate partner violence (IPV) negatively affects victims. However, traumatic experiences and anxious attachment are often overlooked in IPV studies. This study examined effectiveness of relationship perpetration between various types of IPV victimization, the perception of one's ability to help-seek as a victim and a bystander, and how traumatic experiences and anxious attachment can play a role in the ability to help-seek. The data for this project was obtained from the Dating in Young Adults Study (studies 1 and 2). This secondary, archival dataset that examined relationships in young adults ages 18-30, contained questionnaires, self-report measures of IPV, and a qualitative interview. The total sample was 190 participants, 92 individuals from the DYAD 1 study and 98 individuals from the DYAD 2 study. Results indicated that when individuals report being less capable of help-seeking as a victim or as a bystander, the overall and all subtypes of IPV victimization scores were reported as the same. Secondly, based on existing studies of help-seeking, regardless of gender, individuals report the same levels of self-efficacy to engage in help-seeking as both a victim and a bystander. Lastly, in consideration of trauma, anxious attachment, and IPV victimization, each factor uniquely impacted help-seeking behavior above and beyond other subtypes.

Keywords: Intimate partner violence, traumatic experiences, anious attachment, IPV victimization, bystander, help-seeking

**Supported by the McNair Scholars Program*

Smart Surveys: Unleashing AI to Transform Organizational Assessments

College of Arts and Sciences

Student Researchers: Jackie Moss and Dave Barletta

Faculty Advisor: Michael Horvath

Abstract

Lengthy psychological surveys can be challenging in many contexts (e.g., when surveying busy employees). However, it is difficult to shorten surveys because important information can be lost by dropping potentially critical questions. Traditionally, shortening surveys requires multiple experts and several large samples of participants. However, the advent of artificial intelligence (AI) – specifically large language models such as ChatGPT – has potential as an efficient alternative to traditional methods. In our study, we examined several different ways of using AI to shorten a survey of employee engagement. We gave our survey, as well as multiple traditionally-shortened surveys of the same measure, to a sample of employed individuals. We found that AI is capable of creating shortened surveys with similar internal consistency reliabilities of traditionally-shortened surveys. Furthermore, AI-shortened surveys add to the prediction of burnout and work-family conflict over and above traditionally-shortened surveys, although the reverse is also true (to a lesser extent). Finally, we found that the quality of AI-shortened surveys is not uniform – different AI prompts produced surveys of different qualities.

Identifying and Challenging Orientalism in Schools to Support Arab Middle Eastern and North African Youth in U.S. Schools

College of Arts and Sciences

Student Researchers: Robiah S. Darwish and Sendce Mohamed

Faculty Advisor: Shereen Naser

Abstract

This study explores the impact of Orientalist stereotypes in U.S. schools on Arab, Middle Eastern, and North African (AMENA) youth in a Midwestern state. Discrimination can disrupt ethnic identity development and acculturation, adversely affecting the psychological well-being and academic success of AMENA youth (Ahmed et al., 2023; Najjar et al., 2019). U.S. history curricula and textbooks often portray AMENA individuals through Orientalist stereotypes, depicting them as exotic or dangerous, which furthers their marginalization (Said, 1977).

This study consisted of a content analysis of Ohio state model curricula and history textbooks. A content analysis revealed that over 90% of AMENA references were linked to terrorism or oil, with no mention of positive contributions by AMENA Americans (Padgett, 2015).

Interviews with 14 AMENA high school students confirmed the lack of AMENA representation and the harmful effects of these stereotypes in their U.S. history classes. These experiences contribute to feelings of alienation and hinder student identity development (Tabbah et al., 2012). The study emphasizes the need for educators and school psychologists to challenge these stereotypes and create more inclusive curricula (Hickman & Porfilio, 2012).

This research aims to provide recommendations for supporting AMENA youth and confronting the Orientalism that permeates educational settings (Cainkar, 2018).

Assessment of the Intersectionality of Muslim and Queer Identities

College of Arts and Sciences

Student Researcher: Elisha Sledge

Faculty Advisor: Shereen Naser

Abstract

Queerness can be a taboo subject in many Muslim communities. However, little academic research explores the intersection between queer and Muslim identities. This project employs an audio-ethnographic approach to explore the intersections of familial judgment and sexual identity among Queer Muslims. We believe that familial judgment plays a critical role in shaping the experiences of Queer Muslims, potentially leading to heightened levels of anxiety, depression, and suicidal thoughts and attempts because of anticipated familial rejection. By integrating ethnographic methods with audio recordings, this study seeks to capture the nuanced personal narratives and lived experiences of individuals identifying as both Queer and Muslim. Through in-depth interviews and reflective audio documentation, the study aims to address the research question: Are Queer Muslims hesitant to embrace their sexual identities due to judgment from families rather than societal disapproval? Preliminary findings indicate that the fear of familial rejection significantly contributes to internalized stigma and emotional turmoil within this community. They also suggest that the psychological burden associated with familial expectations may be more impactful than societal or communal scrutiny. This work highlights the necessity of creating supportive networks that address the challenges faced by Queer Muslims, ultimately advocating for greater awareness and understanding within both familial and broader societal contexts. It also showcases the necessity of creating supportive networks that address the challenges faced by Queer Muslims, ultimately advocating for greater awareness and understanding within both familial and broader societal contexts.

**Supported by the McNair Scholars Program*

Does Trauma matter? Examining Trauma History Effects on Oral Ketamine Antidepressant Outcomes

College of Arts and Sciences

Student Researcher: Hayley Vance

Faculty Advisor: Ilya Yaroslavsky

Abstract

Treatment-resistant depression (TRD) in the form of major depressive episodes or persistent depressive disorder that do not respond to two courses of pharmacotherapies affects 31% of depressed persons annually and accounts for a $43.8 billion annual disease burden. Ketamine has received growing interest as a breakthrough TRD treatment due to its rapid effects and low side effect profile. However, Ketamine therapies are generally clinic-based through intravenous (IV) and intranasal (IN) administration, which pose barriers to care for many. Home-based, time-released oral ketamine (OK) administration removes barriers associated with clinic-based treatments, is more cost-effective and is comparably efficacious to IN and IV administration routes. However, given its limited use and relative novelty, the time-course for attaining antidepressant effects through OK are not well understood, nor are the effects of such individual differences as trauma histories, that are known to impact treatment outcomes adversely.

This study examined whether OK-induced treatment response (50% symptom reduction), sustained response (response maintained across 2 months), and remission (5 points or lower symptom endorsement) will be evident by the 3rd and whether trauma histories would extend times to reach the above outcomes in a sample of 103 adults with TRD. Our results support OK's antidepressant effectiveness across those with and without trauma histories, and are well-aligned with literature on IV- and IN-based treatment outcomes. Clinical implications and methodological limitations will be discussed.

