2024 Undergraduate Summer Research Award Poster Session

Poster Number	Title of Poster

College of Arts & Sciences

1	Drivers of Dissolved Organic Matter in Reservoir Ecosystems
2	Sensitivity of the Lateral Line System of African Clawed Frogs (Xenopus laevis): Ability to Distinguish Between Nearby, Paired Wave Sources
3	Assessing Water Quality Variability and Optical Gradients in Sandusky Bay and Lake Erie Through Remote Sensing
4	Kinetic Liver Metabolic Adaptations to Fasting *
5	Using an ADCP in Reintroducing Freshwater Mussels (Unionidae) to the Cuyahoga River
6	Effects of Flow velocity on Sediment Type and Potential Mussel Habitats
7	Examination of TbRAP1 and TbCactin Interaction Interface
8	Determining DNA recombination Pathways Responsible for Telomeric and subtelomeric Recombination events in T. brucei Cells Depleted of Telomere Proteins
9	Investigating the Interactions Between Trypanosoma brucei PolIE and TRF Through Yeast-2-Hybrid Analysis
10	Associations between street-level greenness and firearm violence in Cleveland, Ohio
11	Restoration of Native Plant Communities in Meadows
12	Purification of M. jannaschii Dihydroorotase and Co-crystallization with Ligands
13	Understanding the evaporative enrichment of stable carbon isotopes in natural waters
14	Development and Characterization of a Small Molecule Agonist Targeting Epha2 Receptor to Suppress Glioblastoma Cell Proliferation
15	Profiling Sialidase Expression in Macrophages upon LPS Stimulation
16	Synthesis and Characterization of Sialidase Inhibitors
17	The Role of RNase L in EGF Homeostasi
18	The Origin of ISIS and its Founding Father*
19	The Examination of the Forbidden Fruit*
20	The Effect of the Pandemic on Developmental Mathematics: A Comparison of Fall 2019 and Fall 2023 Student Success
21	PAA Decay Modeling at Different Steps of Poultry Processing
22	Engineering a Reproducible Au(111) Flame Annealing Procedure
23	Effects of SesgP9eDrmTurbaraoly 9.72daodup4oefrn
26	Examining the Relationship between Intimate Partner Violence, Trauma, Attachment, and Help-Seeking Self-Efficacy*
27	Smart Surveys: Unleashing AI to Transform Organizational Assessments
28	Identifying and Challenging Orientalism in Schools to Support Arab Middle Eastern and North African Youth in U.S. Schools
29	Assessment of the Intersectionality of Muslim and Queer Identities*
30	Does Trauma Matter? Examining Trauma History Effects on Oral Ketamine Antidepressant Outcomes
31	Why worry on ketamine? Investigating individual differences in generalized anxiety disorder symptom treatment response and remission
32	Focusing on Fury: The Interplay of Attention Bias, Anger Rumination, and Social Emotion Regulation*
33	Effectiveness of Different Scene Coverage Styles in Film & Media Arts
34	Documentary Storytelling and Narrative Structure: Crafting Compelling Cinematic Narratives Through Editing
35	Archaeological Investigations at the Fort Hill Earthwork Complex 2024
36	Camp NeuroSparks: Exploring the Benefits of a 3 Day Program for Chronic Brain Injury Survivors and Their Caregivers
37	Advancing Care for Chronic Traumatic Brain Injury: A Review of Current Practices and Strategies for Addressing Service Gaps
38	The Impact of Adverse Childhood Experiences on Child Development and Communication: A Systematic Review of the Literature*

2024 Undergraduate Summer Research Award Poster Session

Poster Number	Title of Poster
39	The Feasibility of Group Music Therapy in Addressing Mental Health Needs of Unhoused Persons
40	Investigation of Dynorphin B serum concentration in controls versus stimulated mice using stereotaxic surgery
41	Functional Results of Percutaneous Reduction of Calcaneal Fractures and Posterior Arthroscopic Subtalar Arthrodesis (C-PASTA)

Levin College of Public Affairs and Education

42	Artificial Intelligence and K-12 Education: Current Directions and Tools for Educators
43	“Take Us Seriously”: Youth Experiences in Education, Activism, and Research
44	The Landscape of Newcomer Education in Northeast Ohio: Insights from Educators and Non-Profits

Washkewicz College of Engineering

45	Factors impacting the formation of Pickering emulsions stabilized by hexagonal boron nitride nanosheets
46	Creation and Characterization of an ELP-based Bioink
47	Computational Analysis of Blood Flow through Diseased Aorta
48	2D Functional Materials for Carbon Dioxide Capture from Air
49	Exploring an Integrated Sensing and Communications System
50	Generating a Dataset for Deep Reinforcement Learning*
51	Clock Glitch based Fault Injection Side Channel Attacks against AES
52	Detectron 2 Applications in HealthCare
53	Rapid Detection of Antibiotic Resistant Bacteria
54	Developing a Digital Twin Demonstration System for Parcel Sortation
55	Studying the Microstructural Evolution and Property Optimization of 316H Stainless Steel: Selective Laser Melting and Spark Plasma Sintering
56	Microstructure, Mechanical Properties, and Oxidation Behavior of Low-Density AlCuFeNiTi High Entropy Alloys
57	Synergistic enhancement of mechanical and tribological properties of Multiwalled Carbon Nanotubes reinforced IN718 composites
58	Ti-BNNT Metal Matrix composite processed by SPS: Microstructure, Mechanical properties, and Biocompatibility
59	Predictive Modeling of Wind Speed and Solar Radiation for Hybrid Energy Systems in Ohio
60	Integration of Wind and Solar Hybrid Systems in Electric Vehicle Charging Infrastructure
61	Developing Methods for Testing the Electrical Conductivity of Hydrogel/Conductive Nanoparticle Composites
62	Hybrid Electric Aircraft Propulsion Motor Design*
63	Thought Quantification with a Single-Channel EEG BCI*

*McNair Projects

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 accum/5eva/5eva/5i65cn

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

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

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.scidloeo72446 TDii.wr79f1ric.2(cic0l)-5.5(V

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

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:

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. Lipopolys1. Lipopolys1. LeTes upon

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 0ow[(propose a8(S83ive groups, c mm)521 e-1.4(ic21 e-1l5tfp63ch gal5tfp63efam funct3.2 Tw[(l

The Role of RNase L in EGF Homeostasis

College of Arts and Sciences

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 ≥ 2.0 and credit completion ≥ 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 conductiv

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

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 M renlym.6(cw4e decay)ithhd5 TVd gr11.9810

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 bystt

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

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

College of Arts and Sciences

Student Researcher: Hayley Vance

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, interpersonal attention strat655 0 Tdeal3.712 0 3[(Si011 Tc-.0065 c32

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

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:

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

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

[1]*Ashland University*

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

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

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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

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.

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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

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

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 manufmanuce p e9rTc.109rd.5 m 51acii[(m8 man)-5.7(u)-

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 ($2.1x10^{-4}$ and $0.398x10^{-4}$) 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.

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.

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