GSAW 2024: Scholarly Forum Presentation Abstracts

Session I – Arts and Humanities, Social and Behavioral Sciences, and Health and Life Sciences

10:30am – 12:00pm

Arts and Humanities

1. Nicholas Cabezas, *"Domestic Devices: Klara and the Boundaries of the Host"*

Common readings of Kazuo Ishiguro's novels often stress the "inhumanity" of his protagonists. Klara and the Sun is no exception to this trend, considering Klara is an Artificial Friend (AF), an android. Like Stevens or Kathy H., Klara's role is servitude. She, though, is more than human not because of her posthuman condition but because she has the unique ability to cultivate home regardless of habitation. Exile studies emphasizes home and homemaking. Defined by Milbauer and Sutton, "the exile is a traveler[…] always looking for home, attempting in new lands to establish himself or herself as newly at home" (1). Klara's story is marked by departure from the Store to enmeshment in the House. While not "healing" Josie's ailments, she alleviates loneliness and assuages the Mother's bereavement—the guest thus dons the role of host, fixed and comforting. Klara also does this for Rick and his mother, who identify her with their house. Here, too, are blurred boundaries—as Rick's mother asks, "After all, are you a guest at all?" (Ishiguro 143). Derrida implies in Of Hospitality that unconditional hospitality is death, a total ceding of home to the guest (25-27). Klara's "slow fade" marks this transformation (294). If at-homeness is fundamental to human survival, then what does it mean when only an artificial one is at-home and can expand its boundaries? Klara is posthuman not because she is an android but because she can transcend exile, regardless of circumstance—the hostess is human.

2. Hailey Ferry, *"Vocal Flexibility in Musical Theatre"*

Vocal flexibility is a crucial aspect of voice training that is essential to the success of a musical theatre performer in this fast-paced and constantly changing field of entertainment. The partnership between singing artists and teachers is essential in establishing the vocal facility that allows a performer to navigate myriad vocal styles demanded by musicals today. When casting a musical, creative team members are often looking for specific vocal skills or qualities of sound, so the more vocal tools a singer has at their disposal, the more likely they are to be viable candidates for the job. For all singers, balanced vocal registration is crucial to building a reliable and healthy voice and performers must be able to confidently navigate through the passagii, or register transitions inherent to belt, mix, and legitimate styles of musical theatre singing. Over the last half-century, the vocal aesthetic of Broadway has become more contemporary, incorporating more frequent use of belt and mix sounds and abandoning the classical styles found in the earliest American musicals. At the same time, many pedagogues feel that

establishing a “lined up'' vocal instrument must continue to include the foundations of classical, or legitimate, technique. Many techniques may be used to establish a unified instrument that also expresses the ideals of musical theatre sonority. These techniques might include exercises to enhance resonance, straw phonation or other semi-occluded vocal tract exercises, and exercises to enhance the connection between speech production and singing. Voices will respond differently to these approaches, so not every exercise will work the same for every student. In addition to having complete control over the voice, performers may be asked for certain vocal stylings specific to the show they are performing in including accents, character voices, or other vocal effects. With all of this in mind, it is imperative that performers have a trusted voice teacher or vocal coach who is knowledgeable about their students’ professional needs, using tools and resources to maintain optimal vocal health while building vocal and stylistic proficiency.

3. Thomas Marin, *“Punishment of the Body, Nourishment of the Flesh: Violence and Pleasure in Yaa Gyasi’s Homegoing”*

This paper analyzes the ideas of body and flesh as conceptualized by Hortense Spillers in "Mama's Baby, Papa's Maybe: An American Grammar Book" in relation to Yaa Gyasi's novel "Homegoing." The flesh represents a 'liberated' primary subject position concealed by discourse, which turns into the body, a captive subject position that depicts a narrative of social realities. (Spillers 74). If the body is the 'sign,' then the flesh is the material to create that living sign. The theoretical difference between body and flesh becomes an entry point to decipher the depictions of bodily violence as juxtaposed to those of the pleasures of the flesh as depicted in Homegoing. Scenes of terrible violence are used in the tradition of Morrison's idea of 'ripping the veil' and reaching the painful inner life of subjugated black people. (Morrison 90) While scenes of pleasure and eroticism return the subjected body to domesticity, liberating it into flesh that can create new meaning. The pain and markings of bodies are described as a part of the collective history of the diaspora, while the pleasures of the flesh are explored as a return to that primary narrative that escapes dehumanization and ungendering. Through the close reading of scenes that describe bodies in pain and pleasure, using as a framework the theoretical text mentioned before, I will argue that Homegoing creates a narrative in which violence to the body reinforces the idea of a subjugated being while bodies in pleasure often create a return to domesticity, gendering, and a 'liberated' subject-position.

4. Libia Montaño, *“Vocal and Instrumental Symbiosis in the Evolution of the Concerto Form”*

The evolution of the concerto form is a well-documented journey through music history, analyzed predominantly from historical and technical vantage points. The nuanced interplay and exchange between vocal and instrumental forms, however, remain underexplored, especially regarding their mutual influence on the concerto form’s development. This research aims to uncover how this symbiotic relationship has enriched the genre’s expressiveness and structural complexity. The primary objective is to dissect the symbiosis between vocal and instrumental forms from the Baroque to the Classical period, pinpointing intersections that showcase mutual influence. It endeavors to understand how vocal techniques and opera aria structures have been integrated into and reflected within instrumental concerto compositions. Employing musicological analysis, selected opera arias and instrumental concertos will be examined to identify elements indicative of vocal and instrumental symbiosis. Focus will be given to form, ornamentation, and expressivity, with the aim of uncovering patterns that demonstrate a blending of vocal and instrumental traits. Preliminary findings suggest a significant

interaction between vocal and instrumental musical forms, notably in the adoption of the Aria Da Capo structure and the implementation of vocal ornamentation techniques within instrumental music. This exchange has not only augmented the expressive palette of concertos but also facilitated the emergence of new forms and styles within the genre. This study sheds light on the critical role of vocal and instrumental symbiosis in the evolution of the concerto form, offering a fresh perspective on musical genre interinfluence. By highlighting this exchange, the research provides a nuanced understanding of musical innovation and contributes to the field of musicology with an integrative analysis of classical music. Revealing the interdependence between vocal and instrumental expressions encourages a holistic approach in musical education, performance, and appreciation. Understanding music as a dialogic continuum between the vocal and instrumental broadens appreciation for its complexity and inspires future research at the crossroads of musical genres.

Social and Behavioral Sciences

6. **Fahad Aljohani,** ***"The Motivation and Expectations of Students Pursuing Graduate Education: Evidence from The Chaplin School of Hospitality and Tourism Management."***

The study delves into understanding the motivations and expectations of graduate students pursuing a master's degree in Hospitality and Tourism Management. It aims to identify the interplay between intrinsic and extrinsic factors driving students' decisions and aspirations within the field. The primary goal is to determine whether graduate students in this specialty are predominantly intrinsically or extrinsically motivated. Additionally, the study seeks to uncover the expectations these students hold regarding their programs, focusing on skill acquisition, networking opportunities, and career prospects. A quantitative approach was employed, utilizing an online questionnaire distributed among graduate students at a top-tier university in the United States. This method allowed for efficient data collection and analysis, considering both intrinsic and extrinsic motivational factors and expectations of the participants. Findings revealed that while graduate students in Hospitality and Tourism Management are highly motivated, the majority were more extrinsically motivated. They aspire towards career advancement, increased earning potential and expanding professional networks. The study underscores the significance of understanding these motivations and expectations in curriculum development and support structures within the industry. This research contributes to understanding the complex motivations driving graduate students in the hospitality sector, offering insights for educators, policymakers, and industry stakeholders. It emphasizes the importance of aligning educational programs with students' career aspirations and the evolving demands of the industry. The study's findings can inform curriculum design, career counseling services, and industry-academic collaborations, fostering a better match between graduate education outcomes and industry needs. Moreover, it highlights the role of education in developing future leaders and innovators in the hospitality and tourism sector, thus influencing the trajectory of the industry as a whole.

7. **Yery Alvarez,** ***"Bridging Disparities in Cancer Research: Promoting Minority Participation in CART Therapy Clinical Trials"***

Addressing disparities in cancer research necessitates a focused examination of minority participation in clinical trials, particularly in the context of emerging therapies like Chimeric Antigen Receptor T-cell (CART) therapy. Epidemiological data reveal stark differences in cancer incidence among minority populations, with African Americans, Hispanics, and Asian Americans experiencing higher rates of certain cancers compared to non-Hispanic whites. For instance, African American men exhibit elevated prostate

cancer incidence, while African American women face higher rates of breast cancer under the age of 40. Despite these disparities, minority participation in cancer clinical trials remains disproportionately low, with only approximately 3% actively engaging in research endeavors. This underrepresentation extends to trials investigating promising therapies such as CART therapy, hindering our ability to assess its efficacy and safety across diverse demographics. The impact of this underrepresentation is twofold: it limits the diversity of study populations, undermining the generalizability of research findings, and impedes our understanding of disease mechanisms and treatment responses within minority groups. Consequently, concerted efforts to enhance minority participation in clinical trials are imperative to ensure the validity and applicability of research outcomes across all demographic segments. To address this disparity, robust patient outreach initiatives are essential, fostering trust, raising awareness, and facilitating access to clinical trials within minority communities. Collaboration between healthcare providers, community leaders, and advocacy groups is crucial in amplifying these efforts and promoting inclusivity in cancer research endeavors. In conclusion, prioritizing minority participation in cancer clinical trials, particularly in the investigation of innovative therapies like CART therapy, is essential for advancing towards equitable healthcare outcomes. By bridging disparities in research participation, we can accelerate scientific discovery, address inequalities in cancer care, and ultimately realize the promise of personalized treatment approaches for all individuals affected by cancer.

8. Mehri Azizi, *"STEM Students' Reflections; Humanizing First Semester of College"*

Ensuring the retention of STEM students has become increasingly vital in recent decades, with particular emphasis on the pivotal role of the first year of college. This research delves into the self-assessments of life science students at the conclusion of their initial semester, aiming to prompt reflections encompassing both academic and non-academic factors through a broad query. These reflections were then analyzed within the framework of Self-Regulated Learning (SRL) theory, recognized for its efficacy in facilitating student success. Qualitative scrutiny of responses from 321 students spanning the years 2020 to 2022 unveiled four primary themes: problem identification and resolution, future application, introspection, and mid-semester recovery. While SRL theory proves insightful for interpreting student behavior and reflections, it lacks certain categories such as non-academic pursuits, personal preferences, and social dynamics, which are integral to students' lives. These aspects include the significance of friendships, accommodation arrangements, and students' inclinations towards their chosen majors and prospective careers. Thus, we propose an expansion of the self-reflection phase within SRL theory to encompass these non-academic dimensions, recognizing their substantial influence on academic performance during the inaugural college year.

9. Afsana Zarin Chowdhury, *"Exploring Heterogeneity in ICT Usage and Travel Pattern Changes as the Pandemic Subsides"*

This paper presents a study that explored the behavioral heterogeneity in changes in people's ICT usage and travel patterns at the end of the pandemic. A quasi-longitudinal approach was employed to collect data from Florida residents, capturing their online durations and trip frequencies for various activities before the pandemic and at the end of 2021. Utilizing the latent class analysis (LCA) approach to identify subgroups based on the online activity durations and trip frequencies, four distinct classes were identified. A little more than one third (35%) of the respondents are resilient users who showed minimal changes in both online activity durations and trip frequencies. About 33% of respondents are trip minimizers who maintained similar online activity durations but reduced travel for non-mandatory

activities. About 16% of the respondents are substitutive adapters who showed increased online activity durations combined with reduced travel for non-mandatory activities. Another 16% of the respondents are complementary users who demonstrated higher online activity durations as well as trip frequencies for non-mandatory activities. These four latent classes reflect the diverse ways in which people have adjusted their daily routines and activities. The findings offer a starting point for understanding the complexities of behavioral changes in virtual and physical mobility as we transition to the new normal.

10. Katharine Crooks, *"Neural Systems Underlying Sleep Disorders and Sleep Deprivation: An Activation Likelihood Estimation Meta-Analysis of Functional MRI Studies"*

Sleep disruption has been associated with various cognitive and neuropsychiatric conditions, creating a complex interplay between sleep health and brain function. Despite the intricate relationships between sleep deprivation and multiple sleep disorders, there remains a need to systematically investigate the shared and distinct neurobiological mechanisms underlying these conditions. We aimed to break down the brain activity associated with sleep disruption, considering both chronic (sleep disorders) and acute (sleep deprivation) conditions, using the Activation Likelihood Estimation (ALE) algorithm. We conducted coordinate-based meta-analyses delineating common and distinct brain activity convergence across functional neuroimaging studies related to sleep disruption (N=95 articles) involving sleep disorders (n=60) or sleep deprivation (n=35). Across all studies, convergence was observed in the dorsomedial and ventrolateral prefrontal cortex. Sleep disorder-distinct convergence was observed in the dorsomedial prefrontal cortex, whereas sleep deprivation-distinct convergence was not observed. We characterized connectivity profiles of identified regions by linking each with putative mental operations. Outcomes suggest that sleep disruption engenders brain activity linked with negative affect, theory of mind, judgment, decision making, and self-referential memory. Our findings highlight the complex relationship between sleep health and cognitive function across chronic sleep disorders and acute sleep deprivation, offering valuable insights for future interventions.

11. Alexander Eden, *"Exploring the Correlation of Latino/a/e/x Students' Community Cultural Wealth and Performance in an Introductory Biology Course."*

The transition from high school into a college or university can be a critical time for Biology majors. Students enter this new environment on a supposed "even playing field" but their prior experiences or lack of opportunity can affect their level of success. Utilizing Yosso's Community Cultural Wealth (CCW) theoretical framework, this study explores the capital that Latino/a/e/x students are entering a biology program with and how it may result in different outcomes. Most studies that employ CCW tend to adopt qualitative approaches and far less take a quantitative approach. Utilizing a large R1, Hispanic-Serving Institution, a previously developed instrument used with engineering students was adapted and validated for use with biology students. This poster will share quantitative results from the study, including insights from an exploratory factor analysis, confirmatory factor analysis, and regression analysis. Preliminary findings identify aspirational capital (ability to hold on to one's goals in the face of adversity) may play a significant role in predicting success in introductory biology. These findings can help in identifying potential interventions to implement to assist students as they transition. By keeping the capital in mind, we can ensure that students who may "lack" the capital do not need to worry about struggling more than their peers.

12. Breana Frazier, *"I Don't Belong Anywhere": Addressing the Pipeline From Foster Care to Juvenile Delinquency"*

Approximately 355,000 youth were placed in foster care in the United States alone last year (Kelly, 2023). Neglect, physical and/or sexual abuse, are only a few of the many reasons why children can be removed from their family home. While removing children from dangerous situations is a great first step, the lack of mental health treatment provided is proving to be disadvantageous to these children. Studies show that victims of child maltreatment are at an increased risk of juvenile delinquency than non-maltreated children (Huang et al., 2016). The risk of delinquency is even higher for maltreated youth who are placed in an alternative care setting (Huang et al., 2016). The lack of normalcy paired with the trauma endured has caused some foster care children to become frustrated, confused, and lost (Simmons-Horton, 2020). But soon find themselves in a juvenile detention center.

13. Chloe Hampson, *"Habenular Alterations in Resting State Functional Connectivity in Autism Spectrum Disorders"*

The habenula (Hb) is a set of small, bilateral epithalamic nuclei that has been found to play a role in social interaction, reward processing, behavioral adaptation, and sensory integration. The human Hb is functionally connected to the medial prefrontal, cingulate, parieto-occipital, and retrosplenial cortices, as well as insula, thalamus, hippocampus, parahippocampus, and striatum. Prior research has shown Hb disruptions in major depressive disorder, attention deficit hyperactivity disorder, and schizophrenia. Given the Hb's functional and connectional properties, we sought to investigate Hb alterations in autism spectrum disorders (ASD), which are characterized by social communication and interaction difficulties, restricted and repetitive behaviors and interests (RRBI), and atypical intrinsic brain connectivity differences. In the present study, we examined the resting state functional of the Hb among individuals with ASD and neurotypical (NT) controls in functional magnetic resonance imaging (rs-fMR) data from the Autism Brain Imaging Data Exchange (ABIDE). Results revealed significant Hb connectivity rs-fMRI differences, centered around cortical and subcortical midline structures. Brain-behavioral correlations were also assessed across multiple phenotypic measures of symptom severity, social behaviors, and RRBI. These results provide new insight into neurobiological mechanisms of ASD and contribute support to emerging theories emphasizing the significance of reward-based impairments in ASD.

14. Lynette Herbert, *"Evaluating Job Coaches' and Service Providers' Perspectives on Supported Employment"*

The specialists are called job coaches and service providers. Service providers (SP, i.e., vocational rehabilitation, etc.) initiate job profiling, job analyses, job matching, and on-the-job training for their clients (Beyer et al, 1995). Specifically, these processes are commonly facilitated by job coaches (JC) in order to streamline the opportunities and support needed for the employee's success. These JCs help their clients with developmental disabilities (DD) build common skills needed to perform on the job and find meaningful positions. Through this supportive role, JCs often make the first contact with organizations and are in charge of giving the employer a look into the possibility of hiring individuals with DD (Gustafsson et al., 2013). However, no research to date has comprehensively investigated workers with DD and the hiring efforts from a JC or SP's perspective. This research not only addresses a gap in the literature by thoroughly understanding who supported employment providers are, but also their perspectives on the organizations they work with. Furthermore, it also increases awareness of the importance of the role of supported employment in the inclusion of people with DD in the workplace.

