2022 UNDERGRADUATE RESEARCH POSTER SESSION

Student Center Atrium

September 22, 2022

12 PM - 3 PM

ABSTRACTS

ENGAGED LEARNING

Office of Research

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2022 Undergraduate Summer Research Award Poster Session

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2022 Undergraduate Summer Research Award Poster Session

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The Life and Activism of Gloria Richardson in the Civil Rights Movement

College of Arts and Sciences

Student Researcher: Angela Harris

Faculty Advisor: Thomas Bynum

Abstract

Abstract not provided

**Supported by the McNair Scholars Program*

Response Frequency and Turn Accuracy of African Clawed Frogs (Xenopus laevis) to Paired Stimuli with Delays: Effect of Stimulus Order and Frog Motion

College of Arts and Sciences

Student Researchers: Jacob Sherman, Julianne Schulte, Autumn Upper, and Salayna Hritz

Faculty Advisor: Jeffrey Dean

Abstract

The fundamental goal of this research study is to understand how sensorimotor systems influence the behavior of humans and animals. To understand how sensory elements, central nervous system circuits, and the skeletomuscular apparatus contribute to movement, work in our lab has primarily focused on the control of prey-capture in the aquatic African Clawed Frog, *Xenopis laevis,* that use their visual and lateral line systems to detect prey. Here we tested the frog's responses to single stimuli versus paired wave stimuli**,** with various delays between the stimuli in a pair. The wave stimuli were produced by briefly dipping plexiglass rods into the water. First, we tested whether the initial stimulus increases the probability of a response to the second stimulus. Second, we evaluated cases where the frog responded to the initial stimulus and was in motion when the second stimulus occurred, in order to examine influences of the frog's movement on responsiveness and turn accuracy.

Frogs did indeed respond more frequently to double stimuli. Latencies from the first stimulus were longer; those from the second stimulus were shorter. Frogs often responded to each stimulus in turn. As expected if the frog was turning or kicking when the second stimulus occurred, response frequency decreased; unexpectedly, response frequency increased if the frog was gliding. Turn accuracy appeared similar for turns to the first and second stimulus.

Determining the contribution of LIN28B in PUM1 mediated fetal hemoglobin repression

College of Arts and Sciences

Student Researchers: Nikhila Telagarapu and Anita Dhara

Faculty Advisors: Merlin Nithya Gnanapragasam and Mahesh Ramamoorthy

Abstract

β-thalassemia is one of the most common autosomal recessive disorders. It is caused due to an inheritance of two mutated copies of the HBB gene. For this hereditary condition, clinical trials are now being conducted. A novel direct target of EKLF is the RNA-binding protein called Pumilio homolog 1 (PUM1), which controls the target mRNA's 3'-UTR post-transcriptionally. By inhibiting let-7d miRNA and BCL11A, two of Lin28b's targets, we will investigate if Lin28b facilitates the induction of HbF.

Pumilio homolog 1 (PUM1), an RNA-binding protein, is a novel direct target of EKLF, which post-transcriptionally controls the target mRNA at its 3'-UTR, according to our RNA-seq and ChIP-seq results. We discovered that the 3'-UTR of fetal HBG1 has two PUM1 core consensus binding sites and a knock down of PUM1 leads to the induction of γ-globin-protein levels through post transcriptional regulation. Therefor it is hypothesized that a knock down upregulates fetal γ-globin expression both directly and indirectly but Lin28B induction of Lin 28B.

We will test whether Lin28b promotes the induction of HbF post-transcriptionally via downregulation of two of its targets, let-7d miRNA and BCL11A. We have identified shRNAs that can knock down Lin28B in human erythroid cells. We will perform a double knockdown of both LIN28B and PUM1, to investigate the contribution of LIN28B, an activator of fetal hemoglobin, in PUM1 mediated fetal hemoglobin induction.

In conclusion, we propose that PUM1, a post-transcriptional repressor of fetal hemoglobin and a potential therapeutic target for fetal hemoglobin induction to ameliorate diseases such as sickle cell anemia and beta-thalassemia, acts on Lin28b, an previously identified activator of fetal γ-globin. This is because Lin28b is upregulated upon PUM1 knockdown and harbors multiple putative PUM1 binding sites in 3’UTR. Our future studies will indicate whether Lin28b is indeed downstream of Pum1 as its target towards modulating γ-globin mRNA and whether this can be harnessed as a potential therapeutic strategy towards ameliorating β-thalassemia.

A Rapid Optical Assessment of Phytoplankton Composition in Lake Erie

College of Arts and Sciences

Student Researchers: Paige Dillen and Sophia Volak

Faculty Advisor: Brice Grunert

Abstract

Earth's biogeochemical processes are increasingly altered by human activity. This is particularly true in Lake Erie where we have observed increasingly severe harmful algal blooms (HABs). HABs threaten the safety of our freshwater resources and can imperil important native species. Using remote sensing and optical analysis, we can rapidly characterize phytoplankton biomass and composition; however, methods are in need of further development. Throughout Lake Erie's central and western basins, we collected and filtered water samples to analyze for phytoplankton absorption. Filters were analyzed using a spectrophotometer with an external integrating sphere. Collected absorption spectra were then used for Gaussian decomposition, or analysis of phytoplankton pigments. These Gaussian curves, or "bumps" represent specific pigments which provide us with information about the composition of varying species of phytoplankton in Lake Erie. Using this data, we plan to improve our satellite observing capabilities, enabling opportunities to understand and forecast HABs for improved water quality.

Characterizing Phytoplankton Pigments from Hyperspectral Reflectance Data

College of Arts and Sciences

Student Researchers: Sophia Volak and Paige Dillen

Faculty Advisor: Brice Grunert

Abstract

Changes in biogeochemical properties within the Great Lakes have resulted in increasing water quality concerns, with harmful algal blooms as the most visible impact of these changes. Harmful algal blooms threaten ecosystem diversity as well as critical freshwater resources. Using optical properties and remote sensing, characterization of different phytoplankton species can be predicted throughout the central and western basin of Lake Erie at high spatial and temporal scales. At 19 stations, water and radiance data was collected using different instruments, including the Spectra Vista Corporation HR512i. Once collected, raw hyperspectral data was processed using a series of functions and models to create a uniform remote sensing spectra. This spectra shows the reflection at each station at varying wavelengths along the visible light spectrum, and reflects the unique biogeochemistry observed at each station. The reflectance observed in the spectra showed higher reflectance on blue and green visible light than other colors. These peaks in the spectra can be used as spectral indicators for unique phytoplankton species. Categorizing phytoplankton based on absorption properties could allow for greater tracking of different species of phytoplankton, as well as concentration of certain species and times lines of HABs each year. Increased understanding of HABs will assist water quality managers, reducing harm to ecosystems and helping determine what ecosystem conditions different species thrive under.

Generating Knockout and Tagging Constructs for Various Trypanosoma brucei Genes

College of Arts and Sciences

Student Researcher: Elaina Casteel

Faculty Advisor: Bibo Li

Abstract

According to the world health organization, Human African Trypanosomiasis (Human African Sleeping Sickness) recorded over 660 cases in 2020 and over 800 cases in 2021. This infection is transmitted through the parasitic protozoan known as Trypanosoma brucei. Once infection has taken place, this parasite is able to evade the host immunity by regularly changing its variant surface glycoprotein (VSG), its major surface antigen. The VSG is located in the sub telomere region and expressed mono-allelically. By having the ability to repeatedly switch what major surface antigen is present, the parasites become highly evasive to the host immune cells and are able to sustain long term infections. If left untreated, the result is often fatal.

To possibly combat these parasites, the variant surface glycoprotein switching needs to be inhibited. We hypothesize that by being able to manipulate genes with functions directly relating to the VSG switching and telomeric protection, we may be able to decrease the prevalence of Trypanosoma brucei infections in human hosts. In this experiment, we created several different knockout and tagging constructs. Some of the current and completed knockout and tagging constructs include BRCA2, DNA Ligase1, and Tb13400. The results show that the BRCA2 3'UTR and 5'UTR have been successfully cloned into a plasmid. These plasmids may be used in further testing for their effect on Variant Surface glycoprotein functionality in the cell.

Health and Mortality of Girdled Trees After 4 Years

College of Arts and Sciences

Student Researcher: Robert Moore

Faculty Advisors: Sam Harbol[1], Katie Stuble[1], and Kevin Mueller

Abstract

Abstract: Tree girdling is a forest management technique conducted within Working Woods in Holden Arboretum on 20% of the forest canopy between 2018 and 2019. Working Woods is a posts agricultural forest which can be characterized by low species diversity, structural homogeneity, and high levels of invasive species. Forest management can be used to improve the health of structure of these areas. Tree girdling is a forest management strategy designed to resemble natural disturbances in forests. These disturbances create canopy gaps which increase light levels to the forest floor helping to:

- Improve successional development
- Maintain biodiversity
- Influence nutrient cycles

We have assessed the health of a subset of the girdled trees within Working Woods of Holden Arboretum to evaluate the impacts of the girdling treatment.

[1]Holden Arboretum

The Impact of Soil Compaction on Soil Moisture Dynamics of Honey Locust, Red Maple, and Norway Maple Trees in an Urban Environment

College of Arts and Sciences

Student Researcher: Cyenna Ulrich-Cech

Faculty Advisor: Kevin Mueller

Abstract

Soil compaction, a result of urbanization, may be detrimental to the soil moisture dynamics and health of urban trees which subsequently limits their ecosystem services. This study considers two hypotheses: higher compacted soils will negatively impact soil moisture dynamics of red maple, Norway maple, and honey locust tree species on campus; and there will be a difference in the soil moisture dynamics between tree species due to varying tree traits. A preliminary survey was conducted on trees of interest to gather health metric data, and soil compaction, soil texture, and water holding capacity were measured. Additionally, soil moisture measurements were taken throughout the duration of this study for further analysis. In regard to all 36 trees of interest, the lowest soil compaction measured was 243.25 PSI with the highest measurement at 766 PSI, providing a wide range of variability. The average water holding capacity measured was 1.828 g/g and the average percentages of sand, silt, and clay were measured at 56.92%, 27.30%, and 15.77% respectively. 7 total soil moisture events were measured and the lowest soil moisture measurement within the full dataset was 1.85% with the highest at 22.60%, again showing a wide range of variability. Further analysis of the data suggests a relationship between the soil compaction and the health of the tree as well as shows a significant difference between the two maple and honey locust species. Future studies may closer look at the potential relationship between soil compaction and soil moisture dynamics within urban environments.