Why worry on ketamine? Investigating individual differences in generalized anxiety disorder symptom treatment response and remission

College of Arts and Sciences

Student Researcher: Hayley Vance

Faculty Advisor: Ilya Yaroslavsky

Abstract

Generalized Anxiety Disorder (GAD) is a mental health condition characterized by excessive worry that is difficult to control and impairing across multiple life domains. GAD commonly co-occurs with depressive disorders and its pharmacological and psychosocial treatments show poor response and remission rates. Ketamine, a glutamatergic NMDA receptor antagonist, has received growing interest as a novel treatment option for GAD, given its rapid distress-reduction effects and low side effect profile. However, ketamine therapy predominantly occurs within clinics through intravenous and intranasal administration, and relatively little is known about the efficacy of home-based time-released oral ketamine (OK) administration that removes barriers associated with clinic-based treatments. This study examined time to OK's anxiolytic treatment response, sustained response, and remission in a sample of treatment resistant depressed adults who received tele-medicine from an online treatment provider.

In a sample of 86 adults treated with OK through a telehealth provider, this study examined whether (a) a treatment response, sustained response, and remission of GAD symptoms would be evident by the 3rd treatment month, and (b) personal trauma histories will extend times to treatment response, sustained response, and remission. Our results support OK's potential as a GAD treatment for those with and without trauma histories, and well-aligns with literature on IV- and IN-based outcomes. Clinical implications and methodological limitations will be discussed.

Focusing on Fury: The Interplay of Attention Bias, Anger Rumination, and Social Emotion Regulation

College of Arts and Sciences

Student Researcher: Michael Fazio

Faculty Advisor: Ilya Yaroslavsky

Abstract

Attentional bias towards negatively valenced emotional stimuli is a transdiagnostic risk factor for depressive and anxiety disorders. Information processing models suggest these biases keep negative thoughts active in working memory, leading to rumination—an ongoing and passive focus on negative thoughts that increases emotional distress and impairs problem-solving. Understanding the role of attentional biases in anger rumination is underexplored, primarily examined through surveys and reaction-time tasks. Given the potential for negative evaluations in interpersonal situations, attentional bias and anger rumination may contribute to maladaptive interpersonal emotion regulation strategies. Since attentional biases can be modified, investigating their influence on the relationship between anger rumination and maladaptive emotion regulation may provide insights for prevention and treatment. This study explores how anger rumination mediates the relationship between attentional bias and maladaptive interpersonal emotion regulation in a sample of 45 community-dwelling adults from diverse demographic and psychiatric backgrounds. Participants completed self-report measures of emotion regulation and anger rumination, as well as a visual attentional disengagement task using the Tobii 3x-120 eye-tracking system. Results revealed that while generally neither orienting, sustained, nor disengagement biases predicted anger rumination, participants who maintained their attention longer on disgusted faces reported higher levels of rumination. Furthermore, increased anger rumination was associated with more frequent unhealthy interpersonal emotion regulation strategies, indicating an indirect effect of anger rumination on maladaptive responses.

**Supported by the McNair Scholars Program*

Effectiveness of Different Scene Coverage Styles in Film & Media Arts

College of Arts and Sciences

Student Researchers: Jason Talmadge and Natalie Vrobel

Faculty Advisor: James Joyce

Abstract

Film & Television utilize two major styles in covering scenes throughout a body of work; Traditional and Non-Traditional Coverage. Traditional is commonly used in sitcoms as they follow a formulaic scene structure, starting from the wide shot and cutting into individual single shots of characters. Non-traditional is more common within drama and uses any sort of structure that breaks this form. Differences and possible benefits of both types of Coverage were researched to find out if one is stronger than the other. An audience of 18 people watched two different funeral scenes from television. The Traditional Coverage was displayed in a clip from Episode 13, Season 7 of Young Sheldon. The Nontraditional Coverage was displayed in a clip from Episode 3, Season 3 of The Bear. After each clip, they were asked a series of questions broken into six different focuses: entertainment, connection to characters, emotional effect, story clarity, and tone. These focuses were chosen to get a well-rounded understanding of the effects of different styles of coverage. Each audience member was asked to rate these aspects on a scale of 1 to 5 for effectiveness. Once the scores were collected they were compared between both styles of coverage to see which had a higher ranking in each aspect. Results demonstrated that audiences preferred Traditional Coverage for entertainment, emotional effect, and clarity, whereas Non-Traditional Coverage was chosen as more effective for character connection and tone. These findings portray Traditional Coverage as a strong way to portray a story's world to audiences, while Non-Traditional Coverage is stronger in helping audiences experience the story's world.

Documentary Storytelling and Narrative Structure: Crafting Compelling Cinematic Narratives Through Editing

College of Arts and Sciences

Student Researchers: Rojda Aladag and Julian Hackel

Faculty Advisor: Cigdem Slankard

Abstract

This dual research project is comprised of a feature-length documentary and a short documentary.

- The feature-length documentary tentatively titled *Migrant Women* examines how technology can help bring people together and create support systems through online communities.
- The short documentary, tentatively titled, *Pole* relays the inspiring story of a performing artist while she explores pole as a way to expand her work as a storyteller and theater artist.

Archaeological Investigations at the Fort Hill Earthwork Complex 2024

College of Arts and Sciences

Student Researchers: Jacob Corbitt and Noah Haugen

Faculty Advisor: Phil Wanyerka

Abstract

Archaeological investigations were conducted this past summer by archaeologists from Cleveland State University in the wooded area west of the Fort Hill Earthwork Complex, located in the Rocky River Reservation of the Cleveland Metroparks. Our previous investigations between 2017 and 2019 have revealed that the earthwork was created by the Adena culture between 360 and 156 BCE and that this earthwork complex likely represented a cosmogram of the Adena world. This year's research was aimed at following up on previous non-invasive geophysical surveys, which included LIDAR and the use of a magnetometer and ground penetrating radar, that identified numerous magnetic anomalies in the wooded area immediately west of the earthwork complex. Thus, the archaeological investigations carried out in 2024 were the second of a multi-year plan aimed at conducting a systematic Phase I shovel test inventory survey of the entire plateau immediately west of the earthwork in order to look for other areas of prehistoric occupation in order to determine their age and cultural affiliation.

Camp NeuroSparks: Exploring the Benefits of a 3 Day Program for Chronic Brain Injury Survivors and their Caregivers

College of Health

Student Researchers: Morgan Gillie and Amani Salti

Faculty Advisor: Melissa Volk

Abstract

The Camp NeuroSparks project is a collaboration between the Brain Injury Association of Ohio (BIAOH) and Cleveland State University (CSU) to bring additional supports and resources to individuals with chronic traumatic brain injuries at least 2 years post injury and their caregivers in Ohio. The idea for Camp NeuroSparks came about after hearing about the Bright Ideas TBI Camp in Alabama that has been successfully run the last 5 years. BIAOH decided that they would like to bring something similar to Ohio. Camp NeuroSparks also allowed a unique opportunity to provide educational opportunities for pre-professionals in a multidisciplinary setting. Camp NeuroSparks brought 11 traumatic brain injury survivors and their caregivers to a 3 day camp at CSU's College of Health where they were given the opportunity to work with graduate clinician level students from multiple departments to complete an evaluation, receive a day of treatment trials and develop a home care plan for cognitive retraining. In addition, a Samsung tablet was provided for each participant and was loaded with a variety of apps to use at home for cognitive training and rehabilitation. A day of caregiver talks was also included in the camp and covered a variety of topics including assistive technology, financial advice, mental health and nutrition, community supports and resources and vocational rehabilitation.