The sample consisted of employed JCs (n = 30) and SPs (n = 37) working in various industries, including social services. Participants completed online survey assessments comprised of validated scales relating to turnover, hiring efforts and organizational inclusion. The majority of SP reported knowing about an initiative (57%). The quality of the current hiring inclusion efforts of organizations were rated as “fair” (JC 33%, SP 27%) and "good” (JC 37%, SP 24%). The implication of this study is that professionals specialized in assisting the workforce with DD provide advanced insight into an organization’s hiring and inclusion efforts. Their perceptions raise awareness of the importance of the role of the JC and SP in helping organizations to onboard people with DD. Nonetheless, future research is needed to explore further the nature of partnerships between supported employment and hiring organizations to understand better what supports and resources are needed on both sides to maximize the successful integration of people with DD into the workforce.

15. Brianna Hernandez, “*Entangled Ecologies”*

While scholarship and policy making is not often gender-neutral, it is often gender-blind or gender-essentialist. "Often and in subtle ways women's interaction and politics suffer from reproducing prevailing structures of omission and objectification," so there is need for thoughtful investigations into the relationship(s) between gender and the environment to better address major issues of common concern. The aim of this project is to bring together the theoretical frameworks of feminism and environmentalism with the particulars of governance structures to investigate the extent to which the global climate change regime has included women and girls in its policies and practices. To do so, I employ an interpretivist methodology including close reading, critical interrogation of terms, discourse analysis (manual and using NVivo), binary coding mechanisms (using excel), and interviews. This research presents a story filled with tensions, with non-linear paths of transformation, and policies and practices to both learn from and heal from. This project brings together threads of feminism and environmentalism with the particulars of governance structures within environmentally focused organizations to investigate the extent to which the global climate regime has included women and girls - and, sometimes, reproduced problematic binaries and hierarchies in the process. This is of interest to academics, practitioners, and activists as many organizations and movements are grappling with how feminism and environmentalism hang together. It research contributes to a non-essentialist framework for a gender-aware/responsive global climate change regime. This work makes contributions to literatures of feminist institutionalism, ecofeminism (and various iterations of intersectional ecologies), and international organization as well as writings on “systems of continuous meaning negotiation and translation” in development and environment spaces. This project will complement the few existing studies on empowerment as destination and process in development work, such as that completed by Andrea Cornwall through the Pathways of Women’s Empowerment research program.

16. Melissa Hurtado, *Becoming America: Guns, Assimilation, and Fighting Back”*

The literature on American gun ownership has gone from focusing on the criminal use of guns to analyzing middle-class, White men’s interest in concealed gun ownership. Though there is growing attention to gun ownership among non-traditional groups, immigrants have largely been excluded from these studies. Using semi-structured interviews with foreign-born Latino and Caribbean men in Florida and participant observation at gun shows in Miami, this work explores the motivators that account for immigrant gun ownership. The men interviewed cite being motivated by post-COVID uncertainty, wanting to defend themselves against perceived animosity toward their communities, and feeling more American as gun

owners. These findings suggest that part of the appeal of carrying a concealed firearm for immigrants living in Florida is that it allows them to identify with nationalistic images of 'Americanism' from which they are typically excluded and feel more in control in the face of rising violence against their communities. First, this study establishes Florida as an interesting case study due to its pro-gun laws and large immigrant community. Next, this text considers how generalized fear of crime and social unrest factor into immigrants' decision to concealed carry. For some respondents, fear of crime was exacerbated during the social unrest of 2020. Finally, this study uses theories of assimilation and transnationalism to position immigrant gun ownership as a symbol of Anglo-conformity and a tool through which immigrants continuously negotiate their ongoing relationships with the U.S. and their countries of origin. This is particularly important to understand immigrants' pro-gun politics. In this way, this work positions itself within the discipline's debates on the utility of assimilation versus transnationalism to argue that both bodies of research offer useful and complementary frames from which immigrants' social worlds can be understood. Immigrants are asserting their interest in gun ownership by overcoming barriers to access the national gun culture. This agency underscores the need for future sociological investigations into this social phenomenon, highlighting immigrants' role as active participants in shaping the landscape of gun ownership.

17. Nilima Islam Luba, *"Longitudinal Assessment of Economic Recovery of Puerto Rican Households after Hurricane Maria"*

Natural hazards recurringly leave staggering effects on the US economy, especially in the coastal regions. Hurricane Maria's (2017) landfall resulted in numerous fatalities in Puerto Rico and inflicted damages of billions of dollars. As most studies analyze Puerto Rico's economic shock and recovery from Hurricane Maria on a macro level, variation in loss and recovery from the micro-economic aspects remain understudied. This research aims to analyze household-level economic and financial indicators to quantify how households cope and recover from economic shocks caused by natural hazards. Using a combination of household survey, census, and geospatial datasets, we conduct a longitudinal study to explain the change in household income and consumption in three distinct time intervals between 2017 and 2020. Employing a Difference in Difference (DID) approach, we estimate how household characteristics and experience of Hurricane Maria determine a household's economic vulnerability and resilience. Our findings suggest that, unlike most hazards, support from close social networks did not contribute to Hurricane Maria-affected households' recovery. We expect the results will be useful in understanding the nature and extent of vulnerability in promoting resilience in disaster-prone regions.

18. Nick Mattox, *"The Relation Between Spatial Language Comprehension and Mental Transformation During Early Childhood"*

Mental transformation is the ability to visualize and represent two- and three-dimensional objects. Individual differences in mental transformation accuracy predict children's future Science, Technology, Engineering, and Mathematics (STEM) abilities T Spatial-relational language knowledge has been positively associated with mental transformation aptitude during early childhood. However, many previous examinations of this relation focus exclusively on the production of spatial language; the present study adds to the existing literature by measuring comprehension. A sample of 104 typically developing 4- to 6-year-old children (Mean 5.61 years, SD = 0.89; 50 girls) completed age-appropriate measures of their general spatial-relational language comprehension and mental transformation proficiency. Spatial-relational language comprehension was measured using the Boehm-3 Preschool Test

of Basic Concepts (Boehm-3); mental transformation was measured using the 32-item version of the Children's Mental Transformation Task (CMTT). After controlling for age, gender, and parent education, multiple regression analyses found that children with greater spatial-relational language comprehension were more accurate on mental transformation items. These findings suggest that children's comprehension of spatial-relational language predicts individual differences in mental transformation proficiency. Results are discussed regarding how spatial-relational language support spatial cognitive development during early childhood.

19. **Julio A Peraza,** ***"Methods For Decoding Cortical Gradients of Functional Connectivity"***

Macroscale gradients of brain connectivity have emerged as a central principle for understanding functional brain organization. Previous studies have demonstrated that the principal gradient of functional connectivity in the human brain exists, with unimodal primary sensorimotor regions situated at one end and transmodal regions associated with the default mode network at the other. The functional significance and interpretation of gradients remain a central topic of discussion in the neuroimaging community, with some studies demonstrating that they may be described using meta-analytic functional decoding techniques. However, additional methodological development is necessary to fully leverage available meta-analytic methods and resources and quantitatively evaluate their relative performance. The overall objective of the current study was to investigate and improve the framework of data-driven methods for decoding the principal gradient of functional connectivity, thereby promoting best practices for understanding its underlying mechanisms. We comprehensively examined and evaluated different methods and establish a principled approach for gradient segmentation and meta-analytic decoding. To this end, we used the resting-state fMRI (rs-fMRI) group-average dense connectome from the Human Connectome Project (HCP) S1200 data release to identify the principal gradient of functional connectivity. We evaluated three segmentation approaches: (i) percentile-based, (ii) segmentation based on a 1D k-means clustering approach, and (iii) segmentation based on the Kernel Density Estimation curve of the gradient axis. We assessed six different decoding strategies that used two meta-analytic databases (i.e., Neurosynth and NeuroQuery) and three methods to produce meta-analytic maps (i.e., term-based, LDA-based, and GC-LDA-based decoding). In addition, we proposed a method for decoding lower-order gradient maps combined with the principal gradient in a high-dimensional space. We found that a two-segment solution determined by a K-means segmentation approach and an LDA-based meta-analysis combined with the NeuroQuery database was the optimal combination of methods for decoding the principal gradient of functional connectivity. This combination of approaches and our recommended visualization method for reporting meta-analytic decoding findings will enhance the overall interpretability of macroscale gradients in the fMRI community. The current work aims to provide recommendations on best practices and flexible methods for gradient-based functional decoding of fMRI data.

20. **Karinna Rodriguez,** ***"Strategy in Sight: Eye-Tracking Children's Mental Rotation"***

Relying on self-report to understand how children solve cognitive tasks has limitations, particularly with young children. Recent advances in eye-tracking technology allow researchers to leverage this tool to measure young children's strategies for solving cognitive tasks. The current study focuses on young children's mental rotation ability given its reported links to academic achievement in science, mathematics, and language arts. We explore the cognitive strategies employed by 3- to 7-year-olds using eye-tracking when they are solving mental rotation tasks. Prior literature shows participants use two types

of cognitive strategies, holistic and piecemeal. Holistic involves the rotation of an object as a single entity, and piecemeal entails the rotation of an object by its individual components. Our final sample consisted of 148 three- to seven-year-old children (68 girls) from a local science museum. Participants completed a mental rotation task while having an eye- tracker record their eye-movements. By using this data-driven approach we identified how young children solve these tasks. Specifically, latent profile analysis using eye-tracking data revealed two distinct classes among the participants. Class 1, employing a holistic strategy, exhibited fewer visit and fixation counts and shorter visit durations. Class 2, employing a piecemeal strategy, demonstrated more visit and fixation counts along with greater visit durations. These findings underscore the efficacy of eye-tracking data in identifying how young children approach and solve mental rotation tasks, mirroring patterns observed in adults. These findings show value in optimizing eye-tracking technological advances to understand young children's cognition.

21. Luc Sahar, *"Unfamiliarity Reveals Prosodic Correlates of Social Anxiety: Evidence From Naturalistic Reading"*

Individuals with social anxiety exhibit biased self-evaluations of their performance within social settings. Yet, research remains conflicted on whether socially anxious individuals exhibit actual social performance deficits. Relying on relatively broad assessments, prior work suggests socially anxious individuals are no more likely to exhibit actual social performance deficits within structured performance settings—such as giving a speech or reading aloud. However, given the paucity of research studying speech patterns of socially anxious individuals at a fine-grained level, it remains unclear if social performance deficits within structured settings have simply been missed by prior measurement approaches. To investigate this question, we recruited 58 young adults to read multi-sentence passages aloud while being audio-recorded. Participants were informed that their audio was recorded and would be evaluated by researchers, serving to establish a social performance context. Participants also answered comprehension questions about each passage read aloud and provided self-reports of social anxiety symptoms. Employing a reading-aloud task, followed by assessment of reading comprehension, allowed us to measure both surface-level performance deficits (speech errors, disfluencies) and deficits in information retention (comprehension accuracy). Contrary to our predictions, social anxiety symptoms were associated with increased social-performance deficits at the surface level, specifically in terms of the rate of speech disfluencies (hesitations) while reading aloud ($p = 0.02$). No significant relations with the other measures of interest were observed. Thus, individuals with social anxiety exhibit actual social performance deficits within a structured reading aloud task, pausing/hesitating more frequently than low-anxious individuals. To further investigate this phenomenon, we probed whether increased hesitations were more likely to occur before less familiar (low frequency) words. All individuals hesitated more prior to less familiar words; however, this effect was stronger for socially anxious individuals ($p = 0.004$). Future work should explore whether such hesitations before unfamiliar words—among socially-anxious individuals—arises from a fear of guessing unfamiliar words incorrectly, slower processing speeds, or a cognitive control strategy to (over)prepare for unfamiliar material. More broadly, the results demonstrate the utility of a fine-grained measurement approach in studying social performance deficits in social anxiety.

22. Donisha Smith, *"Longitudinal Changes in Dynamic Functional Connectivity Associated with Physics Learning"*

The benefits of active learning in STEM education have been widely investigated at the behavioral level.

However, there is a dearth of studies exploring these effects at the neurobiological level. Neurobiological studies, such as those using functional magnetic resonance imaging (fMRI), can provide insight into the brain's dynamic functional connectivity (dFC) patterns, defined as consistent, replicable brain states that fluctuate over time. Certain dFC analytical techniques, such as co-activation patterns (CAPs) analysis, aggregate similar spatial distributions of brain activity and generate an average representation of brain states assigned to the same cluster. In the present study, dFC differences were examined pre- and post-instruction among undergraduate students who completed an introductory physics course in either a lecture-based or active learning classroom. Six CAPs were identified in rest and task-based fMRI data, corresponding to canonical, large-scale brain networks (e.g., dorsal and ventral attention, visual, somatosensory, control, limbic, and default mode networks). Across CAPs, significant findings were observed for the main effect of time (pre-instruction vs. post-instruction), main effect of classroom (active learning vs. lecture-based), and the interaction between time and classroom. These results enhance understanding of how different teaching methodologies induce long-term differences in intrinsic brain architecture.

23. Ruchi Soni, "*A Mixed Methods Study Exploring Pre-Service Teachers' Science Teaching Beliefs and Experiences in a Science Methods Course"*

Preservice elementary teachers' (PST) competence and confidence in teaching science are essential for effective science teaching. The National Science Foundation (NSF) and the National Science Teachers Association (NSTA) acknowledge that students' achievement in science depends on access to and quality elementary science instruction. Nonetheless, the stats reveal the current situation in science education. The data from the TIMSS (2015) survey reveals that 56% of 4th-grade students had a higher interest in science, while this inclination toward science had declined to 37% in 8th-grade students. This data redirects us to the concerns of the poor quality of elementary science and teachers' preparation for science teaching. The lower level of education, whether at the elementary level or in teachers' preparation programs, has been highlighted in Previous studies (e.g., Czerniak, 1989; McDonnough et al., 2010; Novak et al., 2022) where teachers reported the feeling of unpreparedness to teach science. The lack of preparation has led to poor attitudes and reluctance toward science teaching in elementary classrooms. As a result, this attitude perpetuates low self-efficacy in science and choice of teaching methods when placed in schools. The purpose of this study was to investigate the science teaching efficacy beliefs of pre-service teachers enrolled in the introductory science methods course. Convenience sampling was used to recruit the participants. This sequential mixed methods study used the STEBI-B instrument to measure and categorize participants with high and low scores, followed by semi-structured interviews. A paired sample t-test was used to detect the effectiveness of the course, which was evidenced by the increased self-efficacy scores from pre- to post-semester. The semi-structured interview data revealed three themes: perceptions towards teaching science, self-efficacy foundations, and anxiety-provoking experience indicators. The findings from this unique approach add to the current body of literature focused on teachers' professional development and science teaching efficacy beliefs (STEBs).

24. Sherrard Spiers, *"Determining Effective Remote Salesforce Performance: A Study of Virtual Selling in the United States"*

This thesis identifies and analyzes key considerations driving sales performance of today's salespersons. It examines antecedents affecting a salesperson's sales effort and sales performance whether that

salesperson works in a face-facing sales position or in a virtual, or omni (i.e., both remote and in-person) sales position. An original, domestic survey was conducted in October 2023, polling remote salespersons, hybrid salespersons and physical face-to-face (in-person) salespersons in the food and beverage industries. This research is especially important for selling organizations transitioning to remote or at the very least omni work especially as remote work is no longer the 'work of the future' as recent estimates determine that "by 2036 approximately 60% of the workforce will not know what it is like to commute to work and will only know of remote work" (Lund et. al., 2019). Moreover, understanding what factors contribute to a well-functioning sales organization is crucial for any contemporary company wishing to achieve competitive advantage over its rivals (Guenzi et al., 2016). The truth has been a lack of understanding of the basic correlates of sales effort and performance and, as of now, there have been no impressive studies on remote or hybrid selling. The poor results of the current and previous studies on salesperson performance may be in part due to, amongst other things, the possibly lacking measures of salesman performance. We therefore offer a model and method of predicting and evaluating the performance of in-person, remote and hybrid salesmen and in doing so propose a revised conceptual model for determining the antecedents of sales performance which is moderated by sales channel, personality and an individual's personal attributes (as age, gender, job tenure, education, etc.). The evidence shows that interpersonal skills (coping skills), salesmanship skills, technical knowledge skills, role ambiguity and perceived leadership empowerment does in fact contribute to and hold utility as predictors of a salesperson's sales effort and a salesperson's sales performance. Further the actualities shows that the moderating effect of personality, sales channel and personal attributes on sales effort and sales performance also affects the relationship between sales effort and sales performance.

25. Yuanhao Tian, *"Improved Relations, Improved Business—The Differential Impacts of Diplomatic Ties on Chinese MNCs"*

As China ascends further to the world stage, it increasingly engages with different regions of the world, mostly though state enterprises. While the behavior of state enterprise has been an interesting area of investigation, which has drawn lots of research interest, the private enterprises are also an interesting area of investigation which has not drawn much research interest so far. By using case study of Dominican Republic, we find that there is a differential impact of how Chinese diplomatic ties with host country affect private enterprises' behavior in a target country. The findings of this paper have important generalizable lessons for other possible and emerging cases as China aspires to engage further in Latin America in particular and other regions of the world in general, which may get further complicated if a great powers competition emerges, especially by an intervention of the USA in upcoming decades.