**Supported by the McNair Scholars Program*

Comparative Analysis of Urban Market, Urban Community, and Rural Garden Weeds

College of Arts and Sciences

Student Researchers: Sarah Green and Brielle Paul

Faculty Advisor: Emily Rauschert

Abstract

Analyzing garden weed communities in urban market, urban community, and rural gardens, provides necessary knowledge of urban and community agriculture. The practice of agriculture in urban environments has grown due to heightened interest in supporting local farmers, increasing food availability, and decreasing one's carbon footprint. Therefore, an understanding of what weeds are present in a garden and how to address them is crucial for organic gardens to produce consistent, quality crops for its community and/or customers. To evaluate the weed communities that are present in each garden a field survey was conducted to produce the germinated weeds species richness and abundance. The study focuses on three different types of gardens: urban market, urban community, and rural gardens. The urban community and urban market gardens in this study are in the city of Cleveland while the rural gardens are in surrounding counties of Cleveland. The field weed community surveys were conducted using a 1 x 1 meter plot separated into 3 x 3 quadrants for a total of 9 sections. For each site, there were 10 plots for three different areas including the garden itself, the perimeter, and the lawn (areas within the non-garden interior). Every species present within each plot was recorded with the species name, the location within the quadrant, how many quadrants it was present (quadrant frequency), and the percent cover class per quadrant. In addition, photos of each survey plot were taken. The data from this study will be used to compare urban market to urban community gardens as well as urban community to rural community gardens. This data will determine if the current gardening practices are having an effect on individual gardens and/or garden types.

SFRP-4, TLRs, and EVs Signaling Play Critical Roles in Type Two Diabetes

College of Arts and Sciences

Student Researcher: Anthony Graley

Faculty Advisor: Ángel L. Reyes-Rodríguez

Abstract

Type two diabetes mellitus is a metabolic disorder characterized by insulin resistance and insulin deficiency that resulted from the expression and suppression of polygenic-based signal pathways while under hyperglycemic conditions. These pathways often result in pancreatic β-cell dysfunction, β -cell apoptosis, and poor metabolic control. Available glycemic control treatments are often inefficient and therefore, there is a need for additional therapeutic treatments and targets. To better understand the genetic complexities of type two diabetes, a literature review was conducted from scholarly articles, and a framework was built to explain the pathogenic pathways involved in type two diabetes. Specifically, Toll-like receptors (TLRs), Secreted Frizzled Related Protein Four (SFRP-4), and extracellular vesicles (EVs) were examined, and their interconnective inflammatory mechanisms explored. The study of how these pathways create feedback loops among each other that have the potential to result in the identification of novel therapeutic targets that better regulate this complex disorder.

**Supported by the McNair Scholars Program*

Isolating Life Cycle Stages From a Colpodella sp. (ATCC 50594) Diprotist Culture Using Percoll Gradient

College of Arts and Sciences

Student Researchers: Mary Asraf and Mahdi Salti

Faculty Advisor: Tobili Sam-Yellowe

Abstract

Colpodella species are predatory protists that prey on algae and bodonids. In the literature, two human *Colpodella* species causing opportunistic infections have been reported. *Colpodella* species are phylogenetically closely related to pathogenic Apicomplexa that cause important human diseases like malaria, toxoplasmosis and cryptosporidiosis. Understanding the process of predation, known as myzocytosis will provide insights into the development of intracellular parasitism among pathogenic Apicomplexa. Recent studies using the model organism *Colpodella* sp. (ATCC 50594) have identified developmental stages in the life cycle in culture. However, synchronized life cycle stages have not been isolated. In order to facilitate investigations of life cycle stages of *Colpodella* sp. (ATCC 50594) and its prey, we performed Percoll density gradient centrifugation of diprotist cultures. In this study, we utilized discontinuous Percoll gradients to separate and synchronize trophozoites, cysts and bacteria present in the diprotist culture. Gradient fractions were formalin-fixed and stained with Sam-Yellowe's trichrome stain. Preliminary data from gradients of 10 % (top), 15 %, 30 % and 40% (bottom) show that cysts of both predator and prey could be separated and contained in the middle of the 30 % layer, trophozoites at the 15-30% interface and bacteria and young trophozoites in the middle of the 15% layer. The data demonstrates the feasibility of synchronizing life cycle stages of predator and prey using Percoll gradients. We will perform refractometry to determine the densities of the Percoll fractions containing each life cycle stage.

Elucidating mechanisms that prevent meiotic cohesin function in mitotically dividing embryos

College of Arts and Sciences

Student Researcher: Andrew R. Blazer

Faculty Advisor: Aaron F. Severson

Abstract

Meiosis is the process by which diploid cells divide to form haploid gametes. In contrast, mitosis involves the division of a cell into two genetically identical diploid daughter cells. One key difference between these two processes lies in the cohesin complexes involved. The cohesin complex is a ring comprised of 3 proteins that mediates sister chromatid cohesion (SCC) starting during S-phase DNA replication and continuing until one protein, called the kleisin, is proteolytically cleaved during anaphase. The kleisin subunit differs during meiosis and mitosis and imbue meiotic and mitotic cohesins with distinct properties. In *C. elegans*, kleisin subunits REC-8, COH-3, and COH-4 are meiosis specific, while SCC-1 is required during mitosis. Previous studies have shown that REC-8 levels decrease sharply entering meiosis and implicated the PROM-1 protein as part of an SCF ubiquitin ligase complex that triggers this decrease of REC-8; however, the functional significance of this process is unknown. We hypothesize that PROM-1 is required to destroy REC-8 cohesin complexes that do not load onto chromosomes during meiosis to ensure that they are not inherited by mitotically dividing embryos. To test this hypothesis, we have used genetic crosses to build double mutant *C. elegans* strains lacking *prom-1* as well as *tim-1* or *scc-2*, genes encoding factors that promote chromosomal loading of REC-8 cohesin.

Establishing methods to induce meiotic cohesin expression in mitotically dividing embryos

College of Arts and Sciences

Student Researcher: Kendra C. Brown

Faculty Advisor: Aaron F. Severson

Abstract

Cell proliferation and gametogenesis occur through one of two nuclear division processes, mitosis or meiosis. Mitosis requires one round of cell division and results in two daughter cells with nuclei identical to that of the parent cell. Whereas meiosis involves two rounds of cell division and produces haploid gametes. In both processes, cohesin plays a pivotal role in chromosome dynamics. Cohesin is a tetrameric protein complex that forms a ring-shaped structure that tethers homologous chromosomes and sister chromatids together. An essential subunit of the cohesin complex, known as the α-kleisin, differs between mitosis and meiosis. The meiosis-specific kleisin REC-8 is essential for the production of haploid gametes in most eukaryotes. Paradoxically, staining levels of REC-8 in C. elegans are dramatically reduced upon meiotic entry in wild-type strains, and undetectable in htp-3 mutants that fail to load REC-8 onto meiotic chromosomes. We hypothesize that chromosomally unbound REC-8 cohesin is destroyed to prevent the complex from being inherited by mitotically dividing, fertilized zygotes in which it could cause aneuploidy, infertility, or lethality in the worms. To test this, we are using classic genetics, PCR, and CRISPR/Cas9 genome editing to make transgenic strains with a heat-shock promoter upstream of rec-8 to allow inducible REC-8 production in mitotically dividing cells. A study in mouse oocytes demonstrated that nearly 90% of age-related aneuploidies are likely due to weakened meiotic cohesion. Thus, understanding the regulation of meiotic cohesin is significant to human reproductive health and aging.

Regulation of the Oncogenic Androgen Receptor Variant 7 by micro and long noncoding RNAs in Prostate Cancer

College of Arts and Sciences

Student Researchers: Samantha Gargasz and Eviania Likos

Faculty Advisor: Girish C. Shukla

Abstract

The androgen receptor (AR) is a transcription factor that plays a pivotal role in the development and progression of prostate cancer (PCa). Normally, AR function is dependent on androgen binding. First-line treatments for PCa include androgen deprivation therapy (ADT), which exploits the ligand dependency in order to slow tumor growth. However, the disease can progress to hormone independence, enabling tumor growth without androgens. This can be caused by the development of AR variants within the tumor, some of which exclude the ligand binding domain (LBD) of the receptor. One such variant is AR-V7. Prostate cancers expressing AR-V7 are resistant to androgen deprivation therapy and androgen receptor inhibitors. It is more commonly found in metastatic and circulating tumor cells and is associated with poor prognosis and cancer recurrence. Better understanding of AR variants is necessary to develop treatments. Our lab examines AR on a post-transcriptional level, including how its interactions with micro and long noncoding RNAs impact expression. Based on previous work with the full-length AR, we plan to observe how AR-V7 interacts with various miRNAs and ARLNC1, a long non-coding RNA found almost exclusively in castration-resistant PCa tumors. In silico models suggest that these factors bind within the AR-V7 3'UTR, similar to validated binding sites on the full-length AR 3'UTR. Our lab plans to further investigate these predicted binding sites in vitro.

Purification of Methanococcus jannaschii dihydroorotase and progress towards its co-crystallization with substrates and analogs

College of Arts and Sciences

Student Researcher: Alyssa K. Davis

Faculty Advisor: Jacqueline Vitali

Abstract

Dihydroorotase catalyzes the reversible cyclization of N-carbamoyl-L-aspartate (CA) to L-dihydroorotate (DHO) in the third step of de novo pyrimidine biosynthesis. The reaction is pH dependent, at low pH the biosynthetic reaction is favored, CA → DHO, and at high pH the degradative reaction (DHO → CA) is favored. In this poster we describe the purification of the enzyme from the archaeon *Methanococcus jannaschii* and our progress towards its co-crystallization with substrates and analogs. The overall goal of the project is to determine how the substrates bind and the conformational changes in the protein upon binding of each substrate. The purification consisted of an ammonium sulfate cut, a heat step, and cation and hydrophobic interaction chromatographies. The crystallizations were done with the hanging drop method using both substrates, CA and DHO, and citrate, which is an analog of CA. Our progress on the project will be discussed in the presentation.