Many individuals with acquired brain injury at least 2 years post injury have either maxed out their insurance covered visits or have been discharged from therapies but have not been able to return to work or prior level of function. According to TBI Research Review completed by Mount Sinai Medical Center 50% of individuals with a severe traumatic brain injury are not able to return to work one year after their injury and an additional 20% of individuals with a mild TBI are unable to work after one year. This same research yielded a recommendation to have service providers collaborate with research communities to develop innovative approaches to services for individuals with TBI. Camp NeuroSparks met this recommendation of having research communities, service providers and pre-professionals come together while working with families affected by chronic brain injury and provided opportunities for thoughts on furthering research on innovative ways of working with individuals with chronic traumatic brain injuries.

Advancing Care for Chronic Traumatic Brain Injury: A Review of Current Practices and Strategies for Addressing Service Gaps

College of Health

Student Researchers: Morgan Gillie and Amani Salti

Faculty Advisor: Melissa Volk

Abstract

This literature review will begin to look at what trends for current care have been available to individuals with chronic TBI (defined as at least 2+ years for this literature review), the impact of caregiver involvement post TBI, the gaps in service for individuals with chronic TBI and the apps and resources currently available for individuals post TBI. Data from the CDC from 2020 shows that there were approximately 214,110 traumatic brain injuries resulting in hospitalization that year. These estimates do not include those that visited an emergency room, received care from an outpatient facility or did not receive any care for traumatic brain injuries. Depending on the severity of the traumatic brain injuries the individual may display a variety of short and at times long term deficits. According to data from the Family Caregiver Alliance an estimated 13-16% of households in the United States are dealing with caring for a family member with an adult onset brain disorder. Research from Grewal et al 2004 and Kreitzer et al 2020 show that there are significant gaps in services for individuals with acquired brain injuries as well as gaps in caregiver support. The overall aim for this literature review is to then take the information and continue to explore potential designs for programs targeting chronic brain injury survivors and their caregivers in a way to address gaps and concerns voiced by chronic TBI patients and their caregivers.

Key Words: *chronic TBI, traumatic brain injury, gaps in care, rehabilitation following TBI, caregiver burden following TBI*

The Impact of Adverse Childhood Experiences on Child Development and Communication: A Systematic Review of the Literature

College of Health

Student Researcher: Tyler Johnson

Faculty Advisor: Myrita Wilhite

Abstract

Adverse childhood experiences (ACEs) can be defined as possible early childhood traumatic and stressful events that could result from a variety of sources including abuse, neglect, toxic stress, or household dysfunction. The original ACE study described ten ACEs. In the United States, 34.8 million children are estimated to have been exposed to more than one adverse childhood experience. ACEs have been studied by several healthcare professionals. However, there is very little work investigating ACEs in the Communication Sciences and Disorders (CSD; Speech and Hearing) literature. This study sought to explore the impact of ACEs on communication development, and behavior, and whether or not culturally and linguistically diverse children are at higher risk of experiencing ACEs. It was conducted using a systematic review of the literature of over 40 articles. It was concluded that while ACEs occur in all tiers of society, culturally and linguistically diverse children do appear to be at a higher risk of experiencing ACEs. ACEs are also associated with emotional problems such as depression and anxiety as well as aggression and bullying. Children who experience ACEs are at a higher risk of social language delay and reduced vocabulary development. Additional research is needed to understand how to help clients who have experienced ACEs and are being treated for a communication disorder.

**Supported by the McNair Scholars Program*

The Feasibility of Group Music Therapy in Addressing the Mental Health Needs of Unhoused Persons

College of Health

Student Researchers: Audrey Guildoo and Serena Naizer

Faculty Advisors: Deborah Layman and Lori Lundeen-Smith

Abstract

Somerville (1992) described homelessness as being multidimensional, impacting one's psychological, emotional, physical, and spiritual wellbeing. Unhoused individuals often experience chronic stress, mental health problems, and substance use disorder. (Moore, 2023). While economic issues are among the most critical factors contributing to homelessness, non-economic factors such as racial disparities, mental health and substance use, and domestic violence play a role in homelessness. The US Department of Housing and Urban Development (HUD) estimates nearly 600,000 people experienced homelessness in 2022.

Music therapy can be a relevant and practical service for reducing the mental health impacts of homelessness. While current research on music therapy with this community is limited, research over the last several decades indicates positive benefits from music therapy. Positive impacts of music therapy include experiencing, regulating, and expressing emotions; engaging in meaningful connection; and developing and expressing identities that resist oppression. However, more research about the role of music therapy in approaching and understanding homelessness, as well as music therapy protocols for addressing mental health needs, is needed (Gregory et al., 2022; Lahue, 2022; Landless et al., 2023).

The purpose of this study was to examine the feasibility of group music therapy to address the mental health needs of unhoused persons at an urban medical respite facility. Two music therapy (MTX) majors led group music therapy sessions at the medical respite facility, under the supervision of CSU Department of Music Therapy faculty. Seven weekly sessions were offered at the facility; each session was 45-60 minutes in length. Session participants were divided into groups by gender according to house; one MTX major worked with the women and the other worked with the men. Session mental health themes included accountability, self-esteem, and trust. Music therapy interventions included song writing, lyric analysis, music listening, playing instruments, singing, and music relaxation. Participants self-reported mood via a 5-point faces Likert scale before and after each session. MTX student therapists also recorded engagement observational data during each session.

Results of this feasibility study indicated that group music therapy was an inviting intervention. Group sessions were delivered with current means, resources, and circumstances and easily integrated into the existing milieu. Music therapy interventions were flexible and adaptable to the changing needs of the site and could easily be expanded in the future. Finally, group music therapy successfully improved the mental health of residents as evidenced by improved mood and increased engagement.