26. Ibrahim Yakin, *"The Coactive Influences of Emotion Dysregulation and Disordered Eating among Sexual Minorities"*

Sexual minorities (SM) are up to four times higher in risk for symptoms of eating disorders (ED) compared to their heterosexual counterparts. Identifying as SM predicts greater emotion regulation (ER) difficulties, which in turn predicts higher ED symptoms. However, SMs are not a homogenous group and psychosocial factors may differentially impact the ER and ED and the linkages among them. This study investigated the moderating role of sexual identities (SI) on the links between ER and ED. Adults between ages 18-40 participated in the current study (N = 697, Mage = 22.15, SDage = 3.65). Self-reported sexual identities were bisexual (67.8%), gay (6.1%), lesbian (9.8%), and other (e.g., pansexual, 16.3%). Participants' racial/ethnic identities were Latinx (69.1 %), White (10.7%), Black (13.4%) or other

(e.g., mix ethnicity, 6.8%). Since previous studies found variations in the factor structure of EAT-26 in non-SWAG (i.e., skinny, white, affluent, girls) samples, we examined its factor structure in our sample. Correlation analysis revealed that all subscales of EAT-26 were significantly associated with all subscales of DERS-18 (except awareness), although these linkages were different for different SI groups. Series of regression models tested the moderating role of SI in the linkages among subscales of DERS-18 and those of EAT-26. Two analyses were statistically significant. Identifying as lesbian moderated the association between lack of emotional goals (β = .19, p < .001) predicting higher levels of food preoccupation, F(7, 690) = 8.26, p < .001, R2 = .08. Identifying as 'other' moderated the relationship between nonacceptance of emotion (β = .25, p < .001) and predicted higher levels of food preoccupation F(7, 690) = 14.68, p < .001, R2 = .13. In both of these models SI influenced the effects of emotional dysregulation on eating pathology and specifically food preoccupation. Our findings demonstrate the individual differences among SI groups on the interactions among ER difficulties on ED symptoms. Understanding the differential pathways from ER to EDs risk is important for understanding the lived experience of different SMs, as well as to advancing diversity-affirming research on EDs.

27. Siyu Zhang, *"Investigating Unfulfilled Travel Needs for People with Travel-Limiting Conditions ---- using the 2017 NHTS data"*

Despite increasing awareness of the unmet travel needs of people with disabilities (PWD), there is a lack of research that explores the intersectionality of disability with other aspects of an individual's identity, such as gender, race, ethnicity, employment status, income, and age. To bridge this research gap, this study investigated the disparities of the unmet travel needs within specific subgroups of the disabled population using data from the 2017 National Household Travel Survey (NHTS). Studying the travel needs of the PWD is crucial not only for understanding the unique challenges faced by PWD but also for uncovering potential gender and social inequities in transportation. A logit model with interaction effects was developed to identify influential factors contributing to the decision to "reduce day-to-day travel" due to their conditions. By utilizing this modeling approach, the study identified key determinants that influence the occurrence of unmet travel needs among PWD and shed light on the underlying factors that contribute to the observed variations. The study uncovers intricate relationships between gender, poverty status, race, and travel experiences among individuals with disabilities. The findings underscore the importance of exploring specific subgroups within these categories to gain deeper insights into the travel challenges and needs faced by disabled individuals. This study also reveals the potential suppression of travel desires and overlooked travel needs within the Hispanic disabled population, highlighting the necessity for targeted interventions and support to address these disparities. Policymakers are encouraged to develop strategies tailored to the specific difficulties and special travel needs of disadvantaged groups.

Health and Life Sciences

28. Juliet Akkaoui, *"The Role of Novel Risk Factor IQCK and its Potential Mechanism in the Pathogenesis of Alzheimer's Disease"*

Alzheimer's disease (AD) is a complex and highly heterogeneous neurological disorder that results in gradual neuronal loss and a decline in cognitive function. Therapeutics targeting amyloid pathology in AD patients have failed so far, indicating that the pathogenesis of AD still needs to be understood thoroughly. Genome-wide association studies (GWAS) have identified several novel AD risk loci. Among

these loci, IQ-motif-containing protein K (IQCK), a relatively unexplored gene, has emerged as a potential risk factor for AD. The greatest challenge for future therapeutics is characterizing how these novel risk genes cause AD. To explore the role of novel risk factor IQCK in AD, we used various cell models including iPSC-derived neurons from normal control and AD patient fibroblasts, primary neurons, synaptosomes, newly generated IQCK transgenic mice, as well as lenti and adenoviruses. We used proteomic analysis, immunoblots, immunocytochemistry, and immunohistochemistry to identify potential mechanisms. Antibody-based microarray screening of 8000 proteins revealed IQCK significantly reduces amyloid precursor-like protein 1 (APLP1) and postsynaptic density protein 95 (PSD-95). These results were validated in several cell lines and, most importantly, in vivo in the IQCK transgenic mice using brain homogenates and synaptosomes as well as immunocytochemistry in the primary neurons derived from IQCK transgenic mice. Both APLP1 and PSD-95 are known to play a pivotal role in the maintenance of dendritic spines, NMDA, and AMPA receptor-based signaling, as well as long-term potentiation and cognition. Interestingly, PSD-95 is mutated in schizophrenia and autism, which are believed to result from disrupted synapses. PSD-95 is also disrupted in intellectual disability, a cognitive and mental disorder characterized by a reduction of dendritic spines. Therefore, IQCK-mediated PSD-95 deficiencies could be attributed to the loss of spines and cognitive impairments associated with AD. Understanding the role of IQCK in the loss of synaptic integrity in AD pathogenesis could provide valuable insights into the underlying mechanisms of AD and thus may offer novel therapeutic targets. Further research is needed to elucidate the precise mechanism by which IQCK contributes to the loss of synaptic integrity.

29. Md Shofiul Alam, *"Interactions of NCS Proteins with Doxorubicin/Paclitaxel: A Potential Pathway for Neurotoxic Side-Effects of Anti-Cancer Drugs"*

Doxorubicin and paclitaxel are considered as the potent chemotherapy drugs used to treat various types of cancers including breast cancer, ovarian cancer, leukemia, and lymphoma. They also have several known side effects, they primarily affect peripheral nerves, leading to a condition known as peripheral neuropathy. Although the actual mechanism of doxorubicin/paclitaxel induced neurotoxicity is unknown, it has been proposed that paclitaxel alters the interactions transient receptor potential V4 (TRPV4)/NCS1 and paclitaxel increases the binding of NCS1 to the inositol 1,4,5-trisphosphate receptor. In this study, we investigate if NCS proteins bind with two different anti-cancer drugs doxorubicin and paclitaxel. NCS1, (Neuronal Calcium Sensor 1), downstream regulatory antagonist modulator (DREAM), belong to the neuronal calcium sensor family and they bind to 2-3 calcium ions, and this binding triggers a conformational change that enables it to interact with various target proteins and cellular membranes. They have been implicated in several neuro-degenerative diseases including bipolar disorder, schizophrenia, autism, Alzheimer's disease, Parkinson's disease, and Huntington's disease. In this study, several biophysical techniques (fluorescence, time resolved study, anisotropy, computational study) were used to investigate the interactions of NCS1/DREAM protein with two different anti-cancer drugs doxorubicin and paclitaxel. Our data shows that doxorubicin binds to the both NCS1/DREAM protein with a comparable affinity 102 ± 24 μM and 83 ± 17 μM, respectively. Time resolved lifetime data shows that doxorubicin alters the tertiary structure and shortens the average Trp lifetime for both proteins. On the other hand, paclitaxel shows about one order magnitude stronger binding affinity (~10 μM) for NCS1/DREAM protein than doxorubicin. Docking of doxorubicin/paclitaxel to NCS1/DREAM structure show that both of the drugs are dominantly surrounded by the non-polar residues in N-terminal domain of these proteins. Those drugs binding impact the interactions between NCS1 and D2R peptide as well as the interactions of DREAM protein with site1, site 2 and helix-9 peptide mimicking those protein binding

sites. Overall data shows that both the drugs bind to NCS proteins and these interactions play a potential mechanism in drugs' induced neurotoxicity.

31. Janis Argeswara, *"Estimating The Abundance Of Threatened Marine Megafauna Using Capture-Mark-Recapture Methods: The Potential Of Citizen Science Data"*

Estimating the abundance and demographic parameters of marine megafauna populations is critical for conservation management efforts, particularly for assessing population-level impacts of human activities. However, due to their high mobility, extensive home ranges, and cryptic nature, estimating their absolute abundance is a challenge. Citizen science has the potential to assist researchers in increasing sampling efforts. Here, we explored the value of citizen science data in estimating the abundance of reef manta rays (Mobula alfredi) at a reproductive aggregation in the Nusa Penida Marine Protected Area, Indonesia. From 2012 to 2023, over 800 individual manta rays have been identified using photo-identification methods. The POPAN parameterization of the Jolly-Seber and Robust Design models were fitted to an 11-year photo-identification dataset to estimate annual abundance and a suite of population parameters. CMR models were fitted to three datasets: one solely collected by researchers, one compiling citizen science data, and one combining these two datasets. The models best fitted the combined dataset, with an estimated population size of 813 reef manta rays (95% CI, 787 – 849). The dataset collected by researchers only had an estimated population size of 791 (95% CI, 760 – 840), while the public dataset estimated 545 (95% CI, 471 – 659). The annual population abundance of reef manta rays in the area showed an overall decline from all three datasets. This study indicates that relying solely on citizen science data submission for estimating population abundance and demographic parameters may not be accurate. However, the data is still valuable when combined with data collected by researchers. Citizen science projects are particularly important for the conservation management of highly mobile and migratory species that are threatened. They have proven to help understand animal population abundance, movement, biodiversity, and threats, and have increased the feasibility of scientific projects and public engagement. Encouraging citizen science data submissions can increase sampling efforts and engage the public with marine wildlife research and conservation.

32. Md Adil Arman, *"Dynamics And Diurnal Patterns Of Spontaneous, Recurrent Seizures In A Mouse Model Of Repetitive Blast Traumatic Brain Injury"*

In the last twenty years, approximately 500,000 members of the U.S. military have been affected by traumatic brain injury (TBI). One of the debilitating sequelae it carries is the development of post-traumatic epilepsy (PTE), indicated by spontaneous recurrent seizures that can arise from several months to years after an insult to the brain. The occurrence is substantially higher among military personnel, between 32% and 43%, compared to civilians, at rates ranging between 7% and 25%. Blast injuries due to improvised explosive devices (IEDs) are the leading cause of military TBI and account for approximately 60% of all military TBIs and up to 80% of mild TBI. In comparison with civilian TBIs, which for the most part result from accidents or falls, these present unique challenges and exhibit an increased incident rate. The objective of this study was to investigate whether seizures following repetitive blast-induced TBI exhibit diurnal patterns. Understanding the dynamics and patterns of seizures post-blast TBI is critical for identifying reliable biomarkers and developing preventative measures and effective treatments for PTE. We used a mouse model of repetitive blast-induced TBI in male and female mice aged 12-16 weeks. Mice were anaesthetized and exposed to a controlled blast wave using the blast simulator, which produced primary blast injuries characterized by a peak static overpressure of

approximately 117 kPa for a duration of 2.5 milliseconds. The results showed that 11 out of 53 blast-injured mice developed PTE, with a higher incidence observed in females (25%) compared to males (19%). Seizure frequency analysis revealed significant variability among the animals. Notably, seizures were three times more frequent during the light period than the dark, indicating a 200% increased seizure rate during daylight hours. Our study enhances the knowledge of PTE, following blast TBI and highlights significant diurnal variations of seizure occurrence. This further emphasizes the importance for consideration of the sleep-wake cycle in management and treatment of PTE, which might dictate therapeutic interventions for minimizing the risk of seizures.

34. Hugo Bravo Gallegos, *"Frataxin Gene-Targeted Histone Demethylation Contracts Expanded GAA Repeats In Friedreich's Ataxi"*

Friedreich's Ataxia (FRDA) is the most common autosomal recessive neuromuscular disorder. The disease is caused by expanded GAA repeats in the first intron of the frataxin (FXN) gene. No effective treatment for the disease exists. Thus, a treatment that targets the expanded GAA repeats is urgently needed. We recently found that the inhibition of H3K9 trimethylation (H3K9me3) synergized with DNA base excision repair (BER) to contract the expanded GAA repeats and upregulate FXN gene expression in FRDA neural cells and transgenic mouse brain tissue. We further hypothesize that GAA repeat-targeted demethylation of H3K9me2/me3 at the FXN gene can disrupt heterochromatin and induce BER to contract the expanded repeats. To test this hypothesis, we constructed the FXN gene-targeted CRISPR/deadCas9 (dCas9) plasmid systems with the histone H3-trimethyl-L-Lysine 9 demethylase 4D (KDM4D) fused to catalytically inactivated S. pyogenes Cas9 (CRISPR/dCas9-KDM4D) to induce demethylation of H3K9me2/me3 on the expanded GAA repeats in FRDA neural cells. The plasmids specifically target various regions flanking the GAA repeats at the FXN gene, allowing us to test the effects of repeat contraction in a gene-target location-dependent manner. We further demonstrated that the expression of key BER enzymes, 8-oxoguanine DNA glycosylase 1 (OGG1) and DNA polymerase β (pol β) were significantly decreased in FRDA patient cells, suggesting that the downregulation of BER enzymes in FRDA cells can be improved by the CRISPR/dCas9-KDM4D-targeted GAA repeat contraction. Our study will provide proof of concept for a gene-targeted contraction of expanded GAA repeats via the synergy between histone modifications and DNA repair. The results will reveal the mechanisms underlying CRISPR/dCas9-KDM4D targeted contractions of expanded GAA repeats through the interplay of histone demethylation with BER. The study will further open a new avenue to develop an effective gene therapy for FRDA.

35. Dario Caminha Paiva, *"Longevity And Size Coordinate Structural And Hydraulic Traits Of Flowers In A Tropical Montane Ecosystem"*

Climate change is altering the costs and benefits of plant investments in reproduction. Knowing the costs of flowers and the mechanistic linkages between floral traits and floral performance is crucial to predicting how plants will respond to these changes in the future. Yet, the physiological costs of flowers and the traits influencing these costs of floral production and maintenance remain poorly studied. A few studies have addressed how water and carbon costs relate to flower longevity, but these have been restricted to only a few genera and mostly to cultivated plants that were not growing under natural conditions. To address this fundamental knowledge gap, we investigated how flower longevity and size – two traits associated with the likelihood of pollination – are related to traits influencing the water and carbon costs of flowers in naturally occurring montane plant communities. We sampled 19 species

belonging to 15 families in the endangered Brazilian campos rupestres, a montane ecosystem known for its high diversity and endemism. We found that variation in traits related to carbon construction costs (petal mass per area and petal thickness) was explained by the longevity of individual flowers, while traits related to water maintenance costs (residual conductance and water residence time) were associated with flower size. Our results showcase how the physiological costs of flowers are related to pollinator attraction and thus play an important role in plant reproduction. Furthermore, our results highlight that shifts in the relative strengths of pollinator and non-pollinator selection may alter floral traits depending on the physiological costs of the flower. Therefore, our results can provide insight into how flower production and function may be affected by different components of climate change.

36. Candy Carbajal, *"Pharmacokinetic And Pharmacodynamic Interactions Between The Novel Antiretroviral Cabotegravir And The Opioid Morphine In Animal Model"*

People living with HIV are more likely to have opioid use disorder, even though a significant percentage of this population is prescribed opioids for long-term management of chronic pain, with morphine being one of the most used. Recently, the FDA approved cabotegravir (CAB) as a novel therapeutic approach for the prevention of HIV. Similar enzymes in the liver metabolize Morphine and CAB, and when combined, one drug can influence the rate of metabolism of the other. Here we studied the potential interactions among the novel antiretroviral Cabotegravir and the opioid morphine by evaluating their pharmacokinetic, pharmacodynamics, and toxicological effects using an animal model. Equal amounts of male and female C57BL/6J mice (N= 40/gender) were assigned into groups that received 1) saline, 2) morphine, 3) CAB, and 4) combination morphine plus CAB, via intraperitoneal administration. Latency to react to heat pain (as a function of morphine nociception) was recorded by Hot plate and showed a significant delay in animals exposed to combined morphine and CAB when compared to morphine-treated animals. The delay in behavior correlated with a decrease in morphine metabolism in the liver and secretion in kidneys, as determined by Mass Spectrometry, suggesting enzymatic competition. This was detected by measuring the mRNA expression of opioid receptors and the liver enzymes, involved in drug metabolism. Changes in tissue morphology, synaptic proteins, secretion of inflammatory molecules, and genetic and epigenetic changes were detected in necropsied brains, and the differences were more noticeable in male versus female animals. These findings provide novel insights in the potential mechanisms involved in the adverse drug-drug interactions among cabotegravir and opioids which are used in clinical settings. Furthermore, an understanding of the pharmacoepigenetics will identify new targets that might help in the interference with pharmacokinetics or pharmacodynamics of opioids and cabotegravir.