The Evolution and Morphological Change in Keratella cochlearis

College of Arts and Sciences

Student Researchers: Semra Dervisevic and Claudia Tausz

Faculty Advisor: Julie Wolin

Abstract

Organisms in the phylum Rotifera are vital for freshwater environments; they have a short development time, fast turnover, high production, circulate organic matter, and aid in energy transfer (Li, Cheng, & Chen, 2005). However, they are becoming increasingly difficult to characterize by molecular studies due to cryptic genetic differences that are not reflected in their morphology. This is due to the sensitivity based on responses to environmental parameters such as water temperature and chemical cues from predators (Stemberger & Gilbert 1984, Green 2005). This arises the need to identify the presence and geographic distribution of cryptic species complexes; this study reports findings across the ecoregions of the U.S from collected samples by the National Lakes Assessment in 2017. *Keratella cochlearis* were first isolated from these samples, washed off with TE buffer, had their DNA extracted, and then sent to Functional Biosciences for their DNA to be amplified through a PCR and then Sanger sequenced. The expected results include that those sites with higher densities and larger shapes to have undergo evolution and thus have more abundant cryptic species complexes present (Chen et al., 2012).

**Partially supported by the McNair Scholars Program*

Fingerprinting summer storm events using stable isotope ratios of rainwater in the Great Cleveland Area

College of Arts and Sciences

Student Researcher: Jalen Nunley

Faculty Advisor: Fasong Yuan

Abstract

As the temperature of the earth's surface increases annually global warming has been more of a concern. As a result of this global warming there has been a proportional increase of annual rainfall. In the American Midwest the rainfall has increased from about 5-10 percent. There have been concerns that this warming/ rainfall will reach an apex and the earth’s hydroclimate will change permanently. This experiment is intended to study the rainfall in the Greater Cleveland area and to determine whether rainfall events have a particular isotropic fingerprint that can be determined. Over the summer of 2022 rainwater samples were collected and analyzed for their isotropic signature. We collected 36 rainwater samples encompassing the summer and used statistical methods to determine the mean and standard deviation. Also, for the complete rainfall events that we did collect we isolated those events and determined if there was any isotropic fingerprint or any similarities we can draw from. We concluded that after analyzing the samples there is a low enough standard deviation between samples, we believe that there is an isotropic fingerprint between them.

Quantification of Mercury in the Feathers of Purple Martins Nestlings in Lake County

College of Arts and Sciences

Student Researchers: Samantha DeSimio and Sarah Castle

Faculty Advisor: Erin Avram

Abstract

Many heavy metals bioaccumulate and biomagnify through the food chain, increasing the risk for adverse effects on reproduction and behavior in animals at higher trophic levels. Of particular concern are avian insectivores, which have been shown to have higher levels of heavy metal accumulation compared to avian species that are grainivores or omnivores. The current study quantified mercury in the feathers of Purple Martin (Progne subis) juveniles to evaluate the exposure to this heavy metal in four colonies of these insectivores in Lake County, Ohio. Juveniles (12 – 22 days old) were captured at the nesting gourds, then banded and breast feathers collected. The feathers underwent acid digestion and the mercury quantified using a flow-injection mercury analyzer. Since Purple Martins in Ohio are exclusively reliant on manmade structures for nesting, information about the impact of colony location on mercury accumulation will be useful for the planning of future Purple Martin colonies.

Modified Silver Nanoparticles Coated with Alginate Hydrogel as Drug Delivery Platform to Modulate Biological Function

College of Arts and Sciences

Student Researchers: Kara Timinski, Shaimaa Maher, Haitham Kalil, and Magdy Ibrahim

Faculty Advisor: Mekki Bayachou

Abstract

After lung cancer, breast cancer is the second main source of cancer-related deaths among women. A woman's lifetime chance of being diagnosed with invasive breast cancer has increased in the United States since 1975. Currently, there are various therapeutic modes available for clinical treatment of breast cancer. Some of the treatments include surgery, chemotherapy, and radiotherapy. The efficacy of these treatment options may be weakened by severe side effects like emergence of drug resistance. In addition, systemic distribution of anticancer drugs throughout the body without targeted accumulation at tumor sites decreases the efficacy of conventional chemotherapy. Nanotechnology provides platforms that decrease systemic by optimizing drug delivery. For example, drug-modified nanoparticles can stabilize drugs from quick degradation. This improves the efficiency of drug delivery by increasing the amount that enters the cells. Various biodegradable polymer nanoparticles have been developed as drug vehicles to treat breast cancer over the past few years. In this project, we studied if silver nanoparticles coated with an alginate hydrogel as a nanocomplex platform can produce higher cytotoxic effects in cancer cell lines compared to using silver nanoparticles without the alginate hydrogel. This research work consists of developing a preparation route for the composite alginate-based nanoparticles. Various analytical techniques were used to characterize the Alginate/AgNPs nanocomplex, including UV-vis spectroscopy, SEM/EDX spectroscopy, FTIR spectroscopy, TEM, and Zeta potential measurements. The UV–vis analysis of the nanoparticles-based platforms exhibits the typical surface plasmon peak of silver nanoparticles at around 400 nm. SEM images prove the expected spherical silver nanoparticles dispersed within the alginate hydrogel matrix. EDX analysis further confirms the presence silver nanoparticles within the meshed hydrogel network. FT-IR spectroscopic analysis Alginate/AgNPs nanocomplex was used to compare the changes in the alginate functional groups. We developed and validated a nanoplatform carrier system that can be further modified to embed one or more drugs within the alginate/AgNPs hydrogel platform for efficient drug delivery and multifunctional modulation of biological function in treated cells. In the future work, the cytotoxicity of each AgNP system (i.e., with and without Alginate) will be assessed using established assays such as the MTT assay to quantify the effect of the nanoparticle system on the metabolic activity of the MDA-MB-231 breast cancer cell line.

Optimization of FAZ1 inhibitors for Trypanosomiasis

College of Arts and Sciences

Student Researcher: Lucas Devole

Faculty Advisor: Bin Su

Abstract

African Trypanosomiasis, or African Sleeping Sickness, is an orphan disease found in Sub-Saharan Africa. It is caused by a protozoan in the genus Trypanosoma and is spread by the tsetse fly. The current treatments are experiencing resistance and possess harsh side effects. In earlier research, our lab discovered 2-piperazine-4-amino-6,7-dimethoxyquinazoline derivatives that showed high potency towards *Trypanosoma Brucei* by inhibiting FAZ1. To continue exploring this pharmacophore, we synthesized derivatives containing a triazine ring bonded to the open amine of the piperazine ring. We then tested the IC_{50} values and identified drugs, like compound 12 and 9, that showed high potency and selectivity for the Trypanosome.

Y Box Binding Protein in Triple Negative Breast Cancer

College of Arts and Sciences

Student Researcher: Aidyn Johnson

Faculty Advisor: Bin Su

Abstract

Y Box Binding Protein (YBX1) is a protein that is linked with tumor progression and treatment resistance. An azopodophyllotoxin small molecule, known as SU056, was synthesized that greatly inhibits tumor growth and progression by Y box protein inhibition. This inhibitor hinders cell proliferation, induces apoptosis in cancer cells, and stops cell cycle in the G1 phase. In vitro studies show that this drug delayed disease development by inhibition of the drug efflux and multidrug resistance 1. In vivo studies showed that SU056 independently restrains cancer advancement and reduces disease development with no observable liver toxicity. From SU056, our lab used different aldehydes to synthesize new candidates that would hopefully further inhibit cell progression in different triple negative breast cancer cell lines. We used nuclear magnetic resonance proton spectrum to confirm the structure of the new aldehyde compounds. To check if the cells had better cell inhibition than SU056, MTT assay was used. MTT showed that only one aldehyde had better cell inhibition than SU056 and that was AJ-7.

EphA2 Agonist for the Treatment of Glioblastoma Multiforme

College of Arts and Sciences

Student Researcher: Christia Tannous

Faculty Advisor: Bin Su

Abstract

The most malignant and typical form of primary astrocytomas is Glioblastoma Multiforme (GBM). It is responsible for more than 60% of all adult brain tumors. Despite the wide range of contemporary treatments available for GBM, the disease still has a very dismal prognosis and is fatal. Treatment protocols fail due to resistance and recurrence therefore there is an urgent need to identify new therapeutic candidates. In GBM cell lines, EphA2 regulates vascular endothelial growth factor receptor 2 expression at both the gene and protein levels. EphA2 activation inhibits integrin-mediated adhesion, cell motility, and dissemination. Therefore, the cells on which EphA2 is expressed may have a propensity to be more motile, invasive, and rapidly developing when EphA2 is present in its inactive state. Approximately 90% of GBM tissues and cell lines that we examined had increased EphA2, whereas normal brain did not. In Dr. Su's lab, we identified that the antihypertensive drug Doxazosin as an Epha2 agonist. Preceding, an analog library displayed first findings that suggested increased *in vitro* potency towards glioblastoma. Moreover, restoration of the Ephrin a1 Epha2 axis' conical route, by the use of doxazosin stops migration and triggers apoptosis. A library designed around a triazoline scaffold was created in order to continue producing more potent analogs. Although our efforts resulted in compounds with similar potency this work provides details of structure activity relationships.

Profiling Sialidase Expression of Monocytes upon LPS Stimulation

College of Arts and Sciences

Student Researchers: Christopher Garrett and Majdi Aljohani

Faculty Advisor: Xue-Long Sun

Abstract

Sialic acids (Sias) are commonly found as terminal monosaccharides bound to glycoconjugates on the cell surface. They play crucial roles in numerous biological functions, such as bacterial and viral infection. 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 their optimal pH, subcellular localization, and substrate specificity. Herein we investigated the effect of LPS on the THP1 monocytes and found a higher expression of Neu1, which cleaves terminal sialic acid residues from host glycoproteins (desialylation). Primarily, we noticed that LPS stimulation significantly reduces the total Sia level in LPS treated THP-1 monocytes. Furthermore, we found that Neu1 protein increased significantly in the culture media following LPS treatment. These results indicate that bacterial infection may cause Neu1 sialidase expression, which may result in desialylation of TLR4, thereby initiating the inflammatory signaling pathway, which deserves further investigation.

RNase L mediates spike protein-induced responses in bone marrow derived macrophages & A549 cells

College of Arts and Sciences

Student Researchers: Victor Lufi and Xiaotong Zhao

Faculty Advisor: Aimin Zhou

Abstract

Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) is the causative agent of coronavirus disease 2019 (Covid-19). The virus infects millions of people and causes serious lung inflammation, pneumonia, and acute respiratory distress syndrome (ARDS) in vulnerable individuals, leading to a worldwide pandemic and a global health crisis. The SARS-CoV-2 spike protein (S-Protein) is one of the main targets in understanding the virology of SARS-CoV-2, due to its interactions with the TLR4 receptor on myeloid cells, resulting in exaggerated immune response in the body. Ribonuclease L (RNase L) is an interferon (IFN)-induced protein that functions in IFN action against viral infection and cell proliferation. In this study, we found that RNase L mediated S-protein-induced responses in bone marrow derived macrophages (BMDM) and A549 lung cancer cells, suggesting that regulation of RNase L may be a novel strategy for COVID-19 treatment.