Investigation of Dynorphin B serum concentration in controls versus stimulated mice using stereotaxic surgery

College of Health

Student Researchers: Aditi Adatiya, Hussein Alshaikhli, Sana Altabbaa, Aleena Babar, Om Heer, Mackenzie Lipnick, Meagan Maharaj, and Eman Mohamed

Faculty Advisors: Tony L. Sahley, David Anderson, and Michael Hammonds

Abstract

Dynorphin B, an endogenous opioid peptide, purportedly functions to regulate pain and inflammation within the central nervous system. Past studies have featured its pro-inflammatory effects in peripheral tissues, such as the cochlea, where rising levels of Dynorphin B have been linked to various auditory disorders. In spite of that previous knowledge, the mechanism and theory of regulating Dynorphin B release in the cochlea is still poorly understood (Sahley, et al, 2019). This investigation tested the aforementioned theory of Dr. Sahley to determine whether brainstem stimulation of the Superior Peri-Olivary Nucleus in mice is responsible in-part for the release of Dynorphin B in blood serum. We expect the same increase in stimulated Dynorphin B when we next test the biofluid of the cochlea. Stereotaxic neurosurgery, electrophysiology, and morphology were used to acquire the biofluids of serum and cerebrospinal fluid. The serum biofluid will be quantified by our lab using ELISA to determine concentration differences in Dynorphin B levels between stimulated and control mice. Our Dynorphin B ELISA results are still to be determined; however, we anticipate finding that stimulated mice will have more Dynorphin B than control mice in blood based on previous ELISA results for two stress hormones. Additionally, a related quantification and analysis of the cerebrospinal fluid in mice for Dynorphin B concentrations is currently being investigated by analytic chemist Eman Mohamed via ultrasensitive mass spectrometry.

Radiographic Results of Percutaneous Reduction of Calcaneal Fractures and Posterior Arthroscopic Subtalar Arthrodesis (C-PASTA)

College of Health

Student Researchers: Srihan Anand[1] and Bhavin M. Bohre

Faculty Advisors: Anthony D. Belmonte, Adam T. Groth, and Kevin D. Martin

Abstract

Background: Displaced intra-articular calcaneal fractures of Sanders III and IV are associated with high rates of post-traumatic arthritis. Traditionally, severe subtalar arthritis has often been managed through primary, open subtalar fusion. However, these approaches have yielded suboptimal results, with revision surgery rates reported as high as 60%. Previously, percutaneous calcaneal reduction and posterior arthroscopic subtalar arthrodesis (C-PASTA) has been established as a means of management of non-acute post-traumatic arthritis, resulting in a significant decrease in time to union, return to sport, and revision. Our hypothesis was that the use of C-PASTA for acute Sanders type III and IV would yield favorable results.

Methods: Twenty-two patients with acute Sanders III (27%) and IV (73%) calcaneus fractures repaired with a C-PASTA were evaluated at 3, 6, and 12 months, with a one-year X-Ray. Nicotine and illegal drug use, tourniquet time, functional outcomes including Foot and Ankle Disability Index (FADI), visual analog scale (VAS), functional status at one year, and CT union rate were recorded.

Results: In our cohort of twenty-two patients, mean age was 51 years (range, 25-82) with a mean return for follow-up of 11.6 months. The mean FADI score improved from 70.3 at 3 months to 83 and 93.8 at 6 and 12 months ($P < .0001$), with ten patients (45%) obtaining a score greater than 90. The mean VAS scores were 1.9 at 3 months to 1.5 and 1.1 at 6 and 12 months showing no difference ($P > 0.05$). The mean tourniquet time was 103.3 ± 20.0 minutes. Post-operative CT scans demonstrated twenty-one (95%) of the patients showing a high rate of fusion without complications at 3 months with one non-union. Nicotine and illegal drug use did not impact results.

Conclusion: These findings suggest that C-PASTA is a promising technique for the management of acute Sanders III and IV calcaneus fractures, potentially enhancing successful union rates, reducing the risk of post-traumatic arthritis, and improving patients' quality of life.

[1]*Ohio State University*

Artificial Intelligence and K-12 Education: Current Directions and Tools for Educators

Levin College of Public Affairs and Education

Student Researchers: Harrison Shaw and Esther Adejumo

Faculty Advisor: Xiongyi Liu

Abstract

In this research project, we examined the effects of AI technologies in a K-12 setting. We generated 376 research articles using multiple online databases. After analyzing the articles for their content and relevance to our research, we had 97 articles that investigated topics such as AI tools, student & teacher attitudes towards AI, AI literacy, and finally AI usage in specific domains of teaching. These articles indicated a variety of ways in which the field could be expanded. Overall, the articles show many potential applications of AI in K12 education which are being examined, however many of these technologies require advanced knowledge to use and teachers are ill-equipped to teach AI literacy. In addition, many of the articles showed that students are susceptible to overreliance on artificial intelligence instead of independently using their cognitive and creative skills. Future directions and research recommendations are delineated.

"Take Us Seriously": Youth Experiences in Education, Activism, and Research

Levin College of Public Affairs and Education

Student Researchers: Daylun Armstrong and Wyatt Partington

Faculty Advisors: Katherine Clonan-Roy, Kimberly Fuller, Elizabeth Goncy, and Shereen Naser

Abstract

Through this project we analyzed the experiences of queer youth who engaged in the Youth Research for Social Change (YRSC) program with the THRiVE Collaborative at Cleveland State University and the LGBT Center of Greater Cleveland. This program was guided by the Youth Participatory Action Research methodology, which aimed to empower youth as they researched topics that were of personal significance. The qualitative analysis focused on the discussions youth had within the program, both between themselves and the adult facilitators. Common themes expressed by youth in the YRSC program were ideas of community and collective liberation, education, oppression, activism, identity, and capability. Youth also frequently expressed their frustrations with world atrocities, exploitation, and the deep rootedness of systemic oppression. Youth also critiqued local and global pride events that relied on corporate sponsorships and performative activism (rainbow capitalism). They also discussed their own experiences with racism, misogyny, misogynoir, colorism, texturism, homophobia, transphobia, and ableism. By creating a space where queer youth had autonomy and the freedom to express themselves, the youth in the YRSC program expressed feeling affirmed and empowered to embrace their identities, as well as increased confidence in themselves and their capabilities in research, education, and activism. The YRSC program provides an example of the benefits of creating spaces where queer youth can express themselves freely and form meaningful relationships with their peers. It is important for more spaces not just to accept, but also to foster, queer youth.

Keywords: ableism, activism, collective liberation, community, empowerment, homophobia, identity, inclusivity, LGBTQ+, racism, transphobia, youth autonomy, youth research

The Landscape of Newcomer Education in Northeast Ohio: Insights from Educators and Non-Profits

Levin College of Public Affairs and Education

Student Researchers: Marissa E. Serafine and Ali M. Scoufield

Faculty Advisors: Rick A. Breault[1], Grace H. C. Huang and Vickie Coleman Gallagher

Abstract

This research investigates the landscape of newcomer education in Northeast Ohio, focusing on the experiences of K-12 educators and non-profits working with newcomers. Using a qualitative approach, eighteen educators and non-profit participants were interviewed in focus groups, with the data analyzed through thematic analysis. The preliminary findings reveal four key themes: the importance of student-teacher relationships, appropriate instructional resources and support, the significance of cultural awareness and understanding, the educator's mindset, and the necessity of instructional resource support. These themes highlight the interconnectedness of relational, cultural, and professional factors in creating a supportive educational environment for newcomer students. This research contributes new insights regarding the changes needed to better serve the newcomer student population. The focus ranges from individual relationships to the need for resources and training. The testimonies shared by participants enhance understanding of the attention needed in this often underserved area of education.