37. Somaia Haque Chadni, *"Identification Of A Drug Binding Pocket In Parasitic Type IA Topoisomerases"*

Type IA family of topoisomerases is preserved in all living organisms. The lack of a proven druggable pocket in type IA topoisomerases may be one of the core reasons behind the fact that there are no clinically approved inhibitors of these enzymes yet. A cysteine residue introduced into a rational position of Mycobacterium tuberculosis topoisomerase I (MtbTOP1) may serve as a model for parasitic TOP3β and a target for covalent inhibitors with reactive warheads. Structural determination of a covalent complex containing an inhibitor would aid the identification of a druggable pocket in parasitic type IA topoisomerases. A mutant bacterial topoisomerase I, MtbTOP1-V195C, is used as a target for compounds with acrylamide warheads. The compounds are tested against the wild-type MtbTOP1 and

MtbTOP1-V195C for inhibition of relaxation of negatively supercoiled DNA. The selective compounds are then investigated to confirm that they form a covalent adduct with MtbTOP1-V195C. Hit compounds will be then tested against Giardia lamblia TOP3β, a parasitic topoisomerase I. Among 162 compounds with cysteine-reactive warheads, five are found to be more active against MtbTOP1-V195C in three experimental replicates. When assayed against HTOP1B, only two of them (namely NCI 43 and NCI 86), are observed to exhibit specificity for type IA enzyme. Pre-incubation with the enzyme for 30 minutes, lowered the IC50 value of NCI 43 and NCI 86 supporting the idea of covalent adduct formation between MtbTOP1-V195C and NCI 43. Some structural analogs of these compounds were tested to get more potent and specific inhibition. Certain compounds with acrylamide warheads have the potential to function as covalent inhibitors of the mutant MtbTOP1-V195C and structural optimization of the possible hits may be needed to identify more potent inhibitors for parasitic TOP3β and other type IA topoisomerases. However, this search in turn may shed light on a drug-binding pocket for the development of novel inhibitors of type IA topoisomerases.

38. Aasma Dahal, *"Changes In Hemodynamic Correlation Maps In Mice With Vascular Calcification"*

Chronic kidney disease (CKD) increases the risk of vascular calcification (VC), a leading predictor of cardiovascular morbidity and mortality. Our previous study suggested hemodynamic changes in the peripheries were different with and without calcification during peripheral imaging of murine tails. However, these results were based on hemodynamic changes at point locations, and the overall changes in the entire peripheral tail were not determined. Our current work focuses on understanding the overall changes in hemodynamic correlation throughout the murine tail with and without VC. Here, ten-week-old adult mice were placed on a special diet for 12 weeks to induce CKD (CKD group) and CKD-induced VC (CKD group). Murine tails were imaged using an in-house near-infrared optical scanner (NIROS) and the spatiotemporal diffuse reflected NIR signals were obtained in response to occlusion. Occlusion-induced changes (during the first occlusion cycle) in hemoglobin-based parameters were obtained and analyzed to determine the hemodynamic correlation maps. The hemodynamic correlation maps based on effective oxy- (ΔHbO) and total-hemoglobin (ΔHbT) changes exhibited a predominantly negative correlation in the CKD+VC group compared to the CKD group at week 12(n=5)(sample case shown in Fig 1). This suggests a disruption of flow patterns due to the presence of VC in the CKD+VC group compared to the CKD group. These observed changes may be due to calcification in altering vascular compliance and blood flow. Ongoing work will focus on a more thorough comparison across weeks.

39. Justin Dalrymple, *"The Nervous System Controls Symbiosis In Exaiptasia Diaphana, An Anemone Model For Coral Bleaching"*

Corals are animals that associate with photosynthetic endosymbionts from which they receive the vast majority of their energy needs. Their reefs are the trophic and structural foundation of the ocean's most diverse ecosystems and provide significant services to humans. Coral bleaching is a process by which environtmental stimuli cause a coral host to expel its symbionts and which increasingly threatens reef ecosystems. Much work has been done to characterize the transcriptomic signature of bleaching stress but it remains unclear which pathways directly cause bleaching. We have conducted a screen of 1,280 human pharmaceuticals to assess them for bleaching activity in the model symbiotic cnidarian Exaiptasia diaphana. Our screen returned a list of 104 compounds. To our knowledge, we have shown for the first time that these compounds cause bleaching. The compounds suggest a diverse array of pathways may

play a role in bleaching, including neurotransmitter receptors, ion channels, and nuclear receptor transcription factors. We aim to further characterize this drug-target interaction network to better understand the bleaching drugome and determine its relevance to natural bleaching events.

40. Matthew Dias, *"A Novel High Throughput Screening (HTS) Assay To Discover Bacterial DNA Gyrase Poisons"*

Antimicrobial resistance (AMR) poses a significant threat to global public health. The overuse and misuse of antibiotics have led to the emergence of novel and more dangerous AMR strains, which are predicted to cause more than 317,000 deaths per year in the United States by 2050. To combat this, new classes of antibiotics are urgently needed. One promising target is bacterial DNA gyrase, a conserved and essential enzyme found in all bacteria but not in humans. Fluoroquinolones (FQs), e.g., ciprofloxacin, are a specific type of gyrase inhibitors called gyrase poisons. The mechanism of action of FQs is to stabilize the gyrase-DNA cleavage-complex and convert DNA gyrase into a DNA damaging machine. This gyrase poisoning mechanism makes FQs among the most important and prescribed antibiotics. In fact, FQs are the only type of antibiotics targeting bacterial DNA gyrase. New antibiotics targeting bacterial DNA gyrase need to be discovered and developed urgently as new bacterial strains have evolved FQ resistance alongside with the FDA black box warning on all FQs. One challenge is to develop rapid and efficient high-throughput screening assays to identify gyrase poisons from the millions of compounds found in small molecule libraries. In this study, based on the principle that gyrase poisons cause gyrase-mediated double-stranded DNA breaks, we developed a novel and unique high throughput screening (HTS) assay to discover bacterial DNA gyrase poisons. With the help of T5 exonuclease that only digests linear DNA and does not degrade supercoiled and relaxed plasmid DNA, gyrase poisons can be discovered by this HTS assay rapidly. We validated this HTS assay by screening a small library containing 50 compounds. Our next step is to establish an automatic and miniature HTS assay to screen compound libraries containing thousands or millions of compounds and identify/discover gyrase poisons that can be developed into new antibiotics.

41. Jessica Dominguez, *"Finding New Sources of Antimicrobials to Control Citrus Greening"*

Citrus greening, also known as Huanglongbing (HLB) is a devastating bacterial disease of citrus that affects all varieties with no exception and currently has no cure. In the United States, Candidatus Liberibacter asiaticus (CLas) is the bacterial pathogen responsible for HLB. CLas is an unculturable, phloem-limited bacterium, vector by Diaphorina citri, the Asian citrus psyllid (ACP). CLas compromises the plant's vascular system by plugging the phloem tissue which disrupts the natural flow of nutrients and ultimately results in plant death. With no cure for the disease, current management practices involve routine use of insecticides and antibiotics, both of which have shown only limited effectiveness. Thus, there is an urgent need to develop more sustainable and effective treatment options to prevent, reduce, or eliminate CLas from infected trees and help manage the current citrus greening pandemic. Endophytes are microorganisms that inhabit plant tissue for at least some stage of their life without causing any apparent harm. Endophytes produce a myriad of biologically active secondary metabolites which can benefit their host and/or have antimicrobial activity against phytopathogens. Antimicrobial-producing bacterial endophytes were isolated from organically managed citrus trees. The results of the psyllid homogenate assay (assessing directly against CLas) demonstrated that the culture extracts were highly effective at lysing CLas cells. The antimicrobial producing endophyte isolates were found to be

closely related to Bacillus amyloliquefaciense. The objective is to isolate, purify and characterize the active component/s of the extract. The active component was found to be water soluble. The extract with the strongest activity was analyzed through a bioassay guided fractionation scheme, and we have now narrowed down the activity of the crude extract to two significant fractions. Work is in progress to finalize the characterization of individual bioactive secondary metabolites. The biological control potential of these biologically active species, as well as the individual bioactive secondary metabolites they produce, remain to be evaluated in planta. The availability of effective endophyte-derived antimicrobial treatments would provide novel sustainable treatment options that could help alleviate the ongoing crisis of the citrus industry.

42. Shomita Ferdous, *"Identification of Flexible Hinge Region Residues In Bacterial Topoisomerase IA"*

Topoisomerase IA enzymes are ubiquitous in all domains of life and can catalyze topological changes for both DNA and RNA during vital cellular processes. Bacterial type IA topoisomerases (TOP1A) are promising targets for novel antibiotics to treat drug resistant infections like multi-drug resistant TB. Despite being promising targets for drug design, there are still some unanswered questions regarding the dynamic conformations during catalysis. According to the proposed mechanism, the active domain of topoisomerase 1A undergoes large conformational changes defined as "gate opening" and "gate closing" due to domain rearrangements. These changes control DNA entry and lead to the relaxation of negatively supercoiled ssDNA or decatenation of dsDNA. We are trying to identify the flexible hinge residues of topoisomerase IA which initiate and control domain rearrangements. Our first approach was to use an online server "PACKMAN" to predict possible hinge from the crystal structure of Mycobacterium tuberculosis topoisomerase I. The predicted region proline 506 to leucine 526 with a p value <0.05 was then studied as a potential hinge since they are at the border between domains D2 and D4. From the predicted region, two highly conserved polar residues, arginine (R) at 516 and glutamate (E) at 519 were substituted with alanine (A). In the first screening assay of complementation of topoisomerase I mutation in E. coli AS17 cells, the mutant R516A showed significant loss in activity and E519A showed almost no activity. This suggests the glutamate at 519 position may be required for conformational change after DNA binding. The residue R516 is in a flexible loop of domain D2 and interact with the DNA inside the toroidal cavity as well as maintain inter-domain interaction with E207 of D4 and aspartate (D) at 691 of D5 domains. Our results showed significant loss in DNA relaxation after mutating E207 and R516 which suggest their role as hinge residues in domain rearrangements. Our findings can be utilized in structure-based drug design and inhibitor screening which are still dependent on single conformation crystal structures despite proteins having function-related dynamics and conformational changes.

43. Maria Guerra De Navarro, *"Occurrence of Poly- And Perfluoroalkyls Substances (PFAS) In Wet Atmospheric Deposition From Miami-Dade, South Florida"*

Per-and polyfluoroalkyls Substances (PFAS) are anthropogenic compounds created over 80 years ago that are extremely ubiquitous in the environment and exhibit adverse health effects including cancer. Atmospheric deposition is an important source and pathway for PFAS transportation, especially in areas far from production sites, and it could be comparable to or higher than point source inputs. In Florida, major point sources of PFAS are facilities where Aqueous Film Forming Foam (AFFF) was heavily used in the past, such as military bases, firefighting training facilities, and airports, as well as landfills and

wastewater facilities. This work assesses the occurrence and composition of legacy and emergent PFAS in wet deposition in the Miami-Dade area, South Florida. Rainwater samples were collected in three locations in Miami-Dade County from October 2021 to November 2022 (N=42), encompassing the rainy and dry seasons. The methodology for sample preparation was validated and involves the preconcentration by solid phase extraction (SPE) process, using a weak anion exchange (WAX) cartridge, followed by liquid chromatography-tandem mass spectrometry analysis (LC-MS/MS) using isotopically labeled internal standards. The results show that 74 % of perfluoroalkyl carboxylic acids (PFCA), and 12% are perfluoroalkyl sulfonic acids as the major components. Specifically, perfluoro-n-butanoic acid (PFBA) was the most frequently detected compound, detected in 95% of the samples. Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA) levels detected in rainwater are above EPA-updated health advisory levels, averaging 0.24 ng L-1 and 0.32ng L-1, respectively. PFOS and PFOA fluxes in the Southeast are similar to reported values in the Northeast side of the country. Perfluoro-1-hexanesulfonate (4:2 FTS), perfluoro-1-octanesulfonate (6:2 FTS), perfluorohexanoic acid (PFHxA), perfluorohexanesulfonic acid (PFHxS), PFOA, perfluorononanoic acid (PFNA), and perfluorodecanoic acid (PFDA) are significantly impacted by the season of the year, during the dry season their presence is higher. The perfluoroheptanoic acid (PFHpA)/PFOA and PFOA/PFNA ratios indicate a mixture of point and non-point sources in the rainwater profile. Air mass simulation indicates Northwestern contribution to the increase of the sum of PFAS.

44. Zhen Guo, *"Exploring ATE1-Mediated Arginylation's Role In Genomic Stability And Tumor Suppression Through Bibliometric Analysis"*

Arginylation, a crucial post-translational modification mediated by Arginyltransferase 1 (ATE1), is implicated in essential cellular functions, including protein stability, degradation, and migration. However, the comprehensive molecular mechanisms and broader implications of ATE1-mediated arginylation in genomic stability and disease remain poorly understood. Leveraging a bibliometric analysis, this study systematically reviews the landscape of ATE1 research to elucidate its role in maintaining genomic integrity and inhibiting tumorigenesis. Our analysis reveals a significant correlation between Ate1 deficiency and increased chromosomal aberrations, disrupted cell signaling pathways, and enhanced tumorigenic potential, highlighting ATE1's indispensable role in cellular homeostasis. Conversely, our findings confirm ATE1's function as a genomic safeguard, preventing mutation accumulation and tumor development in physiological conditions. By mapping the trajectory of ATE1 research, our study not only underscores the enzyme's fundamental role in cancer biology but also positions ATE1 downregulation as a critical nexus in the etiology of various cancers. These insights advocate for a renewed focus on arginylation mechanisms as potential therapeutic targets, offering a novel perspective on combating diseases linked to protein dysregulation.

45. Sarah Hardin, *"Effects Of Early Life Lead Exposure On The Cardiovascular System In A Transgenic Mouse Model Of Alzheimer's Disease"*

Lead (Pb^{2+}) is a well-documented developmental neurotoxicant exerting adverse effects on various organ systems. Infants and children in critical periods of development are particularly susceptible to Pb^{2+} neurotoxicity with long-lasting effects on cognitive function promoting cognitive decline. Additionally, substantial evidence indicates significant detrimental effects of Pb^{2+} exposure on the cardiovascular system. Impaired cardiovascular health is also an associated risk factor for the development of Alzheimer's Disease (AD), a devastating neurodegenerative disorder affecting cognitive

function, resulting in social-behavioral problems, and eventually death. The negative health consequences induced by chronic early Pb2+ exposure (CELLE) is also observed in AD subjects. This study addresses a critical knowledge gap by investigating the effects on neurological/cardiovascular health influenced by CELLE in a familial AD animal model.

For these studies, we used the 5XFAD transgenic mouse model of AD and wildtype controls. 5XFAD mice express five human mutations in AD-associated risk genes, exhibiting an aggressive AD-phenotype. We employed ultra-high frequency ultrasound techniques to study the effect of CELLE on the cardiovascular system as a risk factor for late-life AD.

Our preliminary findings in female mice indicate that exposure from birth to 3 months of age to a Pb2+-containing diet results in environmentally relevant levels of blood Pb2+ at 3 months (14.45 ± 1.107 µg/dL) relative to non-exposed controls (<1.9 µg/dL). At 3 months of age, we observed that in female mice, CELLE results in significant increases in body weight (p=0.043, n=11-12), skull thickness (p=0.041, n=11-12) and posterior cerebral artery (PCA) peak velocity (p=0.005, n=10-12) as well as hypertrophy of left ventricular mass (p=0.017, n=5-6) and a decrease in mitral valve A-wave velocity (p=0.005, n=5-6) independent of genotype.

Our research on CELLE seeks to characterize the relationship between Pb2+-induced cardiovascular deficits and its ramifications on the central nervous system, shedding light on the potential risk of AD onset later in life.

47. Niloufar Khakpour, *"The Myogenic Regulation Of Cerebral Blood Flow: A Mathematical Model For Electromechanical Coupling In Arteriolar Smooth Muscle And Capillary Pericytes"*

Capillary-mediated signaling has emerged as a significant component of neurovascular coupling (NVC), allowing blood perfusion to match local demands in the brain. Capillary Pericytes (PCs) can actively regulate capillary tone and diameter and respond to electrochemical signals or changes in pressure. In this study, we present an integrated modeling approach that can link macroscale flow responses to cell-level dynamics, and we explore the role of capillary PCs in coordinating local blood flow distribution and mediating NVC. The cell level models describe membrane potential (Vm) and Ca2+ dynamics in capillary endothelial cells (cECs) and pericytes (PCs), as well as in endothelial (ECs) and smooth muscle cells (SMCs) of parenchymal arterioles (PAs) and pial arteries (Fig. 1). Biomechanical models of arterioles and capillaries are employed to translate Ca2+ signals into changes in vessel diameter. The model is compared against experimental data capturing arteriolar and capillary responses to pressure or extracellular K+ challenges. Network level simulations show how myogenic autoregulation maintains a relatively constant brain perfusion as blood pressure increases. Interestingly, the model suggests significant contribution by contractile capillaries in addition to arterioles in this phenomenon. Simulations further explore the physiological relevance of PCs regulating capillary diameters, identifying two potentially critical regulatory roles. First, PC-mediated, capillary adaptation can promote more uniform blood flow distribution when arterioles constrict. This can preserve blood supply to the deeper and more vulnerable regions of the brain. Second, capillary-level myogenic autoregulation can promote ‘‘blood stealing’’ by redistributing perfusion from unstimulated brain regions towards regions of neuronal activity, maximizing resource utilization.