Ground Level interactions in the Panama Canal Zone

College of Arts and Sciences

Student Researcher: Benjamin King

Faculty Advisor: José O. Solá

Abstract

The prevailing academic consensus in the United States of the relationship between the countries of Panama and the United States has shifted during the last two decades. The idea that the relationship between the two nations was based on the United States acting as a beneficent "big brother" to a fledgling democracy is no longer the commonly accepted version of history. Instead, the consensus has moved towards a more unvarnished and nuanced view in which the United States did offer many benefits to the young nation of Panama; the relationship between the two countries was also less nurturing and more imperial and neo-colonial than previously accepted. This research project aims to answer the following question, what were relations like in and around the Canal Zone? Using oral histories of the residents and neighbors of the Canal Zone that were conducted by the Panama Canal Historical Association and Archive at the University of Florida, this research project examines the thoughts, opinions, and feelings of those who lived in the imperial borderland during the US occupation of the Canal Zone. The analysis of these oral histories has led to the conclusion that the United States routinely took advantage of the young country under its dominion while importing a discriminatory and racially segregated system of government into the ten-mile-wide swath of land bisecting the country of Panama. This research project helps to give voice to previously ignored or unheard local voices.

**Supported by the McNair Scholars Program*

Protecting information with linearized polynomials

College of Arts and Sciences

Student Researchers: James Iler and Kyle Traum

Faculty Advisors: Hiram H. López and Ivan Soprunov

Abstract

In Cryptography, a popular object of study is the McEliece Cryptosystem, which utilizes error-correcting codes to protect messages from eavesdropping when transmitted over insecure channels. A popular coding scheme for this purpose is that of the Goppa code, which can be described in terms of a subfield subcode. A well-known result relating to subfield subcodes is Delsarte's Theorem, which relates the subfield subcode and trace of a code via the notion of duality. Passing instead to the less restrictive concepts of subspace subcodes and linearized polynomials, we were able to generalize Delsarte's Theorem. In the process, we defined the dual polynomial, and examined some of its properties in special cases. Finally, with the Generalized Delsarte's Theorem, we were able to produce a candidate for a Generalized Goppa Code, which may have applications in the McEliece Cryptosystem.

The Therapeutic Function of Music in Meeting the Social/Emotional Needs of Middle Schoolers

College of Arts and Sciences

Student Researcher: Jessica Spore

Faculty Advisor: Deborah Layman

Abstract

The purpose of the current study was to examine how music therapy interventions may assist middle schoolers who have been identified as having social and emotional challenges. Our aim was to examine how music therapy sessions, focused on the musical elements of rhythm and form, affect adolescents' emotional state and ability to identify coping skills. The need for this study was highlighted by research suggesting that active music-making interventions–utilizing improvisation, movement, and instrument play–can enhance processing of and distraction from negative emotions/events, relieving stress, enabling coping strategies, and strengthening social relationships. Additionally, neuroscience research shows that rhythm is processed in the same areas of the brain where emotional regulation occurs. This single-subject pilot study consisted of two middle schoolers who were identified as having social and emotional challenges. Emotional state was measured at the beginning and end of sessions, using a 10-point Likert scale, and coping skills were measured using frequency recording throughout sessions. Preliminary analysis demonstrated that music interventions, focused on rhythm and form, may 1) improve adolescents' emotional state and 2) assist adolescents in identifying how to cope with social and emotional difficulties. Overall, more research should be conducted on the efficacy of active music-making interventions as a non-pharmacological treatment for social and emotional vulnerabilities.

Achieving Reproducible Atomically Smooth Au (111) Surfaces

College of Arts and Sciences

Student Researcher: Jordan A. Miller

Faculty Advisor: Jessica E. Bickel

Abstract

Organic electronics are interesting for use in bendable or more eco-friendly electronics but struggle to compete with inorganics due to their low conductivity. The conductivity of these organic materials can be increased through crystallization. One method to drive crystallization is self-assembly via an atomic surface reconstruction. This work aims to produce atomically flat Au (111) surfaces through flame annealing. Previous work in our group was able to achieve flat terraces but suffered from issues with reproducibility. By switching to larger propane and oxygen tanks, we can demonstrate consistent temperatures over several weeks. Additionally, the setup is altered so the sample, thermo-probe and nitrogen flow stayed stationary, and the position of the flame is altered to change temperature settings, which allows better control over the annealing. The Au (111) samples are annealed in a nitrogen flooded environment with a two-stage process that holds the sample at a higher temperature for 2 minutes and then at 400 ± 10°C for 3 minutes. In this work, we vary the higher temperature between 650 ± 10°C to 750 ± 10°C and examine the effect of time between 2 minutes and 3.5 minutes. Samples are analyzed using a scanning tunneling microscope (STM) and we find that temperatures above 730°C roughen the Au (111) surface or take the Au (111) off completely. The effects of anneal time at the upper temperature anneal were also evaluated and we find that holding the sample between 650°C and 670°C for 3 minutes and then at 400 ± 10°C for 3 minutes produces the flattest surfaces. Future work will include testing longer anneal times at lower temperatures to obtain larger, flatter terraces.

Development of Micromixing Strategies Using Elements of Elongational Flow

College of Arts and Sciences

Student Researcher: George Tomaras

Faculty Advisors: Chandrasekhar Kothapalli and Petru S. Fodor

Abstract

Computational fluid dynamics modeling was used to characterize the effect on mixing of the integration of constrictions formed by the vertices of hyperbolas into a serpentine channel. The new topology exploits the combination of Dean flows formed in the curved sections due to the centrifugal forces experienced by the fluid, with the elongational flows experienced at the constrictions. The latter result in backstep flows associated with the divergence of the fluid out of the constriction. The resulting complex flows enhanced mixing by promoting chaotic advection. Optimization of the mixers with respect to the improvement in the mixing performance relative to simple serpentine designs identifies designs in which the mixing index is over 0.80 for low Re, compared to ~0.53 for the simple serpentines, and rises above 0.95 for Re > 40, both within two mixing cycles.

What's it like next to a cloud?

College of Arts and Sciences

Student Researcher: Jacob Forester

Faculty Advisor: Thijs Heus

Abstract

Due to a lacking theoretical model of cloud-environment interactions, clouds are one of the largest sources of uncertainty in climate models. The purpose of this study is to better understand how humidity is distributed around a cloud, particularly as a function of elevation and as a function of windshear, based on high resolution Large Eddy Simulations. We find the relationship between humidity and distance to be one nearly of exponential decay that reaches a bottom limit of about 90% relative humidity for the distances observed, and at cloud base has a length scale of about 400m. As we increase elevation, we find that this length scale decreases proportionally. Furthermore, we then investigate how our humidity distribution changes as we look in specific directions with respect to windshear. At cloud base there is little to no difference in the length scale between the direction of and opposite of windshear; however, at higher elevations, the direction opposite of windshear has the shortest length scale.

Understanding the Scattering by Polystyrene Microspheres

College of Arts and Sciences

Student Researchers: Collin Douglas and Patrick Herron

Faculty Advisor: Kiril A. Streletzky

Abstract

Using scattering methods (Static Light Scattering (SLS), Dynamic Light Scattering (DLS), and Small Angle X-ray Scattering (SAXS)) we studied structure and dynamics of polystyrene microspheres of various sizes in suspensions of different concentrations as a model system for polymeric microgels studied/to be studied with the same methods. SLS utilizes average light scattering off samples at varying angles to determine the molecular weight (M_w) and radius of gyration (R_g) of the sample using Zimm analysis. The samples form factor ($P(\theta)$), the ratio of intensity to zero angle intensity, was also determined and plotted against known form factors of simple geometrical shapes using Kratky plots. SAXS is similar to SLS but should provide a greater resolution for particle structure over wider size range. DLS utilizes fluctuations of scattered light to determine particle diffusion and hydrodynamic radius (R_h). M_w and R_h can then utilized to determine apparent density (ρ) of the spheres. In this project, we were able to confirm by SLS and DLS the spherical shape and accepted sizes of microspheres. However, the methods became less accurate in determining R_g and M_w for larger and extremely low concentrations of microspheres, which is expected. Issues with low concentration emphasize the need of sample filtration while scattering by larger probes illustrated resolution limit of light scattering setup and strong effect of sample polydispersity. SAXS is being performed to obtain R_g, M_w, and ρ with improved resolution for comparison with light scattering.

On the Importance of the Direct Measurements of the Specific Refractive Index for Microgels and Micelles

College of Arts and Sciences

Student Researchers: Patrick Herron and Collin Douglas

Faculty Advisor: Kiril A. Streletzky

Abstract

Specific refractive index (dn/dc) is the change in solutions' index of refraction as concentration of a solution changes. When static light scattering (SLS) is used to determine structural properties of scatterers in a solution, a separate measurement of dn/dc on the same solutions is crucial to obtain dependable results for molecular weight as a 5% dn/dc error causes a 10% Mw error according to scattering theory. This project is focused on dn/dc measurements for microgels of various crosslinking density, ELP micelles of various composition, and polystyrene spherical standards of various sizes using a Brice-Phoenix Refractometer. The dn/dc values measured were shown to depend on size and concentration of particles, composition of microgels and micelles, and temperature of solutions tested. Here we present how dn/dc results affect Mw values deduced from SLS for microgels and ELP micelles highlighting the critical importance of direct dn/dc measurements for solutions of interest in light scattering.

The Effects of Dual Trauma and Assortative Mating

College of Arts and Sciences

Student Researcher: Madison Slayton

Faculty Advisor: Elizabeth Goncy

Abstract

In the present study, we examined the concept of assortative mating, which means that people tend to find partners who are similar to themselves. Prior research has primarily focused on areas such as attraction and personality, with less evidence on couples who have experienced trauma. Further, less evidence is available about couples who have experienced trauma. The first focus was to detect whether couples who have experienced similar levels of trauma gravitate towards each other using the concept of disordered familiarity and assortative mating. The second question examined whether individual personality traits were also similar, and whether these associations were also evident regarding relationship satisfaction. In our study, 49 couples (N = 98 participants) ranging from ages 18-30 participated in an in-lab protocol. Several measures such as a Relationship Assessment Scale, PTSD Checklist for DSM -5, and the International Personality Item Pool were used for further analyses to examine relationship satisfaction, trauma, and the Big Five personality within couples. Only within couple correlations were shown for openness on the big five personality scale (negatively correlated) and relationship satisfaction (positively correlated). The implications of this work suggest that as one partner reports more openness, the other reports less openness. However, for relationship satisfaction, each partner's relationship satisfaction increased together.