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Factors impacting the formation of Pickering emulsions stabilized by hexagonal boron nitride nanosheets

Washkewicz College of Engineering

Student Researchers: Daniel Habean and Tanner L. Larson

Faculty Advisor: Geyou Ao

Abstract

Pickering emulsions are becoming ubiquitous due to their implementation of solid particles as stabilizers instead of surfactants. Employing nanomaterials towards the stabilization of Pickering emulsions is vital towards fabricating novel materials with unique thermal properties and improved biocompatibility. Hexagonal boron nitride (hBN) nanosheets are lightweight, mechanically robust, with superior thermal and chemical stability and large specific surface areas. This makes hBN an ideal candidate as an interfacial stabilizer for Pickering emulsions. However, obtaining stable aqueous dispersions of hBN still remains a challenge due to its intrinsic hydrophobicity. In this work, we developed methods of dispersing hBN in water through tip sonication using double stranded DNA (dsDNA). These dispersions were used for stabilizing Pickering emulsions under various conditions including sonication time, water/oil volume ratios, and hBN concentration. We utilized the combination of optical microscopy and rheology to characterize the resulting Pickering emulsions. We observed a transition in the type of Pickering emulsion from oil-in-water (O/W) to water-in-oil (W/O) near 40 – 50 vol% of water. Additionally, emulsions with the optimum stability were obtained by sonicating oil/water mixtures of 50/50 (v/v) containing roughly 1.15 mg mL^{-1} hBN for 10 min. This project will lead to the design of novel nanomaterial-stabilized emulsions with unique properties for applications, such as cosmetics, films and coatings.

Creation and Characterization of an ELP-based Bioink

Washkewicz College of Engineering

Student Researchers: Mikala B. McCay and Dana G. Aramouni

Faculty Advisors: Edward Turk[1] and Nolan Holland

Abstract

Bioprinting is a cutting-edge technology that uses 3D printing techniques to create complex biological structures, including tissues and organs, by depositing bioinks layer by layer. This study focuses on the development of bioinks, particularly hydrogel-based materials, essential for bioprinting. Despite various bioinks being explored or invented, challenges such as low mechanical strength, rapid gelation, and high viscosity persist. The successful creation of a self-assembling ELP hydrogel paves the way for improved bioinks in tissue engineering, offering enhanced biocompatibility and mechanical stability. Our research addresses these challenges by utilizing recombinant protein technology to engineer elastin-like polypeptides (ELPs) that form thermo-responsive hydrogels. We designed and synthesized an ELP diblock that dimerizes to form a triblock ELP with alternating hydrophobic and hydrophilic segments, aiming for optimal self-assembly and cell encapsulation at physiological temperatures. This project details the design, gene assembly, protein expression, and purification processes, followed by the characterization of the hydrogel's thermal properties. Our results showed that the modified design of the hydrophilic block (VEV)5 helped achieve a more manageable and effective purification protocol. Data concluded that the hydrophobic block (FIIII)3 has too low of a transition temperature for it to be fitting for bioprinting and further work needs to be done to modify it to achieve the desired transition temperature.

[1] *Gilmour Academy*

Computational Analysis of Blood Flow through Diseased Aorta

Washkewicz College of Engineering

Student Researcher: Ili Yusef

Faculty Advisors: Petru Fodor and Chandra Kothapalli

Abstract

As blood flows through the aorta, the elasticity of the aortic tissue causes the walls to expand. As the aorta returns to its normal state, it acts back on the blood flow, leading to a complex interaction between the blood and the aortic walls. Various diseases can disrupt this interaction, either by affecting blood pressure and heart rate, which leads to irregular blood flow, or by forming plaques or aneurysms that compromise the elasticity of the aortic tissue. Visualizing blood flow in real-time requires access to expensive instrumentation, and abnormalities are often detected late; however, computational fluid dynamics tools can help simulate blood flow. By constructing a geometry that mimics a healthy aorta and applying similar conditions, a simulation of normal blood flow can be achieved. This simulation can then be adjusted to represent specific diseases. Our study was designed to examine the interactions between an aneurysm inflicted descending abdominal aorta and blood flow, and the outcomes were compared to those in healthy aorta. A uniform cylindrical shape that ends with a bifurcation was designed in COMSOL® Multiphysics software to mimic a healthy aorta, and a similar design with an ellipsoid to represent the aneurysm was created to represent the diseased aorta. Fluid flow analysis was developed by solving the Navier-Stokes and solid mechanics equations. Preliminary results from the study indicated that an aneurysm slows blood flow and creates turbulence, increasing pressure on the aortic walls. Results also show that the walls near the aneurysm zone experience higher pressure, which could lead to plastic deformation of the walls, putting them at greater risk of rupture. Future studies are designed to investigate the two-way interaction between the vessel wall and blood flow under aneurysmal conditions.

2D Functional Materials for Carbon Dioxide Capture from Air

Washkewicz College of Engineering

Student Researchers: Vincent L. Arena and Obaid Khan

Faculty Advisor: Shaowei Yang

Abstract

Zeolites are aluminosilicate minerals that exist naturally and can be synthesized. Two Dimensional (2D) materials with nanometer thickness have the advantage of a large surface area and excellent surface accessibility. This gives potential of adsorption application in fields such as direct air capture (DAC). Silicoaluminophosphates (SAPOs) are a type of zeolite molecular sieve, which belongs to the family of aluminophosphate materials. In this work, it is demonstrated how the addition of polyethyleneimine (PEI) to our amino-acid-anchored SAPO has the potential to increase adsorption capabilities of carbon dioxide in atmospheric conditions, giving way to help reduce greenhouse gases and global warming levels. Through the inclusion of L-Histidine (L-His) in our structure, the addition on PEI is included through a pseudo-peptide synthesis procedure to create a peptide bond between the functional groups. The extension of these organic functional groups as active adsorption sites may give greater potential in application. As this work is ongoing, similar work will be used to support its potential through characterization techniques such as SEM, FTIR, XRD, and carbon dioxide adsorption data. This ongoing work brings organic properties to a field with vast inorganic properties. Altering the idea of active adsorption sights to increase capabilities and generate new ones.