48. Lee Seng Lau, *"Exploring Glycomic Strategies To Enhance CAR-T Cell Efficacy Against Diffuse Large B Cell Lymphoma"*

Diffuse large B cell lymphoma (DLBCL) is the most common and fast-growing B cell lymphoma and, while treatments continue to improve, many patients still remain unresponsive to therapy. Chimeric antigen receptor (CAR)-T cell therapy offers a promising option for such patients, involving gene-modified T cells produced outside the body for longer-lasting anti-tumor effectiveness when reintroduced into the patient. However, CAR-T cell therapy can be improved by enhancing tumor kill efficiency and in vivo persistence. T cells express surface carbohydrate chains (glycans) that can bind to glycan-binding proteins (lectins), hindering their function and survival. Experimental evidence suggests that ß-galactoside-binding galectins are elevated in lymphoma patients and, when bound to T cell surface glycans, can suppress their anti-tumor activity and/or lifespan. We hypothesize that galectins significantly compromise CAR-T cell therapy effectiveness and modifying CAR-T cell surface glycans to evade galectin binding could enhance their persistence and activity in vivo. We analyzed Gal-1, -3, and -9 levels in DLBCL patient serum compared to healthy controls. We investigated the binding ability of common immunosuppressive galectins (rhGal-1, -3, -9) on control naïve T cells, on control ex vivo-expanded T cells, and on CAR-T cells. We found that Gal-3 levels were significantly higher in patients with relapsed/refractory DLBCL compared to healthy individuals. Our binding assay showed strong binding of ex vivo-expanded human T cells and CAR-T cells to Gal-1, -3, and -9, correlating with increased susceptibility to Gal-3-induced apoptosis. Furthermore, we observed suppressed ST6Gal1 gene expression in CAR-T cells that is inversely related to Gal-3-binding in temporal flow cytometry assessments. MALDI-TOF MS N-glycan analysis revealed elevated levels of tri-antennary N-glycan species, known to enhance Gal-3-binding. Overexpression of ST6Gal1 in CAR-T cells reduced Gal-3-binding and blocked Gal-3-induced apoptosis compared to control CAR-T cells, suggesting that ST6Gal1 expression and α2,6 sialylation of surface glycans may prolong CAR-T cell longevity. The data suggest that understanding a human T cell's surface glycome can provide strategies to evade immunosuppression and boost CAR-T cell persistence and/or anti-tumor functional activity.

49. Loreen Magarino, *"Provider Perspectives On Caregiver Engagement Within IDEA Part C Early Intervention"*

Early Intervention (EI) is a federally-mandated (IDEA Part C) and state-managed national health service for infants and toddlers (ages 0-3) with or at-risk for a disability, developmental delay, and/or neurodevelopmental conditions[1,2]. Care provision is family-centered and delivered by multidisciplinary health professionals (e.g., physical therapists, general infant/toddler developmental specialists [ITDS; 2,3]. Provider perceptions and beliefs about caregiver engagement influence the quality of care provided to families4. Investigating providers' perspective is imperative for improving caregiver engagement – a key element of this home visitation health service[5]. However, little investigation is dedicated to EI providers' perspectives on caregiver engagement[6]. This dissertation research examines qualitative interviews with EI providers, in English and Spanish language to investigate (Objective 1) how these providers experience and understand the phenomenon of caregiver engagement with families and (Objective 2) the process of tailoring care to align with cultural and contextual dimensions within home-based service provision. Semi-structured interviews, conducted in-person and virtually, focused on provider experiences with home visits, caregiver coaching, their perceived rapport and engagement with families, as well as, cultural and family considerations. A phenomenological approach to qualitative inquiry was selected to investigate and describe the phenomena of caregiver engagement and the

tailoring of care by providers[7]. Thematic analysis of the data included (a) generating initial codes, (b) refining categories, (c) iterative coding, (d) identifying themes and subthemes, (e) reviewing and revising themes, (f) merging with alternative data source analysis and findings, and (g) producing an integrated report. This research contributes to the field by investigating provider perspectives on caregiver engagement, within a diverse sample, of which 92% are ITDS, nearly all self- identify as Latinx (92%), 71% were born outside of the United States, and 100% provide services to families in more than one language. Findings inform future professional development topics and workforce support activities for EI providers serving children and families in the unique transnational, multilingual, metropolitan area of Southeast Florida.

50. Yasir Mamun, *"Revealing The Nucleic Acid Interactions Of Human Topoisomerase 3 Beta, A Unique Dual-Acting Topoisomerase, And Discovering Its Inhibitors"*

Human topoisomerase III beta (hTOP3B) is the only type IA topoisomerase in the human cell that works on DNA and RNA substrates. Studies show that lack of hTOP3B leads to increased R-loops and genome instability; irreversible TOP3B cleavage complexes (TOP3Bccs) lead to DNA damage and reduce cell survival; tumors lacking TOP3B grow more slowly, and positive-sense single-stranded RNA viruses utilize hTOP3B to replicate efficiently, making it a potential anticancer and antiviral drug target. In this study, we highlight the interactions between the residues of hTOP3B and nucleic acids using molecular dynamics (MD) simulation and find inhibitors of the enzyme through in-silico and in-vitro approaches. MD simulation is a well-established tool for studying protein-substrate interaction, and we utilized this method to study the interactions between hTOP3B and nucleic acids. For this, we generated multiple models of hTOP3B complexed with DNA and RNA sequences using the hTOP3B crystal structure (PDB: 5GVC) and 8-mer single-stranded DNA and RNA sequences. These modeled complexes include both covalently and non-covalently complexed structures. We then performed MD simulations of all the generated models. From the simulations, we can highlight the stability of the complexes, conformational changes, sequence preference, and interactions of the binding pocket residues with different nucleotides. Our binding affinity results also provide insight into the substrate preference of hTOP3B. Additionally, developing inhibitors of hTOP3B could serve not only as potential therapeutics but also as biomolecular probes to understand its mechanism of action and biology. We conducted an in-silico screening of a library of potential inhibitors targeting the active site cavity of hTOP3B. We then evaluated the candidates with the best docking scores for their inhibition of hTOP3B relaxation activity and quantitatively analyzed the compounds that exhibited inhibition to determine their MIC. Our results show that in-silico screening combined with inhibition assay can help us find potential inhibitors of hTOP3B. Our work demonstrates that hTOP3B forms stable complexes with both RNA and DNA and highlights the suitability of the complexes for inhibitor discovery and binding study. It also provides a better understanding of the enzyme's interaction with different nucleic acid substrate sequences.

51. Daniel Martinez-Perez, *"Translocator Protein 18 Kda (TSPO) Expression In Microglia Is Associated With Aβ Pathology In The 5XFAD Animal Model Of Alzheimer's Disease"*

Problem Statement: Alzheimer's disease (AD) is the most prevalent neurodegenerative disorder that affects cognition, memory, and social abilities with devastating effects on individuals and their families. The hallmark pathology of AD is the accumulation of amyloid-β (Aβ) plaques and tau neurofibrillary tangles leading to neurodegeneration and atrophy of the brain. Neuroinflammation and microglia activation play an important role in the initiation and progression of AD. TSPO is a well-validated and

widely used biomarker of neuroinflammation, and it is markedly increased in the brain of AD subjects and AD animal models, but its role in AD progression is still unknown. Objective: To examine the trajectory of brain TSPO levels, cellular sources, and its association with AD pathology using a life course approach in the 5XFAD transgenic rodent model of AD. We used the Barnes Maze to assess cognitive performance in male and female wild-type (WT) and 5XFAD mice at 3 months (3M), 7 months (7M), and 12 months (12M). To evaluate pathological endpoints, we included 1.5 months (1.5m), and we measured Aβ-load using immunohistochemistry in different brain regions. To assess TSPO expression in the brain, we performed quantitative autoradiography with the TSPO-specific radioligand [3H]-DPA-713. To determine the cellular sources of TSPO response and its association with Aβ-plaques, we used quadruple-label immunofluorescent. No significant differences in cognitive performance between WT and 5XFAD were found at 3M.but we found a significant difference in 5XFAD at 7M in females and 12M in both sexes. We found an increase in Aβ-load as a function of age and sex. TSPO levels were significantly increased in both sexes at 3M, 7M, and 12M in 5XFAD compared to WT. TSPO increased expression was colocalized with microglia associated with Aβ plaques in an age and genotype-dependent manner and not with astrocytes. Our findings indicate that brain TSPO is an early biomarker of neuroinflammation in AD and TSPO levels increase at the same time as Aβ aggregation, but much earlier than cognitive decline, in an age- and sex-dependent manner. TSPO increase levels were associated with microglia surrounding Aβ-plaques suggesting a role in plaque formation and AD progression.

53. Valeria Nazaire, *"Site-Specific N-Glycosylation Analysis Of Bone Morphogenic Protein Receptor-2"*

Pulmonary hypertension (PH) is an irreversible condition defined by elevated blood pressure within the lung vasculature. If left untreated, PH may lead to right heart failure and eventually death. Mutations in the gene encoding bone morphogenetic protein receptor type-2 (BMPR-2) have been linked to inherited forms of pulmonary artery hypertension. BMPR-2 is expressed in multiple cell types including endothelial cells and mediates cell signaling following ligand binding of the transforming growth factor beta (TGF-β) family ligands. BMPR-2 activation can contribute to cell proliferation, apoptosis, and angiogenesis. Glycosylation of BMPR-2 reportedly influences BMPR-2 ligand binding and receptor activation. Glycosylation is the co- and/or post-translational addition of glycans (sugars) to proteins. Here, we sought to define the glycan structures at three putative N-glycosylation sites on the extracellular domain of BMPR-2 using tandem mass spectrometry. To optimize conditions for the observation of BMPR-2 glycosylation sites via bottom up nano liquid chromatography tandem mass spectrometry (nLC-MS/MS), we tested three conditions for proteolysis (trypsin, GluC, and a combination of trypsin and GluC). Following proteolysis, nLC-MS/MS were performed to reveal N-glycosylation sites and glycan compositions on human BMPR-2. Data were analyzed using ProteomeDiscoverer and Byonic software. We observed N-glycopeptides spanning all three putative BMPR-2 N-glycosylation sites (N56, N110, and N126). High BMPR-2 amino acid sequence coverage was observed for all three proteolytic conditions. We report high coverage of the BMPR-2 extracellular domain, with 100%, 90.4%, and 90.4% coverage achieved utilizing trypsin, GluC, or Trypsin plus GluC, respectively. Glycopeptide analyses revealed complex glycoforms with abundant fucosylation and sialylation. The best workflow for the analysis of BMPR-2 N-glycosylation involved the use of trypsin for proteolysis, which resulted in the highest amino acid coverage and enabled the observation of all three glycosylation sites of BMPR-2 (N55, N110, and N126). Further, tryptic glycopeptides were assigned with higher confidence compared to glycopeptides from the other digests. It is crucial to understand the composition of BMPR-2 N-glycans, in

order to define and elucidate their role in BMPR-2 signaling and in pulmonary hypertension. The nLC-MS/MS method established here will facilitate the study of BMPR-2 N-glycosylation in pulmonary hypertension.

54. Laura Ochoa, *"Modulation Of Glioblastoma Progression By DNA Repair In A Drosophila Melanogaster Model"*

Glioblastoma (GBM) is an aggressive grade IV primary brain cancer responsible for over 200,000 deaths each year. These malignant tumors originate from glial cells, the immune cells of the central nervous system (CNS), and therefore are collectively known as gliomas. Individuals diagnosed with glioblastoma face a daunting survival probability of approximately 6%, with an average life expectancy of 15 months post-treatment. Treatment of GBM poses significant challenges as the anatomical location of the malignancy prevents complete surgical removal, and the blood-brain barrier hinders the delivery of chemotherapeutic agents to the tumor site. Despite significant efforts, our understanding of the mechanisms underlying early-stage GBM cells' sensitivity to chemotherapeutic treatment remains unknown. Among the few chemotherapeutic agents known to counteract late-stage GBM progression is temozolomide (TMZ), a DNA alkylating agent that induces DNA damage, ultimately triggering apoptosis of glioblastoma cells. However, GBM patients frequently develop resistance to TMZ, which is attributed to the overexpression of DNA repair genes in GBM cells. Recognizing the urgent need for earlier and more effective treatment strategies, we hypothesize that DNA repair genes play a crucial role in mediating TMZ resistance during late-stage GBM progression. To test this hypothesis, we propose utilizing a Drosophila melanogaster GBM model to gain novel insights into the cellular mechanisms affecting GBM initiation and response to early-stage TMZ treatment. We will characterize the DNA repair traits of the Drosophila larval GBM model. We will then determine how the TMZ-enhancing genes interact with DNA damage repair mechanisms. Finally, we will conduct a genetic screening of the GBM model larvae to identify new genes that increase the sensitivity of TMZ on GBM cells. Our study will reveal the mechanisms underlying the novel role of DNA repair genes in modulating the effects of TMZ on GBM early development and progression, providing a new avenue to identify novel targets for early diagnosis and treatment of GBM.

55. Mustapha Olatunji, *"DNA Repair Polymerases As Novel Mediators Of RNA Damage Repair"*

Repair DNA polymerases are known to mediate DNA damage repair to prevent genome instability. However, it is found that they can also synthesize RNA, suggesting their new roles in mediating RNA damage repair. Yet, it remains unknown how these repair DNA polymerases can mediate RNA damage repair to maintain transcriptome integrity. We recently found that the translesion DNA polymerase, Pol η, performed RNA synthesis and filled in RNA gaps on an RNA-DNA hybrid. Moreover, a recent study identified an RNA ligase/C12ORF29 that can seal an RNA nick. We further hypothesize that DNA repair polymerases can perform RNA gap-filling synthesis to generate an RNA nick sealed by RNA ligase/C12ORF29. To test this hypothesis, we characterized the RNA synthesis activity of DNA polymerases. We found that pol η and pol θ exhibited efficient RNA synthesis activity on an RNA-DNA hybrid substrate to perform RNA gap-filling synthesis, generating an RNA nick. We also found pol η RNA synthesis activity was significantly increased in the presence of manganese, a cofactor of DNA polymerases. Using molecular dynamics simulation, we found that pol η continuously made dynamic conformational changes to adjust the distance between the 3'-OH group of the RNA primer and the α-

phosphate of the incoming nucleotide, resulting in enzymatic catalysis. Our results have revealed a novel pathway for RNA damage repair and its interplay with DNA repair mediated by DNA polymerases. Our studies will provide a new paradigm to elucidate the molecular mechanisms underlying RNA damage and develop new targets for RNA-based disease therapies.

56. Florida Owens, *"Neuroimmune And Epigenetic Alterations From HIV And Opioid Exposure In The CNS"*

HIV remains a significant worldwide health issue as does its relationship with the opioid epidemic. Substance abuse increases risk for the spread of HIV infection and is associated with treatment non-compliance, more rapid disease progression, and greater mortality. The impact of opioids on the immune system has been widely understood to induce immunosuppression, but it has also been more recently explored in its capacity to stimulate immune activity. In recent years, epigenetic modifications have been implicated in the development of opioid addiction. The unique impact of opioid abuse on the severity, progression, and prognosis of HIV-associated neurocognitive disorders (HAND) and its lasting epigenetic implications are not fully understood. HAND persists despite successful ART, for which there are currently no treatments. The objective of the current study is to examine mechanisms regulating HIV and opioid induced CNS dysfunction through a neuroimmune and epigenetic lens. We hypothesize that opioid and HIV-associated genetic and epigenetic responses can be used as biomarkers for neuropathology and we further speculate that targeting these modifications can abate the neuropathological effects endured due to exposure to HIV and opioid abuse. We analyzed alterations in innate and adaptive immune responses and chromatin modification enzymes within postmortem brain tissue of HIV patients with a history of drug abuse from the National NeuroAIDs Tissue Consortium in addition to a mouse model of opioid use disorder using the highly sensitive and reliable Qiagen RT2 Profiler PCR array. We also observed tolerance and antinociceptive effects of opioid exposure by performing the hot plate test in a mouse model of opioid use. We found that the pathogen recognition receptors in the innate immune response showcased themselves as a major player in mediating proinflammatory pathways related to the advancement of HAND. We also found that chromatin remodeling occurs in response to prolonged exposure to HIV and drug use and promotes inflammation. The accumulated data helps create a general picture of neuroimmune and epigenetic mechanisms involved in the advancement of HIV and opioid induced neurological impairment which could prove promising in identifying novel targets for improved diagnosis and therapeutic interventions.

57. Maria Santiago, *"Suppression Of PARKIN By Cigarette Smoke Through Microrna-Mediated Regulation: Implications For Impaired Mitophagy, Oxidative Stress, And Inflammation, And An Alternative Intervention Strategy."*

Cigarette smoke (CS) induces oxidative stress in airway cells, leading to disruptions in metabolic pathways and triggering inflammation. Interestingly, the mechanism by which CS leads to inflammation is not well-established. This project focuses on understanding how cigarette smoke induces inflammation to develop a therapeutic approach for mitigating its effects. Mitochondria play a pivotal role in regulating apoptotic and oxidative processes. Mitochondria are highly affected by CS and need proper elimination through mitophagy. If not, it results in dysfunctional mitochondria, releasing inflammatory molecules such as Damage-Associated Molecular Patterns, Senescence-Associated Secretory Phenotype, mitDNA

and reactive oxygen species (ROS). Therefore, we hypothesize that CS suppresses the expression of PARKIN (mitophagy protein), culminating in defective mitophagy, senescence, and elevated ROS levels, causing inflammatory responses. To test this hypothesis, bronchial cells were exposed to CS, followed by the collection of supernatants, RNA, and proteins for comprehensive analysis. Additionally, electroporation procedures involving a microRNA, identified as a potential target for PARKIN and upregulated by CS, are currently underway. Various methodologies, including Western blotting, RT-qPCR, Amplex Red assay, staining procedures and Luminex were employed to analyze factors such as PARKIN expression, H2O2 levels, defective mitophagy, senescence, and inflammatory profiles. Results demonstrate that CS suppresses PARKIN at the mRNA and protein levels by 70% and 40%, respectively. H2O2 levels increased nearly three-fold upon CS exposure. Staining procedures indicate a significant increase in defective mitophagy and senescence due to CS. A pro-inflammatory profile was established upon CS exposure by the Luminex assay. This research provides insight into the intricate mechanisms by which CS induces an exacerbated redox state in airways, culminating in pulmonary inflammation. Furthermore, the study explores the potential of therapeutic interventions involving antagomirs and antioxidants to ameliorate the detrimental impact of cigarette smoke.