Keywords: Dual-Trauma, Assortative Mating, Disordered Familiarity, Mate selection, Adverse Childhood Experiences, Childhood Trauma, Adultization

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Adverse Childhood Experiences in Relation to Substance abuse and the Moderating Role of Antisocial Traits

College of Arts and Sciences

Student Researcher: Sydni Davila

Faculty Advisor: Elizabeth Goncy

Abstract

Adverse childhood experiences (ACEs) can lead to numerous negative outcomes such as higher rates of antisocial traits, substance use and abuse, and other health risk behaviors. Health risk behaviors make up a substantial portion of deaths in the United States so targeting these behaviors can significantly reduce the amount of people impacted by such behaviors. This study poses that increased exposure to ACEs and higher scores on antisocial measures will leave an individual at higher risk of substance abuse. This study was conducted using secondary data analysis from a national sample of young adults. A survey was conducted through Qualtrics that provided a total data set of 359 participants (ranging from 18-30) with a mean age of 25 years. In this population, 55.9% of participants were women, 27.8% made between $20,000 and $49,999 annually, and 47.1% identifying as non-White. There was a non-significant, negative correlation between scores on antisocial scales and ACEs. However, there was a significant correlation between ACEs and scores of problematic drug use, and between problematic alcohol use and antisocial personality traits. We can conclude that ACEs relate to illicit drug use but not problematic alcohol use. Further, antisocial personality traits are related to problematic alcohol use but not illicit drug use. By targeting at-risk populations, the premature death rate caused by adverse childhood experiences can be lowered.

**Supported by the McNair Scholars Program*

LGBTQ+ Youth Experiences in School-Based Sexual Education

College of Arts and Sciences

Student Researchers: Veronika Stropko Jorgensen and Angel Ciccarelli

Faculty Advisors: Elizabeth Goncy, Shereen Naser, Kim Fuller, and Katie Clonan-Roy

Abstract

Introduction: Current research has begun to address the gap in the literature regarding LGBTQ+ youth, however, in practice, sex education in the U.S often leave students feeling unsatisfied, excluded, and ill equipped (Cahill et al., 2021; Naser et al., 2020; Haley et al., 2019).The aim of this systematic review is to better understand the experiences of LGBTQ+ youth in U.S sex education and analyze the outcomes for LGBTQ+ youth who revived U.S sex education.

Methods: Data was obtained from articles found through Cleveland State University's Michael Schwartz Library EBSCOhost research database for a systematic review. To be included, articles must be written in English, take place in the United States, have a mean sample population age of 21 years old or younger, be a peer-reviewed article or dissertation, focus on LGBTQ+ youth, focus on some form of sexual education, and must describe either experiences or outcomes related to sexual education. After articles were sorted, 183 articles were issued a full review coding and 34 articles of those articles passed the full review coding and were included in the systematic review.

Results: Amongst the quantitative and qualitative research of the 34 included articles, many LGTBQ+ students discussed their experiences, mental health outcomes, physical and relation sexual health outcomes, identity development and/or other themes related to school-based sexual education. While sentiments and experience varied by curriculum and sample demographics, common themes such as the dominance of heteronormativity in sex education, the use of supplementary sources for sex education, and a general dissatisfaction with the sex education received are apparent.

Implications: Results from this systematic review indicate a need for an inclusive and expansive sex education curriculum for LGTBQ+ students, especially in a school-based setting. A curriculum that addresses the unmet needs of LGBTQ+ youth has the potential to reduce negative outcomes, particularly in the areas of mental health, identity development, and sexual health.

The Effects of Work-Related Intrusions Into Family Time

College of Arts and Sciences

Student Researchers: Clare A. Rieger and Tyrese C. Rushton

Faculty Advisor: Michael Horvath

Abstract

Due to the great advancements in technology today, there are many ways the workplace can contact, or interrupt an employee whilst at home spending time with family. This may not bother everyone, but it does bother some. In our study we explored how individuals respond to work interrupting them while they are with their family. We asked 143 individuals who worked full time outside the home about the most recent time they were contacted by work while they were with their family. Reactions to the interruption related to its severity and importance, as well as to the participant's desire to mix work and home domains. Furthermore, we found that the effect of the interruption's severity depended on how important the interruption was.

The Relationship Between Attachment Styles and Extraversion

College of Arts and Sciences

Student Researcher: Angel Ciccarelli

Faculty Advisor: Shereen Naser

Abstract

Attachment styles and personality are important parts of one's identity and may influence future attitudes towards close relationships. An understudied expression of personality that attachment may influence is extraversion. In this study, we examine the relationship between attachment and extraversion by testing the hypothesis that participants with secure and anxious attachment styles are more likely to be extroverted compared to participants with an avoidant attachment (fearful and dismissive). Sixty-nine participants were recruited from Cleveland State University's SONA Systems online recruitment tool, Research Match, Instagram, CSU Facebook Groups, GroupMe, and email. Participants were asked to complete a self-report survey, which measured their attachment style and extraversion by using the Revised Adult Attachment Scale and the IPIP-NEO 120. Data was analyzed by doing a correlation and linear regression analysis. This study found significant correlations between closeness, anxiety towards relationship, dependency, friendliness, gregariousness, cheerfulness, and excitement-seeking. Furthermore, positive correlations were found between friendliness and closeness, closeness and gregariousness, and friendliness and being dependent. Negative correlations were found between friendliness and anxiety, cheerfulness and anxiety, and excitement-seeking and being dependent. These correlations suggest how extraverted specific attachment styles may be and expand the knowledge of the relationship between attachment and personality.

**Supported by the McNair Scholars Program*

The Influence of Racial Experiences and Academic Pressure on Internalizing Symptoms in Black Youth

College of Arts and Sciences

Student Researcher: India J. Matthews

Faculty Advisors: Shereen Naser and Elizabeth Goncy

Abstract

Previous research establishes that high achievement is a predictor of depression ande anxiety symptoms. Additionally, research establishes that being a racial minority is a risk factor for depression and anxiety. The literature does not directly identify the relationship between high achievement, race, and depression and anxiety. This study aims to investigate whether there are differences in rates of depression and anxiety in Black high-achieving students compared to White high-achieving peers and explore factors that could influence this relationship. Participants 14-19 years old were recruited from Cleveland State University for this ongoing project. It is expected that Black high-achieving students will experience higher levels of depression and anxiety than their White high-achieving peers. It is also expected that experiences with race will strengthen the relationship between high achievement and depression and anxiety, while academic pressure will mediate this relationship. If the results of this study are consistent with the hypothesis, clinical interventions should focus on addressing race-related stressors as well as academic pressure within Black high-achieving youth. Additionally, schools could focus on implementing resources and culturally competent interventions for high-achieving students to address these disparities in internalizing disorders.

Keywords: *racial discrimination, internalized racism, race-related stress, academic pressure, high-achievement, internalizing symptoms, depression, anxiety, youth, adolescents*

**Supported by the McNair Scholars Program*

Understanding the Role of Sleep on Emerging Adult Mental Health in the COVID-19 Pandemic

College of Arts and Sciences

Student Researcher: Dywayne Johnson

Faculty Advisor: Kathleen W. Reardon

Abstract

Emerging adulthood is a critical developmental period that affords many new opportunities for adolescents as they transition to adulthood; however, studies reported that the pandemic caused significant disruptions in terms of development for young adults. As such, it is critical that researchers work to further our understanding of the impacts of COVID-19 on core areas of young adult functioning. Sleep plays an integral role in understanding the effects of mental health, but the impact of the pandemic on sleep in young adults is one area that has been understudied. The main focus of the present study is to highlight the associations between sleep, stress, mental health, and personality that interplay in the context of COVID-19 in the emerging adulthood population. Self-report data were collected from a sample of 33 young adults (ages 18-25) via Qualtrics. Results suggest that there is an important interplay between sleep, mental health, and personality, and further, that the impact of the pandemic affects this interplay in young adults. These results highlight the potential importance of interventions aimed at regulating sleep patterns to support mental health in emerging adulthood.

Keywords: sleep problems, sleep quality, Big-five personality, mental health, COVID-19, young adults, stress, emerging adulthood

**Supported by the McNair Scholars Program*

Does perceived social support mediate the iatrogenic effects of excessive reassurance seeking on depression severity?

College of Arts and Sciences

Student Researchers: Peter Hochman and Brian Brooks

Faculty Advisor: Ilya Yaroslavsky

Abstract

Major Depressive and Persistent Depressive Disorders (depression) are prevalent and debilitating conditions that affect one in six adults across their lifetime (Otte et al., 2016), with an estimated $326.2 billion in disease burden (Greenberg et al., 2021). Subclinical depression symptoms that do not meet diagnostic criteria are reported by 1 in 3 in the US (US Census Bureau, Household Pulse Survey 2020-2022), and have been shown to functionally impair those affected in similar ways to their clinical counterparts (Zhang et al., 2022). Perceived stress is a known risk factor for depression (Rudolph et al., 2000), and diathesis-stress models posit that such risk may arise from how those affected cope with stressors (Vrshek-Schallhorn et al., 2015). Seeking reassurance is one coping response, which, when used excessively, exacerbates adverse effects of stress (Stewart & Harkness, 2016). Reduced social support resources may be one way by which excessive reassurance seeking (ERS) contributes to depression risk (Stewart & Harkness, 2016), as social support is known to buffer against depressogenic stressors (Gariépy et al., 2016). However, it remains unclear whether some forms of social support (e.g., familial vs. peer) are differentially reduced through ERS, and such reductions mediate ERS's iatrogenic effects on depression severity. The present study begins to address these gaps in the literature.