Exploring an Integrated Sensing and Communications System

Washkewicz College of Engineering

Student Researchers: Thomas Terry and Philip Salopek

Faculty Advisor: Zicheng Chi

Abstract

One of the most valuable and unrenewable resources in our current world is the frequency spectrum. As the world becomes more connected, this resource will become even scarcer. In our research we have sought to combine wireless sensing and wireless communication capabilities into one wave, decreasing the frequency spectrum that would be required in total. Chirp spread spectrum (CSS) is a wireless modulation method where the frequency of the transmitted signal continuously varies with time. Frequency modulated continuous wave (FMCW), which uses a wave similar to CSS, is a wireless sensing solution that has been used in military and automotive applications. By combining them together, we envision a system that will reduce the amount of time or spectrum signals need to transmit and sense information. This sustainable usage of spectrum aligns with the usage scenario of integrated sensing and communication from the ITM-2030 [1].

[1]"International Telecommunication Union Recommendations Radiocommunication Sector Framework and overall objectives of the future development of IMT for 2030 and beyond." Accessed: Sep. 05, 2024. [Online]. Available: https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2160-0-202311-I%21%21PDF-E.pdf

Generating a Dataset for Deep Reinforcement Learning

Washkewicz College of Engineering

Student Researcher: Lewis Davis

Faculty Advisor: Sathish Kumar

Abstract

Reinforcement Learning (RL), is a subfield of Machine Learning where a computational agent interacts with the environment, learning an optimal course of action by trial and error. Deep Reinforcement Learning (Deep RL) uses neural networks to learn to perform tasks directly from raw data, such as images or text, without hard-coding task-specific knowledge. In this context, datasets are collections of data used as a single unit for analytic and prediction purposes. Datasets are made for specific tasks with raw data specific to the task or machine being used. There is a need for increasingly robust datasets to increase the use and effectiveness of these tasks. The purpose of this work is to generate a dataset designed specifically for Opentrons Flex, a pipetting robot designed for high throughput and laboratory experiments. For this purpose, an attempt to generate a dataset using Opentrons API, and its protocols was done. Gazebo was utilized to simulate and acquire image data for Deep RL. However, this action was limited by the lack of documentation and files available to run gazebo simulations with. Opentrons API has no documentation that works to recreate its machines in gazebo's virtual environment; without this, simulations for which data can be extracted cannot be done.

**Supported by the McNair Scholars Program*

Clock Glitch based Fault Injection Side Channel Attacks against AES

Washkewicz College of Engineering

Student Researchers: Yuvaraj Vagula and River Stepp

Faculty Advisor: Sanchita Mal-Sarkar

Abstract

Cryptographic systems like the Advanced Encryption Standard (AES) are essential for protecting sensitive information. Despite AES's strong framework, it remains susceptible to fault injection attacks, especially clock glitches on Field Programmable Gate Arrays (FPGA). This study explores the effects of clock glitch-induced faults on AES, focusing on its vulnerability during crucial encryption phases. We developed and executed a fault injection mechanism aimed at the AES algorithm on an FPGA, identifying particular weaknesses during the MixColumns and AddRoundKey stages. Our research emphasizes the importance of the timing of glitches; glitches occurring early in the process affect multiple rounds, leading to significant errors, whereas glitches in later stages cause localized disturbances. Introducing a dynamic clock glitching approach is a noteworthy innovation in fault injection methods, enabling more targeted fault induction through real-time AES core feedback. Our results highlight the necessity for improved fault detection and mitigation techniques to bolster the security of cryptographic systems against such threats. This paper enriches the existing body of knowledge by shedding light on the practical impact of fault injection attacks on AES and proposes countermeasures to enhance cryptographic defenses.

Detectron 2 Applications in HealthCare

Washkewicz College of Engineering

Student Researcher: Fabio Hinojosa Jimenez

Faculty Advisor: Ye Zhu

Abstract

Detectron 2, developed by Facebook AI Research (FAIR), is a powerful and versatile open-source platform for object detection tasks. It supports various operations such as bounding box detection, instance segmentation, and person keypoint detection, providing a flexible framework for diverse applications. With pre-configured models—including Faster R-CNN, Mask R-CNN, and RetinaNet—Detectron 2 simplifies model customization and training, enabling faster performance compared to other libraries like TorchVision. Its ease of use, combined with a preset trainer, makes it highly accessible for both researchers and developers.

This research focuses on the transformative applications of Detectron 2 in the healthcare sector. AI-driven technologies, particularly in medical image detection and segmentation, have revolutionized the early diagnosis of critical conditions such as cancer, cardiovascular diseases, and neurological disorders. Tools like Detectron 2 are instrumental in advancing medical imaging techniques by providing precise identification of lesions, tumors, and other anomalies through the analysis of MRI, CT scans, and X-ray images. By integrating state-of-the-art image detection algorithms with continually improving imaging technologies, Detectron 2 enhances diagnostic accuracy and delivers valuable insights to healthcare professionals. The convergence of AI and healthcare technology presents an exciting future with the potential to significantly improve patient outcomes and treatment efficiency.

Rapid Detection of Antibiotic Resistant Bacteria

Washkewicz College of Engineering

Student Researcher: Genevieve Mann

Faculty Advisor: Siu-Tung Yau

Abstract

Antibiotic resistance in bacteria is an increasingly urgent problem. The inability of hospitals to make fast diagnoses is a large contributor. Hospitals can take anywhere from 7-24 hours, using methods like PCR and ELISA. During this time patients are given broad spectrum antibiotics, which can be ineffective. As well as this, overuse of broad-spectrum antibiotics gives rise to more antibiotic resistant strains of bacteria. Using a modified three-electrode electrochemical cell, it is possible to detect bacteria much faster than conventional methods. With this new way of testing for bacteria, results can be obtained within two hours upon receiving the sample. The sample is placed within a sandwich structure on the working electrode. The structure is made up of five layers. The first two provide a base, while the final three are specialized depending on the suspected bacteria being tested. The sample is placed on top of a capture antibody, then a detection antibody is placed on top of the sample after some incubation. The sample is incubated again, then is tested for around 30 minutes. The testing is an electrochemical immunoassay with an amplified electrical signal. The amplification combined with the bacteria-antibody immune reaction, allows for high detection sensitivity, into single digit CFU/mL. This runs for 17 trials, which are then used to generate a graph which is used to interpret the results. The entire process takes around two hours. Currently, the prototype is able to test for E. coli, MSSA, and MRSA. The platform is showing promising results with clinical samples obtained from University Hospitals. This is a low cost, time effective way to test for bacterial infections that can test for both a specific species and antibiotic resistance.

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Developing a Digital Twin Demonstration System for Parcel Sortation

Washkewicz College of Engineering

Student Researcher: Issa Hamideh

Faculty Advisor: Wenbing Zhao

Abstract

Ordering a package from Amazon or any other massive company with warehouses may consist of a step where a conveyor belt is used to automatically sort packages. You might question as to how you always get the correct package right on your doorstep, and that's not because of the worker who is delivering your package but it's because of the use of parcel sortation system. The parcel sortation system handles thousands of packages daily by sorting each individual parcel. The way to design such a system is by making a simulation to make it efficient and accurate when parcels go through the sortation system with no trace of errors. The simulation in this study is created by incorporating best practices of parcel sortation systems work in the real world. Further investigation and analysis shows that the best and most efficient way is to make the parcels directional by using its information via zip codes.