58. Rajib Kumar Shil, *"Role Of Galectin-9 In Boosting The Effectiveness Of Immunotherapy Against Multiple Myeloma"*

Multiple myeloma (MM) is one of the most prevalent hematological cancers, characterized by uncontrolled proliferation of malignant antibody-producing plasma cells. It is a progressive disease preceded by an early proliferative, clonally expanded plasma cell syndrome, known as monoclonal gammopathy of undetermined significance (MGUS), transitioning to a smoldering MM and then active MM disease. MM is associated with high mortality rates, with no cure thus far. The cellular glycan repertoire or glycome signature of myeloma cells has emerged as an important regulator of the cellular signaling pathways controlling MM cell behavior and survival. Thus, the MM glycome is considered an attractive candidate for developing new therapies. Recently published data from our laboratory revealed a strong binding capacity of the carbohydrate-binding protein, galectin (Gal)-9, to human B cell glycans. Interestingly, Gal-9-binding has resulted in upregulated expression of the signaling lymphocytic activation molecule F7 (SLAMF7), a key regulator of B cell activation, proliferation, and resistance to apoptosis. Importantly, a monoclonal antibody targeting SLAMF7 (Elotuzumab) is approved for the treatment of refractory MM. Similar to its binding to B cells, we hypothesize that Gal-9 binds MM cells to mediate upregulation of SLAMF7, which can potentially sensitize MM cells to Elotuzumab-induced death. We analyzed the Gal-9 binding capacity and its effects on the upregulation of SLAMF7 in MM cell lines as well as primary MM patient cells using a flow cytometry-based assay. We also examined the enhancement of antibody-dependent cell cytotoxicity activity in Gal-9-primed MM cells, compared with non-primed cells by co-culturing natural killer (NK) cells in the presence of anti-SLAMF7 Ab. All methods were conducted at least 3 times and analyzed for statistical significance using Student's paired t-test (*p≤0.05, **p≤0.001). We found that Gal-9 significantly enhanced SLAMF7 expression on MM cell surfaces, compared with controls (p<0.05). Furthermore, co-culturing of natural killer (NK) cells with Gal-9-primed MM cells in the presence of anti-SLAMF7 Ab has resulted in enhanced antibody-dependent cell cytotoxicity activity, compared with non-primed cells. The findings imply that the Gal-9-binding activity of MM cells can be exploited to elevate SLAMF7 levels on their surfaces, and hence boost the anti-myeloma therapeutic efficacy of Elotuzumab.

59. Jose Souchak, *"Signature Human Melanoma Cell Surface Glycans License Vascular Adhesion Through Galectin-3"*

Melanoma is a relatively rare yet highly lethal form of skin cancer, and despite recent therapeutic advances, only ~30% of patients with metastatic melanoma (MM) survive beyond five years. Understanding the molecular mechanisms that drive melanoma to systemic dissemination and extravasation is fundamental for predicting metastatic potential and developing novel anti-melanoma therapies. Previous studies revealed that human MM cell surfaces, unlike normal melanocytes, possess an abundance of linear poly-N-acetyllactosamine glycans (poly-LacNAcs) characteristically recognized by β-galactoside-binding proteins known as galectins (Gal). We hypothesized that circulating galectins, namely Gal-3 and -8, which are functionally associated with melanoma progression, bind to MM cell surface poly-LacNAcs, facilitating cell "bridging" to vascular endothelial cells (ECs) to initiate tumor cell adhesion and subsequent extravasation into distant tissues. We analyzed Gal-3- and -8-binding activity using flow cytometry on MM cells and human vascular EC surfaces, revealing the absence of E-selectin-binding glycans (sLeX/A) on MM cells and robust Gal-3 and -8 binding activity. Using RT-qPCR, we analyzed the mRNA expression for fucosyltransferase enzymes (FUT3-7), crucial for the formation of sialyl Lewis X and A (sLeX/A) that mediate E-selectin-dependent-adhesion, revealing a lack of FUT3-7 mRNA expression, necessary for sLeX/A formation. Additionally, parallel-plate chamber assays were used to simulate the physiological shear stress of circulating MM cells flowing over human ECs in the presence/absence of Gal-3 and -8, revealing that Gal-3 supported MM cell adhesion to the HUVEC under physiologic shear flow. Data were analyzed using mean fluorescence intensity (MFI), relative quantification (RQ), or fold change ± standard error of the mean (SEM). Statistical significance was assessed with the Holm-Sidak method, controlling for Type I errors ($\alpha=0.05$, $p \leq 0.05$), with all experiments conducted in triplicate. Our research data supports our hypothesis of a galectin-based mechanism for MM cell metastasis, separate from canonical E-selectin reliance. Our data promotes the viability of targeting galectins and their MM cell surface ligands as novel therapeutic targets, especially for melanoma patients with elevated Gal-3 and -8 levels.

60. Johnathan Spaulding, *"Supervised Machine Learning Methods Identifying Eukaryotic HGT"*

Horizontal or lateral gene transfer (HGT or LGT) is the movement of genetic material from one organism to another, separate from parent to offspring. With an increase in the amount of eukaryotic organism genomes being sequenced, there has been an increased amount of HGT genes being identified. Thus, this opens the opportunity to using new methods such as machine learning techniques to identify and predict HGT from genomic data. The objective of this project is to develop a bioinformatic method able to accurately identify HGT in eukaryotes using machine learning. During this project I will train multiple machine learning models on a dataset containing HGT genes and non-HGT genes. The models that perform best during the training and testing phase will be the models that are deployed in an R/python package. This project will develop a model that will accurately identify HGT genes in eukaryotic genomic sequences. Once this bioinformatic method is available to the scientific community, researchers will be able to identify HGT genes in their eukaryotic organism of interest. This in turn will lead to down stream scientific discoveries such how this gene is key to the organisms' lifestyle or an estimate of when this organism obtained this gene. This model will be a stepping stone to increasing our understanding of evolution by enabling researchers to see how frequently HGT occurs in eukaryotes and discovering its profound effects on host organisms.

61. Noble Amadi, *"The Neural Recruitment of Executive Function in Monolingual and Bilingual Preterm Born Children"*

Children born preterm are greater risk for deficiencies in executive functioning (EF) as compared to term-born children. While bilingualism has been shown to enhance the EF of term-born children it has yet to be explored whether bilingualism also enhances the EF of preterm-born children. This research explores the influence of bilingualism on executive function (EF), particularly focusing on inhibitory control, in preterm-born children. The study focuses on comparing inhibitory control, a crucial aspect of executive functioning (EF), in monolingual and bilingual preterm-born children. We employ the Go/No-Go (GNG) task, a recognized tool for evaluating inhibitory control, alongside functional near-infrared spectroscopy (fNIRS) to assess cerebral responses, thus enabling a comprehensive comparison of EF in both groups. We analyzed brain activity and compared inhibitory control in 23 preterm-born children, aged 6-7 years, who were categorized as either monolingual or bilingual based on detailed language assessments. Our findings reveal that in the GNG task, bilingual children exhibited a significantly faster response time while maintaining comparable accuracy to their monolingual counterparts. Additionally, the fNIRS data indicates that in the same Brodmann-Areas (BA) typically activated during Go/No-Go (GNG) tests, bilingual children show a weaker oxygenated hemoglobin ([HbO]) response compared to monolingual children, suggesting a more efficient neural engagement in executive function (EF).These results underscore the potential cognitive benefits of bilingualism in enhancing inhibitory control among preterm-born children, highlighting its importance in early educational and clinical strategies aimed at mitigating EF deficits associated with prematurity.

62. Kingshuk Panda, *"HIV Tat-Mediated Disruption of Lung Circadian Clock"*

Introduction: People living with HIV (PLWH) are at an increased risk for chronic obstructive pulmonary disease (COPD), asthma, and poor health outcomes. COPD exacerbations increase with disease progression and predominantly occur at night or in the early morning hours, possibly due to circadian dysregulation in mucus physiology and lung inflammation. Circadian rhythms are near 24-hour biological oscillations mediated by changes in the expression of clock genes. Peripheral circadian clocks can rapidly become desynchronized with adverse environmental stimuli. We are investigating lung inflammation as a consequence of HIV-mediated disruption of the lung clock to identify the mechanism involved. To identify how HIV disrupts the lung clock and causes lung inflammation, focusing on bronchial epithelial microRNA dysregulation. We used a lung-specific HIV-tat transgenic mouse model to assess circadian dysregulation. We analyzed the microRNAome to identify specific miRNAs involved in circadian gene suppression. The impact of microRNAome dysregulation on the lung molecular clock and lung inflammation is being evaluated. Our preliminary data suggest that HIV Tat dysregulates the microRNAome to suppress circadian genes, leading to increased lung inflammation. Specific miRNAs involved in this process are being identified. Understanding the role of microRNAs in HIV-mediated disruption of the lung clock and inflammation could lead to therapeutics that reset the circadian clock, potentially decreasing lung inflammation in PLWH. These findings could have implications for managing lung diseases in PLWH and improving their quality of life.

63. Alyssa Sanchez, *"Tracking Accelerated Heroin Decomposition for Geographic Profiling."*

Heroin (diacetylmorphine) is a semi-synthetic opioid classified as a Schedule I substance in the US. According to the CDC many opioid overdose deaths are due to heroin. This work focuses on developing a better understanding of heroin's decomposition processes and accelerating it. Heroin readily

hydrolyzes into primarily O6-MAM and then back to morphine; therefore, the concentration levels of these compounds can provide information on the decomposition kinetics. In this project, heroin samples of different geographical origins were examined using a UPLC-PDA, and decomposition was simulated using an environmental chamber to tract the relative kinetics of decomposition to O3- and O6-monoacetylmorphone (O3- and O6-MAM) and morphine. Known samples from four regions of origin were studied: Mexico, South America, South-East Asia, and South-West Asia. Previous studies have demonstrated that differences in manufacture and impurity profile affect decomposition. Therefore, we selected a trial set of original seized samples for decomposition analysis. The method optimization experiments resulted in an updated gradient method as well as detection parameters. Reproducibility studies yielded relative standard deviations within acceptable ranges for retention time, peak height, and peak area, respectively, for a standard mixture at 0.01 mg/mL of morphine, 0.05 mg/mL O6-MAM, 0.01 mg/mL O3-MAM, and 0.2 mg/ mL heroin. This led us to decide that, in the future, these will be the conditions under which the instrument will be operated for optimal results. Decomposition of various samples was accelerated at 75°C and 65% relative humidity. Results show that while some samples with lower initial quantities of O6-MAM and Morphine are fairly stable others decompose at elevated temperature and humidity. All this data combined serves to determine the ability of heroin profiling after extensive decomposition has occurred and is essential for the prosecution of the responsible parties.

64. <u>Andrea Ramirez Torres,</u> *"Analysis of Pre- and Post- Coital Microbial Transfer Using Deep Shotgun Metagenomic"*

The goal of this project was to examine the potential of the genital microbiome as a method to detect sexual assault. Prior reports have noted that as many as 60% of rape kits present no detectable male DNA. However, there is another potential source of DNA for detection of sexual contact. Recent studies have demonstrated that there are significant differences between the male and female genital microbiome. These differences could be exploited to detect contact ; however, little is known about the genital microbiome and its ability to transfer between individuals. To examine this issue, heterosexual couples were recruited and asked to provide samples of their genital area pre- and post-sexual intercourse. The respective microbial profiles from each sample were next sequenced using shotgun metagenomic sequencing. The results clearly demonstrated transfer from the female vaginal and labial microbiome to the male penile microbiome with lower, less detectable levels of transfer from male to female. Strain analysis demonstrated the potential to differentiate and track bacterial transfer across specific individuals based on sequence specific markers with the bacterial genomes.

Session II – Physical Sciences and Engineering

12:30pm – 2:00pm

1. **Mahmoud Abdelaal,** ***"Resilient Power System Operations With Enhanced Cyber-Physical Security With Digital Twins"***

Cyber-physical modern power systems underpin many of our society's critical infrastructures. In addition to the challenges in modern power systems of reliable operation, distributed control system complexity, overall system stability, as well as monitoring the healthy operation of the assets, there is an important challenge of maintaining cyber-physical security and resilience. Ensuring their cyber security is important and complex, and Innovative solutions are required to ensure the resilience of the electrical system due to the rising frequency of cyberattacks. To deal with all these challenges, we propose to implement the Digital Twin (DT) technology as an integrated solution that can cover every asset in the studied power system. DT with the new advanced technology of analytics as machine learning and artificial intelligence provides simulation capabilities to predict, optimize and estimate future states. This strategic solution can be a fully integrated situational-awareness platform for the system operator based on the digital twin shadow and the machine learning insights for both physical failure and cyber threats events. The DT will not only introduce a virtual replica of the studied system for state estimation and prediction but also will introduce the appropriate scenario of operation after detecting such events to guarantee the continued operation. The candidate optimal scenario of operation will be selected in real-time or even faster-than-real-time, if high-performance computing is used, based on the What-If scenarios capability of the digital twin and contingency analysis.

2. **Ahmed Aghmadi,** ***"Experimental Validation Of Stability Enhancement In A Dc Microgrid With Hybrid Battery/Ultracapacitor Storage System And Pulsed Power Load"***

DC standalone microgrids are gaining prominence as viable alternatives to traditional grid systems, driven by the escalating integration of renewable energy sources (RESs) and the widespread utilization of DC loads. Nevertheless, the intermittent nature of RESs presents a formidable challenge, particularly in scenarios involving pulse loads or variable pulse load patterns, leading to power imbalances and instability. This research addresses the critical issue of managing constant and variable pulsed loads in DC standalone microgrids by proposing an innovative Hybrid Energy Storage System (HESS). The HESS strategically combines ultracapacitors and batteries to form a dual-storage solution capable of efficiently handling high and low-frequency components in power exchanges. The study introduces a novel control strategy for the HESS, incorporating intricate formulas such as a sharing coefficient (δ), cut-off frequency of the low-pass filter (LPF), and compensation factor (ρ) to calculate reference currents for the battery and ultracapacitor. Simulation and experimental validation are conducted to assess the proposed control strategy, revealing superior performance in DC bus voltage regulation compared to traditional battery-only systems. The contributions of this study lie in proposing an efficient control strategy for HESS that emphasizes constant and variable pulse load mitigation, achieving enhanced DC voltage regulation, investigating the effects of both constant and variable pulse load conditions on microgrid performance and stability, and implementing real-world experiments to validate the efficacy and performance of the proposed HESS control strategy under constant/variable pulse load conditions. The outcomes of this

research hold broader significance in advancing resilient and reliable power systems, paving the way for sustainable energy solutions and contributing to the broader landscape of future energy grids.

3. Romaine Byfield, *"Deep Learning/ Ai Integration For Real-Time Structural Health Monitoring Of Additively Manufactured Metallic Parts"*

The integration of deep learning techniques with Structural Health Monitoring (SHM) offers promising avenues for real-time assessment of structural integrity. This study explored Convolutional Neural Networks (CNNs) and long short-term memory (LSTM) in monitoring metallic parts fabricated through Additive Manufacturing (AM). Fractures of varying lengths, and loads at various points along the length and width of AM metal specimens, were used to test the efficacy of deep learning techniques to detect and classify these structural conditions. The Surface Response to Excitation (SuRE) method, using piezoelectric transducers, monitored dynamic responses to excitation waves. Our results showed changes in signal magnitude and profile as conditions changed, which the deep learning model utilized for feature extraction and classification. For signal processing the Continuous Wavelet Transform (CWT) was used. Additionaly, synchrosqueezing was applied to the CWT to assess its impact on the CNN's ability to extract features, by aiming to enhance its linear time-frequency representations. The 2D CNN, especially with synchrosqueezed wavelet transform, detected changes accurately. Increasing dataset size and optimizing CNN architecture improved accuracy significantly. Notably, synchrosqueezed wavelet transform achieved 100% accuracy from a 96-image dataset, showcasing its effectiveness. This study highlights deep learning coupled with SHM for real-time monitoring and assessment of structural integrity, with implications for aerospace and civil engineering. Further optimization of deep learning algorithms promises enhanced efficacy in diverse settings.

4. Jake Carrier, *"Harnessing Lignin: Steps Towards A Sustainable Co2 Sorbent"*

The urgent need to address rising CO2 levels and limit the wider impact of global warming has spurred the development of many pioneering technologies over recent years. However, reluctance on the political stage to embrace the widespread deployment of carbon capture and storage (CCS) and negative emissions technologies (NETs) have arisen due to high costs. In response, our research focuses on the development of renewable and low-cost CO2 sorbents, derived from lignin, a sustainable and abundant biomaterial. In this study, we explore the covalent modification of commercially available kraft lignin using three alkylamines - tetraethylenepentamine (TEPA), diethylenetriamine (DETA), and triethylenetetramine (TETA) - which are well known for their ability to form strong and reversible bonds with CO2. The resulting sorbents are thoroughly characterized using FTIR, UV/Vis and NMR spectroscopy, confirming the presence of amine functional groups following modification. Using a gas adsorption analyzer, analysis of CO2 isotherms of lignin before and after modification shows a dramatic increase in CO2 capacity due to the successful introduction of the alkylamines. These findings highlight the potential of lignin to serve as a sustainable source material for commercial-scale sorbent production and aims to encourage further discourse surrounding the utilization of renewable resources in developing more economically viable solutions to current climate concerns.