Impact of Comorbid PTSD and Social Anxiety Disorder symptomology on interpersonal stress

College of Arts and Sciences

Student Researcher: Brian Brooks

Faculty Advisor: Ilya Yaroslavsky

Abstract

Post-traumatic stress disorder (PTSD) is a disorder characterized by an elevated stress response as a result of significant trauma, and a chronic experience of stress (Kvedaraite et al. 2020; Zalta et al.2021; Preston et al. 2021). PTSD may in particular associate with interpersonal forms of stress, as interpersonal trauma, the most commonly reported precipitant of the disorder, is associated with increased interpersonal dysfunction relative to other trauma forms (Creech et al., 2019; Preston et al. 2021). Social anxiety disorder (SAD), marked by distress during social interactions, frequently co-occurs with PTSD (Carleton et al., 2011). Evidence suggests that co-occuring PTSD and SAD symptoms are associated with worse functional and emotional outcomes than either disorder alone (Colimore et al. 2010; Carleton et al., 2011; Zayfert et al 2005). However, it is unclear whether their co-occurrence leads to worse interpersonal stress than either alone. We examined the impact of comorbid PTSD and SAD symptomology on interpersonal stress across familial, intimate relationship, social, and close friend domains.

Dance/Movement Therapy: Trauma

College of Arts and Sciences

Student Researcher: Sadie Pinckney

Faculty Advisor: DeAndra M. Stone

Abstract

The use of Dance Movement Therapy through the lens of trauma amongst African American adolescents has been groundbreaking. This is especially important as society aims to bridge the gap amongst African American adolescence and privileged adolescents. However, there is a further need to develop effective modes and methods of treating underprivileged youth. This project aimed to develop a thorough Healing in Motion Program designed specifically for African American adolescents in America. The primary methods were experiential learning, Dance Movement Therapy-informed techniques, and creative activities. The program guides facilitators through ten modules of content. It is designed to be replicated in order to measure its effectiveness. Over the course of a 10-week period, adolescents would be assessed before, during, and after the program. By the end of the 10-week period, adolescents show improvement in self-concept, self-esteem, and self-awareness.

**Supported by the McNair Scholars Program*

A Mixed Method Approach to Examine Resettled Refugees' Parenting Practices

College of Education and Public Affairs

Student Researcher: Olivia L. Russo

Faculty Advisors: Grace H.C. Huang and Eddie T.C. Lam

Abstract

A staggering 20.7 million refugees worldwide were forcibly displayed as of 2020 (UNHCR, 2021). While relocated to a new country with a different language and culture than their own, one of the biggest challenges parents face is raising their children in a new culture that comprises of different values and beliefs. Using both quantitative (Study 1) and qualitative (Study 2) approaches, this study was aimed to investigate parenting practices of resettled refugees and immigrant families in the US.

Study 1 was an online survey and participants (N = 670) responded to the 40-item Revised Parenting Style and Practices Scale (R-PSPS) and demographic questions. Study 2 was one-on-one interviews with Congolese parents (N = 31). Results of Study 1 showed no significant ($p > .05$) difference among participants with different marital status. However, significant ($p < .05$) differences were found in Autonomy (AT), Discipline (DC), and Parental Involvement (PI) among participants with different household incomes. Overall, parents with the highest income (over $150,000) had significantly higher AT and PI scores than all others. Likewise, significant ($p \leq .001$) differences were found in Expectations (EP) and AT scores among participants with different religions. Those who were unaffiliated with any region and those believed in Christianity or Buddhism had significantly higher EP and AT scores than those with other religions. Study 2 focused on Congolese parents' parenting practices and US schooling perspectives and identified three themes: (a) Parenting Strategies, (b) Parents' Aspiration for Children's Education and Success, and (c) US Schooling.

In conclusion, parents of different marital status have similar parenting style and practices. However, there seems to be a positive relationship between income level and AT scores. Meanwhile, those with the highest income both the highest AT and PI scores. This indicates that higher income parents have higher level of educational involvement and foster their children's independency. Similarly, Christians and Buddhists as well as those without any region have higher expectation and foster their children's autonomy than those people with other religions.

Brainstem-stimulated Stress Biomarkers in Mouse Serum and Cerebrospinal Fluid

College of Health

Student Researchers: Aditi Adatiya, Saily Aloni, Gena Asi, McKenna Greene, and Sabreena Ighneim

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

Abstract

This poster describes the process of using mice for locus coeruleus stimulation, serum and cerebrospinal fluid extraction, perfusion, and removal of the brain. The locus coeruleus is being investigated to determine if there is a relationship between locus coeruleus stimulation and stress hormone production. The cerebrospinal fluid collected from the mouse is being analyzed using a mass spectrometer to be detected for Dynorphin B, an indicator for stress and pain, by the Analytical Chemistry Department. The sample of serum is used in the ELISA immunoassay kit to measure corticosterone levels- the product of stress responses. The fixed brain is later sliced via cryostat and stained on a slide to confirm the accurate placement of electrodes. The overall hypothesis for the experiment is that stimulated animals will have higher levels of corticosterone in the serum when compared to the controls (non-stimulated mice). The results of the experiment are in the slides and ELISA plate, both of which are in the process of being analyzed. More experience using the cryostat and staining equipment is needed to optimize our results. After investigating the locus coeruleus, the long-term goal of the experiment is to make a connection between stress hormones and their effect on the auditory system.

Factors Contributing to Health Disparities in the African American Community

College of Health

Student Researcher: My'Jia Brown

Faculty Advisor: Ángel L. Reyes-Rodríguez

Abstract

Diabetes Mellitus is a group of chronic metabolic disorders characterized by hyperglycemia (elevated blood sugar levels) over a prolong period of time affecting 37.3 million Americans, 90% of them suffering from type 2 diabetes. Type 2 diabetes patients are characterized by insulin resistance, and in some cases, a decrease in insulin production. Among African Americans, the prevalence of type 2 diabetes is up to 2.3-fold higher than their White counterparts. This review aims at examining the different factors that contribute disparities in health outcomes in African American communities. The difference in genetic factors, such as G6PD deficiency, and its consequences for accurate HbA1c measurements tests were explored. Socioeconomic factors, such as food insecurity and healthcare access were examined, and lifestyle interventions were explored. Together, this illustrates the complicated interconnectivity of genetic and socioeconomic health determinants and suggests a need to further understand how they intersect to design better interventions to serve African American communities.

**Supported by the McNair Scholars Program*

Customer Participation Scope: Unpacking Customer Relationship Management and Open Innovation Activities

Monte Ahuja College of Business

Student Researcher: Onyinye Muoh

Faculty Advisor: Todd Morgan

Abstract

Innovation has been shown to have a growing importance for companies' performance. New products are responsible for more than 40-percent of profit and that number has been steadily increasing. Recently, there has been a shift regarding companies being more open to co-creating products with customers, termed customer participation. While customer participation research has been extensive, much work remains. A key question is "*Who* should firms involve in the NPD process?" This research seeks to answer this question by examining *customer participation scope*, or how narrowly or broadly customer segments are used as co-developers. Firms that have a narrow scope primarily focus on large, powerful customers who account for a large proportion of sales. Firms that have a broad scope focus on a wide range of customers from multiple segments. Our study surveys 441 companies in the US on a variety of questions revolving around customer collaboration and innovation success. The results of our analysis suggest that companies benefit from involving a greater number of customer segments in innovation (i.e., broad customer participation scope). Our findings also indicate that when customer needs are complex, having a greater number of customer segments involved in NPD is beneficial for companies as it helps generate products that meet current and future needs. We also examine communication intensity between customers and companies. We find that greater communication intensity (i.e., more frequent) helps assist a broader customer participation scope, suggesting that frequent communication with customers helps company performance.

This study makes three contributions to the customer participation literature. First, we measure a new customer participation construct: customer participation scope. The latent variable ranges from a narrow (or limited) scope to a broad (or wide) scope, depending on the number and type of co-creation partners selected from the customer network and how companies focus their efforts on developing products. Second, we investigate how customer networks influence performance. The results of our study suggest that customer networks are helpful in revealing previously undiscovered market opportunities. Third, this study makes an incremental contribution to frameworks of moderating factors that impact customer participation processes' impact on performance. While research has begun to uncover these factors extensively, complexity of customer needs and communication are key aspects of success and we are the first to examine such effects in this context.

A Systemic Review of HIPPA Breaches

Monte Ahuja College of Business

Student Researcher: Hailey Marcum

Faculty Advisors: Michele Heath and Tracy Porter

Abstract

The current research surrounding healthcare information security, has demonstrated a number of areas for concern in recent years. The purpose of this research is to understand the causes and predictors of HIPAA breaches. Previous research has demonstrated that there is a relationship between hospital organizational characteristics and the types of HIPAA breaches especially influence of EMR capabilities, hospital size, system membership, and teaching status on various types of HIPAA Breach. Research revealed several associations between healthcare breach characteristics and the number of individuals affected, suggesting that more individuals are affected in hacking/IT incidents and network server breaches independently and that network server breach location and unauthorized access /disclosure breach type were predictive in combination. The pandemic forced 60% of organizations to move further into the cloud, which caused more vulnerabilities

Improving the Dispersion Yield of DNA-Coated Hexagonal Boron Nitride Nanosheets with Solvent Treatment

Washkewicz College of Engineering

Student Researcher: Sara R. Groetsch

Faculty Advisor: Geyou Ao

Abstract

Hexagonal-boron nitride nanosheets (BNNSs) are 2D materials with superior mechanical strength, thermal conductivity, electrical insulation, and chemical and thermal stability. These properties make them an ideal candidate for various types of applications. However, the low dispersion yield of BNNSs in solvents, such as water, creates a limitation. In this study, we investigated the effect of alcohol treatment of bulk hexagonal boron nitride (hBN) material on the dispersion outcome of nanosheets. Specifically, hBN was soaked in methanol, ethanol, and isopropyl alcohol for various durations and then dried before dispersion using probe tip ultrasonication. We prepared dispersions of hBN:DNA = 1:2 mass ratio in deionized (DI) water using double-stranded DNA, which interacts with BNNSs *via* π-π stacking. The dispersion quality of DNA-coated BNNSs (DNA-BNNSs) using hBN with and without alcohol treatment were examined by UV-vis absorbance measurements. The preliminary results showed no significant improvement in BNNS dispersion yield with alcohol treatment of bulk hBN material. Future work will involve the optimization of the alcohol soaking method to evaluate its benefit for improving BNNSs dispersion yield. Upon achieving improved dispersion yield and stability of BNNSs in water, we will focus on developing applications, such as emulsions using BNNSs as multifunctional emulsion stabilizers.