Studying the Microstructural Evolution and Property Optimization of 316H Stainless Steel: Selective Laser Melting and Spark Plasma Sintering

Washkewicz College of Engineering

Student Researchers: Grace Ellis and Amit Choudhari

Faculty Advisor: Tushar Borkar

Abstract

This study investigates the microstructural evolution and property optimization of 316H stainless steel (SS316H) using two advanced manufacturing techniques: Selective Laser Melting (SLM) and Spark Plasma Sintering (SPS). SS316H, traditionally manufactured through conventional methods such as hot and cold rolling or machining, faces limitations in producing complex geometries. Additive manufacturing (AM), particularly SLM, addresses these geometric constraints, enabling the fabrication of intricate components with enhanced properties. In this novel exploration, SS316H was successfully processed via SLM for the first time, and its mechanical properties were compared to those of SPS-produced samples. The study reveals that SLM significantly enhances the yield strength (~515 MPa), hardness (~220 HV), and wear resistance (coefficient of friction, COF = 0.56) compared to SPS. The microstructural analysis indicates that the superior performance of SLM-printed samples is attributed to refined grain structures and reduced porosity, leading to improved mechanical properties. These results position SLM as a promising technique for producing high-performance SS316H components for critical applications, including nuclear reactors, turbine blades, and aerospace parts. The findings contribute to the growing body of research supporting the broader adoption of AM in the manufacturing of complex, high-strength components. This study marks a significant advancement in the field of additive manufacturing, demonstrating SLM's potential to replace traditional fabrication methods and improve the mechanical performance of SS316H for demanding engineering applications.

Microstructure, Mechanical Properties, and Oxidation Behavior of Low-Density AlCuFeNiTi High Entropy Alloys

Washkewicz College of Engineering

Student Researchers: Muhannad Alghanboosi and Manoj Mugale

Faculty Advisor: Tushar Borkar

Abstract

This work aims at studying the oxidation characteristics and mechanical properties of the synthesized high entropy alloys (HEAs) having different compositions after a long oxidation test. New HEA compositions that were tested include: Three different HEA compositions were prepared and subjected to oxidation conditions for 100 hours. Each of the alloys was then subjected to mechanical testing for hardness and compressive strength after oxidation in order to determine the effect of oxidation on the physical characteristics of the given alloys. Further, microstructural examinations were conducted with optical microscopy to quantify and characterize the oxide layers developed on the surface of all the alloys. According to the observed results, the oxidation resistance and mechanical properties of the coatings established differences between the compositions. The hardness measurements revealed the variation of resistance to degradation while the compression tests helped in understanding the variations in mechanical properties due to formation of oxides layers. Scanning electron micrographs of cross-sections of the samples provided evidence of different oxide scales for the different alloy compositions, thus confirming the chem compositional effects on oxidation trends. This work provides useful information concerning the thermal life and co-efficient of the HEAs under oxidative environment and how and in what manner different compositions impacts on the oxidative resistance and mechanical characteristics of the materials. These findings are critical in maximizing the HEAs for applications where high-temperature oxidation is a key consideration.

Synergistic enhancement of Mechanical and Tribological properties of Multiwalled Carbon Nanotubes reinforced IN718 composites

Washkewicz College of Engineering

Student Researchers: Ashraf Aladwan and Sanoj Karki

Faculty Advisor: Tushar Borkar

Abstract

The effect of multi-walled carbon nanotubes (MWCNTs) on enhancing the mechanical and tribological properties of Inconel 718 (IN718) was evaluated in this research. IN718 reinforced CNT composites with varying CNT concentrations (0.1, 0.2, 0.5, and 1.0 weight%) were prepared using high-energy ball milling and spark plasma sintering (SPS) fabrication techniques. Density measurements confirmed high density (99.8% to 99.97%) of all the SPS processed composites. X-ray diffraction, scanning electron microscopy, and energy dispersive spectroscopy of IN718-CNT samples confirmed the uniform distribution of CNT in IN718 matrix leading to microstructure refinement. IN718-0.5 weight% CNT samples showcased the highest hardness (332.4 ± 17 HV), yield strength (861.88 ± 6.5 MPa), and tensile strength (1149.5 ± 7.9 MPa) which were higher by ~20.4%, ~46.8%, and ~13.5%, respectively when compared with pure IN718 alloys. Tribological Testing with (5 and 10)N loads also confirmed that the 0.5 weight% samples have the lowest Coefficient of Friction (0.49 and 0.55) and wear rate (2.1×10^{-4} and 0.398×10^{-4}) values lower by ~30.5%, ~13.7%, ~86.5%, and ~45.6%, respectively, suggesting its highest tribological performance and maximum wear resistance in comparison to pure IN718 samples. The results indicated that grain refinement, dislocation strengthening, and load transfer contributed to the strengthening of IN718 reinforced CNT composites. The improvement in tribological properties is attributed to the increase in hardness and the formation of a CNT protective layer on the worn surfaces. This work opens up possibilities of using CNT reinforcements to overcome the existing limitations of pure Inconel 718 alloys and broaden its applications in various industries.

Ti-BNNT Metal Matrix composite processed by SPS: Microstructure, Mechanical properties, and Biocompatibility

Washkewicz College of Engineering

Student Researchers: Mohammed Al Maawali and Satyavan Digole

Faculty Advisor: Tushar Borkar

Abstract

In this study, we explored the potential of titanium-boron nitride nanotube (Ti-BNNT) composites processed using spark plasma sintering (SPS). Our research aimed to understand how these composites perform in terms of their microstructure, mechanical strength, and compatibility with biological systems. We carefully examined the structure of the Ti-BNNT composites to see how the SPS process affects their grain size, phase distribution, and how well the different components bond together. We then tested their mechanical properties, including hardness and tensile strength, to see how the addition of BNNTs improves performance. Additionally, we evaluated the biocompatibility of the composites by conducting cell viability tests to ensure they are safe for use in medical applications. Our findings show that Ti-BNNT composites offer strong mechanical performance while maintaining good biocompatibility, suggesting they could be valuable for both advanced engineering and medical uses.

Predictive Modeling of Wind Speed and Solar Radiation for Hybrid Energy Systems in Ohio

Washkewicz College of Engineering

Student Researcher: Veer Gaudani

Faculty Advisor: Navid Goudarzi

Abstract

This project explores the predictive modeling of wind speed and solar radiation in Cleveland, Ohio (and, more specifically, the rest of Ohio) to assess the feasibility of a hybrid charging station for electric vehicles (EVs) that utilizes both renewable energy sources and natural gas. The primary objective is to leverage machine learning techniques to accurately forecast the potential energy generation from wind and solar resources in the region. By analyzing time-series weather data, we aim to predict the station's energy output and determine its capacity to meet daily energy demands for charging EVs.