5. Srabanti Datta, *"Investigating The Role Of Machine Learning And Deep Learning For Determining The Performance Of Perovskite-Based Solar Cells"*

Solar energy is a promising source of renewable energy, but its low efficiency, instability, and high manufacturing costs remain a big challenge. Recently, machine learning (ML) techniques have gained

attention in the photovoltaic (PV) sector because of advances in computer power, tools, and data creation. In this research paper we have implemented both ML technique and Deep Learning (DL) technique. The main goal of our work is to find out, how DL techniques perform to predict the performance of perovskite solar cells (PSCs). With our dataset we have compared the Xgboost model and the DNN model. For predicting Power Conversion Efficiency (PCE) of PSCs, both the model show almost similar result. Therefore, we can predict that DNN model can also be implemented for predicting solar cell model after preprocessing of the dataset finely. Though, ML algorithm performed better than the DL technique, there is a very big opportunity of DL in this sector. DL methods require large number of data to get a good model.

6. Melissa De Jesus, *"On A New Paradigm For Binary Phase-Separation Processes"*

The classical Cahn-Hilliard equation (CHE) was originally introduced to model phase separation, a phenomenon in which a binary mixture begins to separate after it reaches some critical temperature. With the use of nonlocal operators, we can model separation with a less traditional macroscopic approach, as opposed to a microscopic view that is used with differential operators. For this, we consider a doubly nonlocal Cahn-Hilliard equation (dnCHE), where we can allow for additional flexibility in how particles interact with each other and how they move within the domain. To further extend our applications we replace the classical time derivative with a time kernel that allows us to play with the speed of diffusion of particles. In doing so, this modification can be used to model dynamic processes in which particles are thought to have some 'memory'. We establish both the existence and uniqueness of a solution to this modified equation. We also use some numerical experiments to justify that this modified model is still physically consistent.

7. Preyojon Dey, *"Real-Time Assessment Of The Impacts Of Polystyrene And Silver Nanoparticles On Hatching Process And Early-Stage Development Of Artemia Using A Microfluidic Platform"*

Development of real-time in-situ monitoring techniques is crucial for a mechanistic understanding of the impacts of pollution on the marine species, which is challenging to acquire through traditional end-point toxicity testing. Here, we investigate how different nanopollutants impact the vulnerable hatching process and early-stage development of marine organisms, by observing real-time oxygen consumption and morphological changes using a microfluidic platform. We compare the effects of polystyrene (PS) and silver (Ag) nanoparticles (NPs) at environmentally relevant NP doses from 0-1 mg/L on the hatching process and nauplius stage of Artemia. The four stages of Artemia hatching - hydration, differentiation, emergence, and hatching - are distinguished by both metabolism and morphology. NP exposure altered the hydration duration at the lowest dose, prolonging differentiation, and slowing emergence from the cysts resulting in a shortened hatching period. NPs also increased oxygen demand in every hatching stage except differentiation. Overall hatchability rose with NP concentration, while survivability showed an inverse trend. This might be attributed to increased NP aggregation in saltwater at higher concentrations which decreases bioavailability during hatching but not post-hatch consumption. Overall, Ag NPs had a greater impact on hatching and mortality than PS NPs. Both NPs significantly affected swimming speed, however, while PS NPs decreased speed, Ag NPs increased it.

8. Andrew Forero, *"New Ultrahigh Resolution Mass Spectrometry Approaches For The Molecular Analysis Of Dissolved Organic Matter"*

There is a need for higher resolution tools for the analysis of complex mixtures at the chemical formula and structural level. Dissolved organic matter (DOM) is composed of a variety of organic species. The present work will feature a novel detection platform for the acquisition of tandem trapped ion mobility spectrometry and ultrahigh resolution FT-ICR MS/MS. in the proposed approach, the Ft-ICR signal is collected in phase with the excitation waveform so that a direct absorption mode FT spectrum could be detected. The advances of the absorption mode and processing protocols were evaluated with the Suwannee River fulvic acid (SFRA) DOM standard. The absorption mode FT spectra allowed for a better dynamic range as well as increased mass resolution (2x). The new electronics resulted in better data transfer from the digitizer to the workstation (2x), allowing for online post-processing of the FT-ICR signal in true absorption mode. Ongoing data processing of the SFRA dataset will allow the estimation of the analytical advantages and peak detection improvements when compared to reference SFRA DOM 21T FT-ICR MS data.

9. Cassandra Fuller, *"New Mass Spectrometry-Based Tools For Histone Epigenetic Marker Screening"*

The molecular complexity of histone proteins and the high diversity of post-translational modifications (PTMs) and their combinations along the histone sequences make them a very challenging analytical problem. In addition to the large number of modifiable residues, their proximity, and the labile characteristics of the PTMs, their dynamic range requires the development of new screening tools. Here, we describe a bottom-up proteomics method based on online liquid chromatography and mobility separation, in tandem with electron-based mass fragmentation (LC-TIMS-q-ECD-ToF MS/MS) for the characterization of histone PTMs. The method was optimized using H4 N-terminal tail positional isomers with varying numbers and positions of acetylations. Validation was performed using HeLa cells treated with a histone deacetylase inhibitor (HDACi) that stimulates an increase in the number of PTMs. Results showed that the H4 4-17 proteolytic fragment (propionylated and untreated form) preferentially ionizes to the 2+ state, allowing for mass-selected electron-capture dissociation (q-ECD) in addition to collision-induced dissociation (CID). The H4 4-17 peptides can be separated in all domains (LC, IMS, and MS) by the number of acetylations (up to 3). Tandem CID MS/MS (100% coverage) and/or ECD MS/MS (85% coverage) confirmed the peptide sequences and acetylation positions. The positional isomers, H4 4-17 (1-3 ac), are not separated in the LC and MS domains, but some are separated by IMS in their default form; when propionylated, the positional isomers are less separated in the IMS domain. The analysis of HeLa + HDACi pull-down histones resulted in the observation of typical peptides from all core histones with four types of PTMs (ac and me1-3) in good agreement with previous experiments. The most abundant peptides showed effective electron-based MS/MS. Inspection of a priori designated peptides and their PTMs showed an average ECD efficiency of 3% (50-69% coverage).

10. Rafael Camilo Gutierrez Melgarejo, *"Bond Performance Between Precast Uhpc Substrates And Field-Cast Uhpc Connections"*

Ultra-High-Performance Concrete (UHPC) represents a remarkable advancement in the field of civil engineering and construction materials. Characterized by its extraordinary compressive and tensile strengths, stiffness, and ductility, UHPC has revolutionized numerous aspects of construction and structural design. Historically, its primary use has been as a connection material for precast concrete components, where it contributes significantly to the durability and performance of structures. This has

been particularly beneficial in situations requiring accelerated construction processes and minimal traffic disruption.

In recent times, the growing familiarity and confidence of engineers, construction professionals, and owners in UHPC's capabilities have spurred its application beyond traditional roles. One such evolving use is in the construction of precast structural elements. However, a major challenge in this application is the connection and bonding between these UHPC precast elements, especially when considering the joints which are often made with UHPC as well. Although established construction methods exist for bonding conventional concrete precast members with UHPC, there's a notable research gap in understanding the bond dynamics between UHPC precast members and cast-in-place (CIP) UHPC. This gap is underscored by observed instances of cracking at precast UHPC-to-CIP UHPC interfaces in practical applications. Addressing this gap, the proposed research aims to investigate and enhance the bonding between precast UHPC and CIP UHPC joint material. A key goal is to scrutinize the bond between hardened and freshly cast UHPC. In this context, the current AASHTO LRFD Bridge Design Specification's design capacity equations will be critically assessed, paving the way for the development of new cohesion and friction coefficients, or alternative design capacity equations tailored for UHPC-to-UHPC bonds. The primary goal of this research project is to explore the bond between cured and freshly poured Ultra-High-Performance Concrete (UHPC). We will assess the current AASHTO LRFD Bridge Design Specification's design capacity equations (§5.7.4.4) [2] and develop new cohesion and friction coefficients for the UHPC-to-UHPC bond, or alternative design capacity equations. The findings from this research will inform the development of construction specifications tailored for use by the Florida Department of Transportation (FDOT).

11. Yashas Hariprasad, *"Securing The Future: Advanced Encryption For Quantum-Safe Video Transmission"*

The rapid growth of digital communication and video transmission has brought about an urgent need for robust encryption methods to ensure the security and integrity of video data. Traditional encryption techniques, while effective, face increasing challenges from advancing computing capabilities. Quantum cryptography has emerged as a promising solution to secure video transmission. In this article, we propose a novel cutting-edge Hybrid Quantum Video Encryption Framework. Our key idea is to integrate the strengths of quantum encryption and the current transmission paradigm to enhance the security of video transmission. By combining the proposed quantum encryption framework which uses a pseudorandom number generated key to perform a row-wise XOR operation along with the secure SSL-encrypted HTTP transmission over the internet, this framework provides a robust defense against eavesdropping, interception, and manipulation of video data. The experimental simulation conducted under the new computational integrated paradigm shows the strong encryption capability of the proposed method. The superior performance of the proposed method as validated through statistical analysis, outperforms the state-of-the-art video encryption frameworks in terms of Information Entropy and Correlation Coefficient for encrypted plain images offering a significant advancement in the field of secure video transmission.

12. Sajid Hasan, *"Performance Improvement of Single Photon Avalanche Diode By Implementing Surface Field"*

Single Photon Avalanche Diode (SPAD) is a photo-sensitive diode with a p-n junction. The device works in the Geiger mode and can detect even a single photon. When a photon incident on the device, because

of being biased at a very high voltage, generates a huge current also having a picosecond time resolution. SPADs are made with Custom technology which is expensive and complicated. CMOS technologies are used to make it cheaper to produce and make it easy to implement other readout circuits. Because of the planner nature of the CMOS technology, it creates more electric fields around the edges. The Edge breaks down earlier known as Premature Edge Breakdown (PEB). Different types of Guard rings, STIs, and gates have been used previously to prevent PEB. However, they are expensive, difficult to fabricate, and increase the overall area of the device. In our work, we have introduced a better surface field to prevent PEB further and improve performance.

We have implemented a surface field (in the form of a gate) on top of the junction and n-well in standard CMOS technology to prevent PEB. We used the Sentaurus device, a TCAD tool, to implement our design and simulate the device's performance. From the simulation, we discovered that introducing a surface field improves the device's performance by preventing PEB. We found that the gate voltage can modulate the electric field, making it more uniform. Finally, the IV curve reveals that the surface field can module the breakdown voltage of the device. Thus, we can say that the surface field improves the performance of the device. Our work gives an insight into the effects of the surface field on device performance. This effect can be achieved by any inner or outer surface field. Our improved SPAD with the increased surface field can be used in Light Detection and Ranging (LIDAR), single photon emission computed tomography (SPECT), positron emission tomography (PET), 3-D optical ranging, and fluorescence lifetime imaging (FLIM). Moreover, from our analysis, we can say that the performance of our device will be better than the regular SPAD or PGSPAD.

13. Kerrie Hooper, *"An Nlp Cluster Analysis Of Ai Ethics Syllabi"*

With new technology comes new responsibilities. Examining AI through an ethical lens has become increasingly important and significant. Numerous organizations, such as IEEE, have developed AI ethics guidelines. Additionally, academia is essential for fostering innovation and developing gifted people who work in both the ethical and technical spheres. Academia prepares students to be culturally responsive, have a collaborative mindset with interdisciplinary skills, and be aware of equity issues and other social problems that plague society. To assess the content in academia, a Natural Language Processing (NLP) analysis of AI ethics syllabi at the university level was conducted. This study can be described as a scoping review of 45 AI ethics syllabi that are publicly available and sourced online. Some important features captured from each syllabus are the course description, topics, department, and year. Using various NLP tools for analysis, a general exploration of AI ethics curricula was conducted. Through supervised and unsupervised clustering and Latent Dirichlet Analysis (LDA), various patterns in AI ethics syllabus contents were found. Some of these include patterns from syllabi across various academic departments and the pre-post Chat-GPT era. This study is insightful as it acts as a baseline for investigating various AI ethics topics that converge across academic departments, as well as uncovering potential gaps in AI ethics syllabus contents.

14. Md Tanvir Hossain, *"An Integrated Approach For Evaluating The Role Of Land Use And Shoreline Changes On Carbon Sequestration In Mangrove Forests Of Nijhum Dwip Island, Bangladesh"*

Mangrove ecosystems play a crucial role in climate change mitigation through their unique ability to sequester carbon, provide habitat for diverse flora and fauna, and act as a natural buffer against coastal erosion. This study focuses on Nijhum Dwip Island, situated in the Bay of Bengal, Bangladesh, to

investigate the intricate relationships among land use patterns, shoreline dynamics, and carbon sequestration in its mangrove forests. In this study, land use land cover (LULC) change patterns were identified for four different years utilizing the Google Earth Engine (GEE). Besides, the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) model was combined with GEE to evaluate the changing patterns of carbon storage (CS). Shorelines were then manually digitized, and a transect-based analysis was carried out by using the Digital Shoreline Analysis System (DSAS) extension in ArcGIS. According to the study, about 440 hectares of mangrove forest has disappeared between 1990 to 2020. Agricultural land has increased from 10.37% to 28.66% and settlement cover has increased rapidly from 0.29% to 1.11%. The study uncovered that from 1990-2010, Nijhum Dwip Island experienced a loss of 574.8 mt of CS, owing to a 36.5% reduction in mangrove forest (8.34 km2). About 1227 hectares of land area is added, as accretion rate is higher than erosion. The south-eastern side of the island had a mean erosion linear regression rate (LRR) of 7.6 m yr−1. The accretion trend at the north-western side had an LRR of 37.7 m yr−1. The water cover climbed to 1.88% from 0.58% because of sea level rise. Shoreline is expanding towards north-western and north-eastern direction. The findings are important in predicting the changes of coastal ecosystem boundaries and enable effective planning for sustainable coastal resource management in this island and beyond.

15. Hossam Hussein, *"Interconnected Microgrids: Toward More Green Energy"*

Microgrids (MGs) have primarily been used to supply standalone loads in emergencies or main utility outages. While pursuing sustainable and carbon-free resources, they gradually witnessed a high penetration of renewable energy resources such as wind and photovoltaic systems, which rely on the utilization of power electronic converters to maximize their generated power. However, due to their intermittent nature, the incorporation of energy storage systems (ESSs) to compensate for the unpredictable absence of generation is mandated. The widespread integration of these distributed energy resources (DERs) has dramatically changed the infrastructure of traditional power networks, leading to what is known as decentralized energy systems, which consequently collide with multiple challenges. For instance, low inertia incorporated with these inverted-based systems can negatively affect the entire system's reliability and stability under severe operation scenarios. Additionally, uncoordinated utilization of the ESS can result in insufficient available energy, which is not acceptable with some load types, such as constant power loads (CPL). Moreover, in some circumstances, the unbalance between generation and load demand might result in load-shedding or even generation curtailment, which is not economically feasible. To address these technical issues, clustering these MGs together to build networked microgrids is considered a promising solution. A networked microgrid is composed of multiple nearby microgrids linked together to gain additional flexibility for resilient operations. Networked microgrids collaborate to prevent possible power shortages in microgrid clusters by sharing critical renewable and energy storage re-sources. However, controlling the local resources of each microgrid, including the ESSs' charging and discharging, maintaining the DC-bus voltage, and even overseeing the power shared by multiple MGs, is challenging. Therefore, a MG control technique and distributed energy management are used co-operatively to handle the shared power between the NMGs system. Numerical simulation results with a networked microgrid system verify the accuracy and soundness of the suggested distributed energy management. The applicability of the suggested technique is confirmed by hardware implementation, and several operational scenarios further evaluate the proposed system on a practical two-microgrid system located in the FIU testbed. This will open the door toward more green energy systems.

16. Olga Ibragimova, *"Lanthanum Hydroxyl Borate With Promising Deep-Uv Birefringent Properties"*

Deep-ultraviolet (deep-UV) materials play an important role in modulating light polarization in the optical communication, laser industries and spectroscopy. For example, for laser-based ultrahigh resolution spectrometry and/or microscopy coherent light in the deep-UV region is required. The ideal material for these needs must possess high transmittance in the short wavelength range, large birefringence, and a short UV cutoff edge (λcutoff < 200 nm). Today, the scarcity of such materials meeting these criteria underscores the importance of exploring novel deep-UV crystals with substantial birefringence. Borates of rare-earth elements have already proven themselves as a stable material with significant birefringent optical properties, which depend on the crystal structure and anionic BO3 groups in particular. The main contribution comes from the planar arranged BO3 anionic groups. The birefringence is also sensitive to the exact orientation of the BO3 groups and increases as more arranged they are. In the present study, we have applied methods of single-crystal X-ray diffraction in laser-heated diamond anvil cell to synthesize the novel type of high-pressure lanthanum hydroxyl borate with unique arrangement of BO3 groups. The new compound La2B2O5(OH)2 was synthesized by the reaction of lanthanum hydroxide and boron oxide at extreme conditions (30 GPa and ~2400 K). The single-crystal X-ray structure determination revealed: $P\bar{3}c$, a = 6.555(2) Å, c = 17.485(8) Å, Z = 6, R1 = 0.056. The three-dimensional structure consists of discrete planar BO3 groups and three crystallographically different La ions: one is surrounded by 9, one by 10, and one by 12 oxygen anions. The current work describes the novel high-pressure/high-temperature lanthanum hydroxyl borate that can be used as a potential deep-ultraviolet birefringent material.