Catalytic Gasification of Household Plastics

Washkewicz College of Engineering

Student Researchers: Peter J. Sankovic, Mason J. Lang, and Kristen M. Reyes

Faculty Advisor: Jorge E. Gatica

Abstract

Gasification processes convert carbon-based (organic) materials to gaseous products typically referred to as synthetic gas. Thus, gasification is an alternative for reducing carbon footprint in energy generation as well as for waste management. The umbrella Research Project aims to adapt this technology to convert space exploration and municipal waste into high-value products as a route to Sustainability. The activities for this Summer examined Catalytic Gasification to convert household recycled materials into synthetic gas. Four reactions take place during this process: two oxidation reactions (one producing CO_2 and the other producing CO), the Water-Gas Shift, and the Sabatier reaction. The target products from this process are methane and hydrogen. Gasification experiments using polyethylene as a substrate and 5 wt% ruthenium supported catalyst were examined. Gaseous products analyzed using gas chromatography indicated that (i) selectivity of oxidation favors CO_2 over CO at lower temperatures, (ii) while The Water-Gas Shift reaction produces hydrogen gas, this gas appeared promote methane production, and (iii) methane production was observed to be relatively constant over time. Further research on consumer grade plastics is needed to fully understand the reaction kinetics. These experiments provide a foundation to expand the application of catalytic gasification as a mechanism to recycle other household plastics like PET and nylon.

Using HiFi Assembly to Generate Repetitive Genes in Modular Plasmids to Produce High Molecular Weight Polypeptides

Washkewicz College of Engineering

Student Researcher: Amin Boukzam

Faculty Advisors: Edward Turk[1] and Nolan Holland

Abstract

Elastin-like polypeptides (ELP) constitute a genetically engineered class of “protein polymers”, characterized by having many repeats of GxGyP amino acid monomers. Here, ‘x’ stands for any amino acid, and ‘y’ is any amino acid except for proline. ELP’s are known for their ability to assemble and disassemble a 3D hydrogel matrix in a reversible process dependent on temperature. This makes them ideal for making bio-inks with embedded cells. It is able to do this based on their hydrophilic and hydrophobic properties. The hydrophobic ends of the ELP will come together naturally, to reduce its surface area exposed to the solution around it. The hydrophilic ends extend out into solution, sometimes latching on to other hydrophilic ends creating an ELP lattice.

This transition happens over a narrow temperature range depending on the structure. The transition temperature can be changed on the amino acid substitutes and the length of the polymer, i.e. the number of GxGyP repeats. It is expected that longer hydrophilic blocks will result in lower concentrations of peptides needed to form the gels. This project focused on building a library of ELP's of varying sizes, with the goal of trying to optimize the properties of these gels. The DNA plasmid which contains the gene for the ELP is designed so that the length can be doubled using digestion and HiFi assembly. We started with a DNA plasmid holding a 17xGXGVP repeat, eventually building one as long as 513xGXGVP repeats. In total, a library containing 16 different plasmids was created. Each plasmid encodes ELP's of different properties due to their number of repeats, as well as hydrophilic and hydrophobic groups. The next step with these plasmids is to test if they can be used to express the desired ELP's. Then they will be purified and their properties as hydrogels will be tested.

[1] *External Advisor, Gilmour Academy*

Flexible Electronic Device For On-Demand Ocular Drug Delivery

Washkewicz College of Engineering

Student Researchers: Marko Krieger, Naomi Addai Asante, and Andrea Zuccaro

Faculty Advisor: Metin Uz

Abstract

In this study, ocular therapeutics delivery, directed through wireless electrical stimulation (WES) applied via graphene and/or silver-based wireless flexible electronic device, was investigated for the treatment of ocular conditions such as age-related macular degeneration (AMD). Here we propose to develop a self-administered flexible electronic device in the form of a contact lens, integrated with reservoirs for ocular therapeutics loading, along with a ring-shaped conductive antenna for WES directed on-demand therapeutics release. Conductive graphene and/or silver based wireless circuit designs were successfully fabricated using high throughput laser etching and polymer casting-based circuit transfer methods. The polymer casting allowed incorporation of model drugs, Rhodamine B (RhoB) or Bovine Serum Albumin (BSA), into the wireless flexible electronic device. The device provided good conductivity, flexibility and stability after multiple washing and bending cycles. Controlled release properties of the device was observed for the model drugs under different WES parameters. The results showed that 20 Vpp with 13 MHz favors agarose gel penetration of RhoB. It was also observed that under 10 Vpp with varying range of WES, the BSA deposited the most effective concentrations at 15 MHz. The device material also did no caused any toxicity and/or cell viability issues. The retinal pigment epithelium and stem cells attached and proliferated on device surface for at least 15 days. In the future, more detailed experiments will be conducted to precisely and accurately control the drug release and evaluate the therapeutic activity on in vitro AMD models and ex vivo pig eyes to demonstrate the potential clinical feasibility.

A dual-SDA strategy for zeolite nanosheet synthesis

Washkewicz College of Engineering

Student Researchers: Ward Sweilem and Obaid Khan

Faculty Advisor: Shaowei Yang

Abstract

Zeolites are widely used as adsorbents, catalysts and membrane materials because of their uniform pore size, large surface area, unique structure and excellent chemical and thermal stability. When the molecule size approaches the zeolite pore size, the molecule diffusivity in zeolite decreases exponentially, which has limited the application of zeolite for many applications involving bulky molecules. Zeolite nanosheets, also referred as 2D zeolite, have only nanometer thickness (comparing to micrometer for conventional zeolite), which makes the internal zeolite pore much more accessible and greatly reduce the overall transport resistance. Zeolite nanosheets have been proven much better adsorbents and catalyst than conventional crystals. We aimed at developing 2D zeolite with a novel dual-SDA strategy. Through the series of 2nd SDA explored; we will reveal the underlying mechanism for 2D zeolite growth. We here demonstrate that we have successfully achieved both silicoaluminophosphate (SAPO) and high-silica 2D zeolites. More investigation is continued in our lab to figure out the mechanism behind the structural transition and produce 2D zeolite cost-effectively.

Who is at Fault? The Role of Road Familiarity and Distracted Driving on Crash Injury in Northeast Ohio

Washkewicz College of Engineering

Student Researcher: Kriya Shah

Faculty Advisor: Emmanuel Kidando

Abstract

Motor vehicles have been an integral part of the American way of life providing an unprecedented degree of mobility. Yet for all its advantages, more than 36,000 people's lives are lost every year due to motor vehicle crashes and three million more people sustain injuries. In order to prevent these crashes, the causes must be understood. Many factors contribute to crashes such as distraction, weather, congestion, road complexity, and familiarity with a route.

This research used crash data for the analysis gathered from Northeast Ohio counties including Cuyahoga, Summit, Lake, Lorain, and Medina. Data for analysis from 2017 to 2019 were obtained from the Ohio Department of Public Safety database. We used three approaches to investigate the crash pattern involved with distracted driving, familiar, and unfamiliar drivers: descriptive statistics, text mining, and Bayesian networks.

Findings from the text networks suggest that the use of cell phones and passenger distraction are the common sources of crash occurrences. Bayesian networks, on the other hand, revealed that the likelihood of drivers being at fault in a crash is high by 33% for familiar drivers compared to unfamiliar drivers. Moreover, the probability of familiar drivers is high being distracted at an intersection compared to unfamiliar drivers by 37%. For injury severity, type of collision, weather, and alcohol involvement are the attributes found to have a direct relationship with injury. Angle crashes and alcohol involvement were found to be associated with injuries.

GNN Based Deep Learning Technique for Cybersecurity

Washkewicz College of Engineering

Student Researchers: Aayush Shastri and Danny K. DeJesus

Faculty Advisor: Sathish Kumar

Abstract

There exist various cybersecurity attacks on a network which can immobilize networks, retrieve private information, or slow down traffic. In this work, we intend to develop a graph neural network (GNN) to detect and classify multiple cybersecurity attacks. GNNs provide a way to clearly visualize real-world data relationships as nodes and edges. In our case, we instantiate nodes as the source and destination of the attack. Edge features are then embedded using the network flow data for its respective source and destination nodes. Most related works for GNNs implement node classification, while our method extends the application of GNNs to classify edges. As there currently exist classical methods to detect cybersecurity attacks, we intend to use those methods as benchmarks to compare the performance of the GNN method.

Quantum Support Vector Machine Approach for Detecting DDoS Attacks

Washkewicz College of Engineering

Student Researchers: Danny K. DeJesus and Ahmad M. Alomari

Faculty Advisor: Sathish Kumar

Abstract

One of the most common cybersecurity attacks that threaten the security of networking systems is the DDoS attack. These attacks can destroy and shut down an entire distributed systems platform. In this work, we demonstrate that quantum machine learning can be efficiently applied to detect DDoS attacks through our QSVC intrusion detection approach. The idea here is to combine the computational power of quantum properties with the classical SVM to detect DDoS attacks. To verify the performance of DEQSVC, we simulated it using the Qiskit platform and executed it on an IBM quantum computer. The results show that DEQSVC outperforms the compared benchmark algorithms by generating 99.49% detection accuracy.

Toward Autonomy in Water Quality Monitoring Vehicles: An Adaptive Sampling Approach Using LoRaWAN

Washkewicz College of Engineering

Student Researchers: Tarin Cheewakarn, Jake Staas, and Sai Siddhi Karnati

Faculty Advisor: Mehdi Rahmati

Abstract

Remotely operated vehicles (ROV) have become more popular among researchers and general users for underwater explorations. The vehicles allow users to deploy compact sensors and explore areas of interest, which is the central focus of many missions and particularly this research. However, observation and sampling become difficult when the environment is challenging. To explore regions that may be far out, an ROV will need to forgo its wired tether. If the vehicle dives below the surface without a tether, it will lose its connection, and therefore, a method of keeping communication above the water while the vehicle delves beneath the surface is a necessity. Through the usage of Long Range (LoRa) radios, an over air communication can be generated to send script commands for the extended distance between a gateway device and a ground control station. In our research, we analyzed the telemetry communication of LoRa radio to make it compatible with our adaptive sampling algorithm. The setup developed in our work provides an energy-effective solution to underwater observation.

Autonomous Nursery Cart Abstract

Washkewicz College of Engineering

Student Researchers: Kenneth Bender, Russell Buttriss, Shereen Elfadil, and Luke Anderson

Faculty Advisors: Qin Lin, Hongkai Yu, and Zhiqiang Gao

Abstract

One of the key emerging technologies developed in the last few years is autonomous vehicles. Their ability to detect and track distant obstacles, control speed and braking, and navigate through different routes make them a legitimate substitute for manned vehicles in everyday uses. Autonomous carts that are designed specifically for small scale services are still not as efficient in design as autonomous passenger vehicles. This is due to a high cost per unit that can overwhelm budgets on small projects. This project aims to develop an autonomous nursery cart used primarily to help workers collect vegetables and grains from fields with complex routes. The key to this project is to minimize cost by lowering processing requirements while still maintaining autonomous capabilities.