In addition to predicting energy output, the results of this study will provide guidance on optimizing the design and operation of such hybrid stations. This includes determining the ideal balance between energy sources, infrastructure design, and operational efficiency, ensuring a steady and reliable supply of energy without taxing electrical grids too much. Ultimately, the research will help determine the feasibility and design criteria for hybrid charging stations that can meet the energy needs of future EV users while supporting sustainability goals.

Integration of Wind and Solar Hybrid Systems in Electric Vehicle Charging Infrastructure

Washkewicz College of Engineering

Student Researcher: Hamza Khan

Faculty Advisor: Navid Goudarzi

Abstract

Implement and design and hybrid system that utilizes wind and solar power to charge an EV charging station. As well as collecting power data to assess potential for possible locations for other hybrid systems. The hybrid system will contain a wind turbine and solar panel as a means of generating power. A datalogger will be built using Arduino to collect and analyze data. Finding suitable components that are efficient and communicate well with each other. The system will need a controller for both the wind turbine and solar panel. Purpose of the controller is to regulate current and protect the battery. Wind turbines will require a controller that not only regulates current but also rectifies current. A wind turbine produces three three-phase Alternating currents. A rectifier will convert this current to Direct Current which is useable by the battery. Selection criteria include short circuit voltage and maximum supported current. Otherwise, the system could fail. Afterward, a battery will be required that can store all the generated power so that it is usable. But most appliances don't run on DC which is what the battery outputs. So an inverter is required. Inverter will Convert DC to AC making it usable for multiple applications. Such as powering appliances and lights. But in this case, powering an EV charging station.

Developing Methods for Testing the Electrical Conductivity of Hydrogel/Conductive Nanoparticle Composites

Washkewicz College of Engineering

Student Researchers: Michael Borovich, Kylie Schmitz, and Tanner Larson

Faculty Advisors: Megan Jack[1], Geyou Ao, and Liqun Ning

Abstract

Peripheral nerve injuries (PNIs) affect millions and can have severe impacts on an individual's quality of life [1]. Current treatment options for large-gap PNIs are limited by donor availability and donor site morbidity, leading to interest in the development of nerve guidance conduits (NGCs) [1][2]. NGCs are fabricated using biomaterials with specific properties which allow the body to bridge larger nerve gaps than it otherwise could without intervention. In PNI applications, NGCs should be flexible with high tensile strength, permeability, and electrical conductivity [1]. Electrical conductivity is of particular relevance for PNI treatments due to nervous tissue operating based on electrical potential differences [1]. Thus, electrically conductive NGCs would allow for increased regenerative capabilities through exogenous electrical stimulation (ES) or endogenous electrical signaling [3].

This work focuses on developing a cost-effective process for easily measuring the bulk electrical conductivity of hydrogel/conductive nanoparticle composites, specifically focusing on gelatin methacrylate (GelMA) with single-walled carbon nanotubes (SWCNTs). An iterative design process was utilized to establish an effective two-point probe protocol. This protocol ultimately consists of sandwiching a sample (of known dimensions) between two flat electrodes which connect to a high resistance ohmmeter. The screen readout of the ohmmeter is recorded, then the video is processed using an optical character recognition (OCR) python script which outputs a resistance versus time plot. This plot is used to find an average resistance value, which in combination with the known dimension of the sample, is used to calculate the material's bulk electrical conductivity. The results from those trials demonstrated positive correlation with SWCNT concentration, however material preparation and testing procedures must be optimized to reduce error. Future work would involve testing samples with higher SWCNT concentrations to reach conductivity values closer to those of peripheral nerve environments. Finally, electrical conductivity values obtained from this process will be used to guide in vitro electrical stimulation studies for neural tissue.

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Hybrid Electric Aircraft Propulsion Motor Design

Washkewicz College of Engineering

Student Researchers: Justin Gliha and Charles Farrington

Faculty Advisor: Hanz Richter

Abstract

Currently, most aircraft are powered by fossil fuels. However, due to decreasing fossil fuel supplies and increased air pollution, many techniques are being developed to reduce the use of fossil fuels in aviation. One of these methods involves using a hybrid electric and gas propulsion system. Tyler Kaptain developed a simulated gas turbine that incorporates a physical scaled electric propulsion system however due to size limitations, speed limitation, and the use of a single spool system instead of a double spool system the process is not very representative of an actual turbine. By using different values for scaling and by viewing different expected torque values it is possible optimize the system to determine which motor would be best to make Kaptain's system more representative of an actual turbine. To do this it was determined that the design limitations of the motor would be the current of 60 A, and voltage of 55 V. Using these limitations along with the proposed the modifiable scaling factor and torque an algorithm was designed using a large set of values form a data set of specified flight conditions. Using this data set it was determined that 600 ft*lb. was appropriate for an external torque value and the scaling factor (η) was used as a design variable. By using these design parameters, it was possible to select a motor that is able to be integrated into Kaptain's system that would allow for a more efficient design. The next step is to test the modified system.

**Supported by the McNair Scholars Program*

Thought Quantification with a Single-Channel EEG BCI

Washkewicz College of Engineering

Student Researcher: Michael Angelo De La Cruz Ortiz

Faculty Advisor: Eric Shearer

Abstract

BCIs (Brain Computer Interfaces) combine measuring and data analysis technologies to translate brain activity to computerized action. EEG (electroencephalography) measures electromagnetic brain activity non-surgically. However, effective non-surgical BCIs which can classify thoughts require multi-channel EEG measurement, such complex systems are un-optimal for the severely motor impaired, these are expensive, uncomfortable and unreliable in such dynamic environments. This project aims to expand on data processing methods to further optimize single-channel EEG BCIs. It is hypothesized that when an EEG signal undergoes FFT (Fast Fourier Transform) into partitioned activity at frequency ranges [Delta (0-4Hz), Theta (4-8Hz), Alpha (8-12Hz), Beta (12-30Hz) and Gamma(30-140Hz)], quantifying patterns in conscientious brain activity lies in how aforementioned values vary over time with respect to each other. To test this, a forty-eight-minute data set was recorded from one subject wearing a mind flex headset by Mattel to collect brain activity data while being instructed to think about the commands: up, down, left, right, forward and backward under detailed parameters of thought (imagining a written command and imagining a memory which defines a command). The data was computationally processed via a statistical PCA (Principal Component Analysis) algorithm; output was rendered as principal component scatter graphs. When the subject imagined words, the scatter graphs created condensed clusters of data points, each command having unique cluster shapes. Imagined memories defining a command resulted in more scattered data clusters relative to the latter. Furthermore, all scatter graphs had distinguishable cluster density difference between imagined words and imagined memories.

**Supported by the McNair Scholars Program*