Computing the center of uncertain points on cactus graphs

Washkewicz College of Engineering

Student Researchers: Divy H. Kanani and Ran Hu

Faculty Advisor: Jingru Zhang

Abstract

In this project, we consider the one-center problem of uncertain points on a cactus graph. Given is a set of n uncertain points and a cactus graph G. Each uncertain point has m possible locations on G associated with probabilities. The one-center problem aims to compute a point (the center) x^* on G to minimize the maximum expected distance from x^* to all uncertain points. To the best of our knowledge, this uncertain one-center problem has not been studied on cactus graphs. In the project, we propose a prune-and-search algorithm that solves it in O(|G| + mn log mn) time.

A Mobile App for Gamified Learning of Data Structures

Washkewicz College of Engineering

Student Researcher: Lincheng Ou

Faculty Advisor: Wenbing Zhao

Abstract

People learn new information in a variety of ways. Some common forms are visual, auditory, kinesthetic, and reading/writing. However, when it comes to engineering, and specifically computer science, the most effective way of learning is hands-on. Unlike other subjects, computer science cannot be fully comprehended through purely reading or listening. A student could gain basic understanding of concepts by reading books, but it is difficult for the person to gain a full understanding until he/she has gone through sufficient amount of practices. For a beginner, hands-on learning in computer science can be a daunting task. This project seeks to solve this problem by presenting core fundamentals of data structures in a game-like environment. Instead of physically writing code, the user will be actively dragging pre-written code blocks and assembling them. Once done, the user can run the code and visually see the assembled program in action. The application is written using React Native and is still in its early stage of development. The project's goal is to help strengthen student understanding of data structures in computer science.

Mixed Reality Object Detection with HoloLens2 and Custom Vision

Washkewicz College of Engineering

Student Researcher: Sean Mendicino

Faculty Advisor: Ye Zhu

Abstract

This project looked to employ Microsoft HoloLens2 and Microsoft Cognitive Services Custom Vision to deploy object recognition technology within a mixed reality environment. Our primary goal was to use Microsoft Cognitive Services to both recognize and label objects within the user's real-world environment. A secondary goal was to recognize real and virtual, as well as real and real, interactions between objects within the Mixed-Reality environment. To achieve this end, we first created an object recognition model using Microsoft's Custom Vision cognitive service. We chose Custom Vision specifically because it allowed greater control over A.I learning. We created the basis for our mixed reality application using Unity's MRTKv2. The application used scripts to take pictures of the user's environment and sent them to the Custom Vision resource using a Unity Web Request. The Custom Vision response was then received and passed along to another set of scripts using the "messenger" script adapted from the HoloToolkit2017, now called MRTKv2017. The information from the Custom Vision response was then used to project a label onto a debug plane placed in front of the user's view. During the course of the research, we discovered a number of challenges and while we were able to label real world objects within the mixed reality space, we lacked sufficient time to implement the recognition of object interactions. We recommend that future extensions include recognizing both virtual and real objects at the same time and recognizing interactions between objects.

Cleveland State Weather Station Application

Washkewicz College of Engineering

Student Researcher: Evelyn Landis

Faculty Advisor: Ye Zhu

Abstract

We were tasked with assisting the Environmental Science department on their research by creating an application that collects data from their Netatmo weather stations into readable files. This program had to retrieve data from multiple weather stations, ensure that the data is only downloaded into the files once, and it had to be capable of running without user interference. To do this we modified the Netatmo 1.0.7 program (by Rene Devich) to meet these requirements and we modified it to collect data from the rain station module. The program, when it runs, downloads the data into three files based on the station the data originated from and the module it was collected by. If we are to continue this project in the future improvements would include making the CSV files more legible, giving phone access to the application, and getting rid of the repeating data types.

Pool Boiling: Ambient Pressure Increase to Enhance Heat Transfer

Washkewicz College of Engineering

Student Researchers: Forrest Osborn and Ezekiel T. Villarreal[1]

Faculty Advisor: Heng Ban

Abstract

Nuclear energy's potential to reduce greenhouse gas emissions from electricity generation is currently under debate. To better understand the inner dynamics nuclear power plant, pool boiling and platinum wire were used to model water cooling of nuclear fuel cladding and burnout phenomenon. Joule heating was used to generate and measure heat transfer rate from a platinum wire inside a pressurized vessel of water. Voltage, current, and duration were varied to achieve transient boiling along a wire of approximately 10 mm in length. A slow-motion camera was utilized to capture images of the resulting bubbles during the pulse and temperature, voltage, and current data was collected and analyzed to produce boiling curves of transient boiling behavior. These measurements indicated that the heat transfer rate was positively correlated with increased pressure. These experiential learning project and results contributed to a better understanding of the heat transfer rate inside a nuclear reactor and further comprehension of safe nuclear power plant design.

[1]*Materials and Mechanical Engineering Department, University of Pittsburgh*

**Supported by the McNair Scholars Program*

Design and Development of Light Weight High Entropy Alloys

Washkewicz College of Engineering

Student Researchers: Zachary Taylor and Manoj Mugale

Faculty Advisor: Tushar Borkar

Abstract

High-entropy alloys (HEAs) are a novel family of solid-solution alloys that have gained international interest due to their exceptional characteristics. Because of the need from the transportation and defense sectors, lightweight HEAs have attracted researcher's curiosity as prospective advanced materials. Low-weight high entropy alloy synthesizes using mechanical alloying followed by spark plasma sintering (SPS) process with a mass ratio of AlCrFeMnTix(0.1,0.15,0.2, and 0.25). The synthesized HEA is comprised of a mixture of body center cubic (bcc) and ordered bcc ($L2_1$) solid solution phases. To investigate the role of titanium in improving the mechanical and tribological properties, $Al_{1.5}CrFeMnTi_x$ (x=0.1,0.15,0.2, and 0.25) alloys have been selected. The results show that the density of the alloy is 5.7 g cm^{-3}, which fulfills the criteria of low-weight HEA; also, from the XRD, the BCC+ $L2_1$ phases are present in selected HEA compositions.

Modeling and Simulation of Hybrid Wind-Solar Systems: EV Charging Station Case Study

Washkewicz College of Engineering

Student Researcher: Youssef Mostafa

Faculty Advisor: Navid Goudarzi

Abstract

With increasing energy demands and a need to reduce the negative environmental impact due to energy generation, built-environment hybrid renewable energy projects for energy and sustainability development are critical elements to address these challenges. One direct application of these innovations is powering electric vehicles (EVs). The rapid adoption of EVs in the past few years comes with huge electricity demand and a need for a significant increase in EV charging stations. Innovative distributed wind and solar energy projects are relatively less mature than utility-scale ones. Hybrid renewable energy solutions have demonstrated promising performance for distributed power generation.

This USRA project initiated the studying of a hybrid wind-solar system to address the need for continuous power generation to meet the baseload of an EV charging station. To achieve this goal, hourly wind and solar data in Cleveland-OH for 10 years was used to develop a MATLAB code to estimate the hourly wind/solar power density values. A significant amount of the project timeline was devoted to analyzing the data to gain more insights into weather characteristics in the Cleveland metropolitan area. A Tesla Model 3 car performance and charging specifications were used to determine the required power and battery bank capacity for a single EV charging station with a 24 hour-availability. The results showed a high mean wind speed potential of 10.5 m/s in Cleveland. The highest wind speeds were observed in December and January and the lowest ones were in June and July. The highest solar energy densities were observed in June and July and the lowest ones were in December and January. It clearly shows the advantage of using a hybrid system to achieve 100% availability throughout the year. Further analysis is ongoing to obtain sub-hourly wind and solar data, integrate the cost-performance tradeoff analyses, and develop demonstration projects.

We wish to extend our special thanks to the CSU USRA program that funded this project during Summer 2022.

Simulation-based estimation of muscle forces from wearable sensors

Washkewicz College of Engineering

Student Researchers: Dawud Sharrieff and Dana Lorenz

Faculty Advisor: Antonie van den Bogert

Abstract

In human movement, muscle forces can be estimated from mechanical analysis. However, there is not a unique solution because there are more muscles than kinematic degrees of freedom. Furthermore, the analysis traditionally requires data from expensive laboratory equipment, including 3D motion capture and force-torque sensors for external forces. We aim to overcome both limitations by using mathematical musculoskeletal models, and trajectory optimization to track data from cheap wearable sensors: inertial measurement units (IMUs) and electromyography (EMG) electrodes. Preliminary results for a arm curl exercise will be presented.

Developing a kinematic model to analyze pelvic to trunk, hip, and head/neck to trunk flexion angles

Washkewicz College of Engineering

Student Researchers: Kaitlyn Boellner, Gita Regmi, and Simon Detmer

Faculty Advisor: Ann Reinthal and Hanz Richter

Abstract

Introduction: Walkers are prescribed to reduce loading of the lower limbs and/or to improve balance and stability. However, walker use has been associated with lower levels of physical functioning in addition to a higher fall risk after a period of use. Studies based on biomechanics can explain certain adverse effects of walker use. Specifically, the forward-leaning posture observed in many walker users reflects partial load transfer from the lower limbs to the arms.

Purpose: This project tests a prototype rollator that addresses problems arising from the forward-leaning posture. The project compares resulting hip, trunk to pelvis, and head/neck to trunk angles using the prototype rollator, a standard rollator, and no device when walking.

Methods: One participant completed walking trials under three conditions: with a standard rollator, the prototype walker, and with no device. Measurements were taken at toe off of one foot during one gait cycle using motion capture with Cortex software (Motion Analysis Corp). Then, this project developed the methodology to calculate joint angles for the trunk, pelvis and head/neck body segments.

Results: Kinematics data for the three walking conditions are displayed below.

	Pelvis-trunk flexion (degrees)	Hip flexion (degrees)	Neck/head-trunk flexion (degrees)
No device	0	2	0
Prototype	41	6	36
Rollator	46	8	33

Conclusion: Pelvis-trunk and hip flexion were closer to normal no device walking as compared to the standard rollator, while the neck/head-trunk angle increased with the prototype walker. We believe that the prototype walker encourages a more upright posture although we will need to investigate further to understand why the neck/head-trunk flexion angle increased.

Acknowledgements: This project was supported by the USRA program, the NSF REU program, and a CSU FRD grant.