17. Nahin Irfan, *"Modeling Of Perimeter Gated Spad-Based Direct Time-Of-Flight Sensor For Low Light Lidar Applications"*

Light Detection and Ranging (LiDAR) systems play a key role in various applications, such as smart devices, entertainment, industry, autonomous vehicles, and space exploration, driven by the increasing demand for accurate depth sensing. Here, an innovative model is introduced of a perimeter-gated SPAD-based direct time-of-flight (TOF) sensor designed specifically for low-light LiDAR applications. A perimeter-gated SPAD is an improved version of SPAD that includes an extra field-modulating gate terminal to mitigate perimeter edge breakdown without unnecessarily increasing the device size. When a polysilicon is included over the junction and an induced voltage is present, the additional voltage prevents the early breakdown. The gate terminal of the perimeter-gated SPAD device controls the device's noise, sensitivity, and dynamic range. For the LiDAR system, in low light conditions, the device noise of SPAD sensors is the dominant noise factor. As perimeter-gated SPAD reduces the device noise, this sensor will improve LiDAR system performance. For our work, we developed a numerical model for the LiDAR system. The developed model includes background noise and device noise, as well as all the key components that influence a typical LiDAR acquisition system. Device noise is decreased by using the perimeter-gated SPAD, which raises SNR. When the applied gate voltage is increased, it is observed that the dark count rate (DCR) decreases. By controlling the electric field, the gate voltage substantially lowers the band-to-band tunneling noise, which is the predominant noise at low temperatures and contributes to reducing DCR. It is also observed that the SNR is improved with the increase of the gate voltage. To our knowledge, this work represents the first DTOF LiDAR modeling for low-light applications

using perimeter-gated SPAD. It was discovered that SNR increases through a decrease in device noise. Additionally, we contrasted the SNR with the current direct SPAD-based TOF LiDAR model, which similarly demonstrated an improvement in SNR with the perimeter-gated SPAD device. LiDAR systems are broadly used in many applications. SPAD devices are commonly used in the LiDAR detection system. Using the perimeter-gated SPAD in the LiDAR detection system can improve the device's noise and distance measurement.

18. Jamal Julien, *"Strategic Vulnerabilities Identified In Al-Shabaab's Ied Supply Chain"*

Al-Shabaab's use of Improvised Explosive Devices (IEDs) presents a significant threat to security forces Somalia. How can seasonal rainfall patterns be leveraged to identify vulnerabilities in Al-Shabaab's supply chain? To analyze the environmental impact on Al-Shabaab's IED operations and identify strategic opportunities for disrupting their supply chain by exploiting geographic vulnerabilities during the wet seasons. Utilizing historical IED records, terrain and river data, road networks, and satellite imagery, the study employs statistical and mathematical models to examine the data. Python libraries such as pandas, matplotlib, and scipy are used for data manipulation, plotting, and curve fitting, enhancing the analytical approach to understanding the seasonal variations and their effects on militant logistics. Though with low confidence, this analysis suggests that Shebelle River seasonal flooding near the Balcad Nature Reserve significantly undermines Al-Shabaab's operational effectiveness. The seasonal flooding around the Balcad Nature Reserve disrupts the militants' IED supply chain, creating strategic chokepoints that could be exploited to counter their operations. This study highlights the potential for using NASA's Soil Moisture Active Passive data set to enhance the analysis of militants' IED effectiveness. This research contributes to the strategic counterterrorism efforts in Somalia by offering a novel perspective on leveraging environmental factors against militant logistics. It provides a quantifiable understanding of how seasonal variations affect Al-Shabaab's logistical capabilities, emphasizing the importance of geographical intelligence in countering militant operations.

19. Ukesh Karki, *"Molecular Modeling And Simulation Of Mirna-Ago2 Complex"*

Argonaute 2 (Ago2) loaded with a microRNA (miRNA) forms an RNA-induced silencing complex (RISC). This complex then targets mRNA through miRNA-mRNA base-pairing leading to translation inhibition or degradation of the target mRNA. It's also been suggested recently that some viral target mRNA can attack miRNA by unloading the miRNA from Ago2 in the RISC. Structures of several RISC are available in the protein data bank (pdb) but generally with missing nucleotides in either the target mRNA or miRNA or both and the lack of full structural models of the Ago2-miRNA and Piwi-interacting RNAs has limited computational investigations to understand the functional mechanisms of Ago2-miRNA-mRNA interactions such as target recognition and stability. In this work, we developed an automated modeling tool RNAForge, which allows us to model full structures of Ago2-miRNA-mRNA complexes based on the available pdb structures. The modeled complexes can be used to perform molecular dynamics simulations to investigate the dynamics of target recognition and miRNA-mRNA interactions. We leveraged the tool to model the RISC of Ago2 and miR-27a complexed with two different targets that either stably bind RISC or destabilize the miRNA from the RISC. The target mRNAs we investigated are 1) Atf3, binding of which to miR-27a leads to its translation inhibition and 2) HVS HSUR-1, a viral gene expressed by Herpesvirus saimiri, is known for destabilizing mir-27a and resulting in overexpression of FOXO1. We performed molecular dynamics simulations to investigate the molecular mechanisms of these two processes in RISC-target RNA interactions.

20. Francisca Kasubi, *"Evaluating the Effectiveness Of Tsm&O Strategies In Reducing Incident Clearance Duration Through Quantile Regression"*

In the dynamic field of transportation engineering, effectively managing traffic incidents is crucial for ensuring safety, mobility, and environmental sustainability. The I-95 corridor within the Florida Department of Transportation District 4 (FDOT D4) serves as a pivotal case study for this study, given its high traffic volume and strategic significance. This study aims to assess the impact of Transportation Systems Management & Operations (TSM&O) strategies—namely, Dynamic Message Signs (DMSs), Road Ranger Service Patrols (RRSP), Severe Incident Response Vehicles (SIRVs), and Express Lanes (ELs)—on the duration of incident clearance, focusing on various traffic conditions and incident severities. Employing a quantile regression analysis, this research diverges from traditional average-based evaluations to explore how TSM&O strategies affect incident clearance duration across different distribution points. This methodological choice allows for a nuanced analysis of the effectiveness of these strategies under varied operational scenarios. The findings reveal that a comprehensive approach combining RRSP, SIRV, and ELs significantly outperforms other strategies, highlighting the necessity of a multifaceted strategy tailored to the severity of incidents. Such insights are instrumental for the development of more effective, adaptive, and data-driven TSM&O strategies, enhancing the management efficiency of traffic incidents. The contribution of this study lies in its innovative analytical approach and its practical implications for traffic management. By demonstrating the efficacy of integrated TSM&O strategies, the research offers valuable guidelines for the implementation of similar solutions in traffic networks worldwide. Furthermore, it underscores the potential of integrated traffic management solutions to foster safer, more efficient urban mobility. This research not only advances the understanding of traffic incident management strategies but also provides a scalable model for improving transportation systems globally. Its broader impact includes informing policy decisions, guiding infrastructure development, and promoting environmental sustainability through more efficient traffic management practices.

21. Md Akib Zabed Khan, *"Exploring A Chatgpt-Assisted Course Recommendation System"*

Choosing appropriate courses for a semester is a challenging task for undergraduate students. To facilitate the course selection process, different course recommendation systems have been proposed implementing different machine learning algorithms and techniques. At the same time, recently, there has been a rapid development of Large Language Models (LLMs) like ChatGPT, which have influenced all walks of life. LLMs have been adopted in numerous applications, offering new capabilities that were not thought of before. In this paper, we explore their potential to assist stakeholders in higher education with course recommendations. We propose the ChatGPT-assisted course recommendation model (GPTaCR) which utilizes the output of ChatGPT to form rules that capture relationships among courses. Inspired by the association rule mining algorithm, first, to maintain the privacy of students' data, we generate sets of courses that are frequently taken together by past students since we cannot directly provide a student's history to ChatGPT. By providing these sets of courses and different contexts (course names, acronyms, descriptions), we ask ChatGPT to offer a set of courses for students to take next. In this way, we form rules and use them to generate recommendations for students, based on their prior course registration history. We use real-world course enrolment data from our school (KFSCIS, FIU) and course descriptions collected from departmental catalogs of FIU. We evaluate the performance of our

proposed GPTaCR model by comparing it against the baseline approaches and exploring how its different parameters affect the results. While we partially use student enrolment data and provide limited course information, ChatGPT can build reasonable recommendations using its vast knowledge base. This serves as a proof of concept and a first look into ChatGPT's capabilities in recommendation tasks in education. Conversely, since our best models consider courses to recommend from both frequent course sets and suggested courses by ChatGPT, tools like LLMs do not offer reliable recommendations by providing just course content and one student's registration history. Our work provides motivation for current and future work, as additional research is needed to better incorporate LLMs in course recommendations to assist students and administrations in higher education.

22. Santosh Khatri, *"Enhanced Sensitivity For Studying Biomolecular Interactions In Crowded Environments With Nanopipettes"*

The dynamics of individual molecules underpin biochemical processes, shaping cellular properties and ultimately influencing human behavior. Nanopore sensing, a cutting-edge technique enabling single-molecule detection, offers immense potential for elucidating the complex details of molecular behavior. However, existing methods, like nanopipettes, are limited in sensitivity due to their variable pore size and the speed of biomolecules. To address this challenge, a novel approach utilizing nanoconfinement at the nanopipette tip has been developed. This innovative method allows for the detection of smaller biomolecules, such as DNA bases and short peptides, using a nanopipette with a pore size significantly exceeding the size of the molecules itself. The technique involves backfilling the nanopipette with the target molecules and subsequently driving them out through a combination of concentration gradients and nanopore bias. This breakthrough enables deeper understanding of intermolecular interactions and the detection of small single molecules at the nanoscale. Overall, the ability to detect and study small biomolecules with enhanced sensitivity using nanopipettes opens exciting avenues for research in drug discovery, personalized medicine, and biotechnology, paving the way for advancements in the field of molecular sciences.

23. Abhijith Kunneparambil Sukumaran, *"Tribological and Radiation Shielding Response of Novel Titanium-Boron nitride Coatings for Lunar Structural Components"*

Lightweight alloys of Aluminum (Al) and Titanium (Ti) are significant components of space systems because of their high strength-to-weight ratio. However, their poor tribological response in the presence of lunar regolith and lack of neutron shielding ability can result in premature failures. Hexagonal Boron Nitride (hBN) reinforced titanium coatings were produced by atmospheric and vacuum plasma spray methods at low and high-volume concentrations of hBN to counter these undesirable results after powder preparation by cryo-milling. The microhardness results showed that coating hardness was 3.0 times that of conventional Ti6Al4V (335 HV) substrate in the case of low vol.% hBN (900 HV) concentration and 1.5 times in the case of high vol.% hBN coating (516 HV). Furthermore, tribological characterization by ball-on-disk tests in the presence of JSC-1A lunar regolith simulant revealed a 70% reduction of wear volume on the Ti/low vol.% hBN coatings compared to conventional material. The science of boron nitride retention and secondary phase effect in the coatings were examined using characterization techniques such as SEM, XRD, and Raman spectroscopy. Developed coatings were subjected to the simulated extreme lunar condition of neutron radiation. The coatings exhibited effective radiation shielding ability up to 27 % with an increase in % hBN content.

24. Daniela Leizaola, "*An Objective Aid For Diabetic Foot Ulcer Debridement Utilizing An In-House Nirs Imaging Device"*

Diabetic foot ulcers (DFUs) are a significant challenge for diabetic patients and largely affect their lifestyle. Currently, clinical assessment of DFUs primarily relies on visual cues by the patient and/or clinician, which results in subjective evaluations. Scalpel debridement is a standard intervention to promote wound healing by removing non-viable tissue and enhancing the potential to heal. The quantity and location of tissue to remove remains a subjective assessment; thus, an objective method by optical imaging could improve the scalpel debridement process. To address this gap, an in-house noncontact near-infrared spectroscopic (NIRS) imaging device, named SPOT, was utilized to provide spatial (2-D) tissue oxygenation maps of DFUs during the debridement process. Fifteen subjects were recruited and imaged across four weeks (40 cases) to evaluate tissue oxygenation changes before and after scalpel debridement using the SPOT device. SPOT captures diffuse reflectance signals at discrete near-infrared wavelengths (690, 810, 830nm) to reconstruct effective hemoglobin-based parameters (e.g. oxygen saturation) by applying a modified Beer-Lamberts law. Preliminary results (6 cases) revealed distinct increases in oxygen saturation (ΔStO2) in regions outside the wound (when compared to the wound) following debridement, shown in Fig 1. In turn, a reduction in the contrast between the two regions (more homogenous) post-debridement was prominent, seen by the percentages in Fig.1. On-going work involves analysis of all cases to determine the potential of using SPOT as an objective guide in debridement procedures by identifying regions that might still require removal.

25. Prince Mahmood, *"Comprehensive Monitoring Of Multifunctional Green Stormwater Infrastructure Across Southeast Florida"*

Sustainable and Resilient Green stormwater infrastructures (GSI) are nature-based solutions that promote an environmental protection approach by reducing stormwater runoff, safeguarding water quality through contaminant removal, and enhancing resource efficiency through mitigating greenhouse gas emissions and reducing Urban Heat Island (UHI) effects, thereby preserving ecosystems in response to climate change. Despite the acknowledged multifunctionality and interconnected nature of GSI systems in contributing to resilient urban environments, a definitive assessment of their impact on enhancing resilience in urban coastal areas remains an area requiring further exploration. However, approaches to maximize the performances of urban coastal GSIs, including those in southeast Florida, are currently very limited, primarily due to a lack of performance monitoring data. Thus, this study introduces, a comprehensive monitoring plan designed to assess the long-term performance of different GSIs across various urban development areas in Miami, FL. The first location, referred to as "Arena", comprises a network of exfiltration trenches (ETs) and a rain garden situated in a 342-acre site on the Modesto A. Maidique Campus (MMC) of Florida International University (FIU) in Miami, FL. The second site, known as "Factory Town", a 6.5-acre post-industrial redevelopment site in Hialeah, FL, features a rain garden and a bioswale. Finally, the third site, situated within a 33-acre commercial zone recognized as the "Miami Design District," features green roofs and incorporates urban trees along the sidewalks. To investigate the performance of GSIs, we employed a wireless sensor network containing different on-site sensors to measure water levels, soil moisture, soil temperature, air temperature, humidity, wind speed, wind direction, and rainfall. Additionally, we conduct soil infiltration measurements in the field with different infiltrometers (Modified Phillip-Dunne and SATURO) to assess temporal (annual, seasonal, monthly, and daily) variations of Saturated Hydraulic Conductivity (Ksat) and collect samples of soil, stormwater runoff, and groundwater for laboratory analysis to evaluate the efficacy of different GSI types

in improving water quality, reducing runoff volume, and mitigating UHI effects. Details of the monitoring design, preliminary data, and associated analyses are presented herein. The outcomes of this program help researchers, practitioners, and managers to incorporate nature-based GSI systems into coastal resilience plans.

26. Samuel Miller, *"High-Throughput Atmospheric Pressure Screening Of Fentanyl Analogues."*

The surge in synthetic opioid usage, particularly fentanyl and its analogues, has become a critical public health concern worldwide, escalating the opioid crisis and posing challenges for detection methods. There is a need for analytical tools capable of fast and direct screening of known and unknown fentanyl analogs. A novel workflow utilizing direct solid (Direct Analysis in Real Time, DART) and liquid (nano electro spray, nESI) screening coupled Trapped Ion Mobility Spectrometry (TIMS) and tandem Mass Spectrometry (MS/MS) for the rapid and accurate identification of fentanyl analogues is described. Over 235 fentanyl and fentanyl analogs were studied, standards were divided into fourteen distinct groups to collect reference mobility and MS/MS fragmentation spectra. The sample set contained 50 fentalogues that can be separated by their mass-to-charge ratios (m/z). Isomeric species with a Δ1/K0 >0.0045 V·s/cm2 were resolved in the mobility domain and others with Δ1/K0 <0.0045 V·s/cm2 identifiable by their mobility selected MS/MS fragmentation patterns. This study showcases the advantages of that DART/nESI with TIMS-MS for the rapid screening (few min) of fentanyl analogues. While nESI exhibited superior ionization efficiency, DART showcased increased sample throughput with minimal sample preparation. This research contributes to the advancement of detection capabilities in combating the opioid crisis by introducing a rapid screening method without the need for lengthy chromatographic separations. The proposed DART/nESI-TIMS-MS workflow holds promise for enhancing prevention efforts, forensic investigations, and public safety initiatives by enabling swift and accurate identification of fentanyls. Its potential to streamline detection processes could significantly impact public health and law enforcement strategies worldwide.

27. Nasim Mohamadiazar, *"Near Real-Time Pluvial Flood Mapping In Urban Areas Using Deep Learning And Sentinel-1 Imagery"*

Urban flooding, exacerbated by intense rainfall events, known as pluvial floods, poses a significant challenge in the United States. Traditional flood prediction methods using physics-based models face limitations in real-time applications. This is because they are time consuming due to the model's complexity and computational burden, necessitating the adoption of data-driven approaches. This study aims to develop a Near Real-Time (NRT) flood prediction model using Convolutional Neural Networks (CNN), Sentinel-1 imagery, and spatial watershed characteristics data to provide rapid and accurate pluvial flood inundation predictions. The NRT flood mapping approach is successfully applied to Miami-Dade County, Florida as a case study. The research modifies the U-Net architecture for image segmentation and combines digital elevation models, imperviousness, hydrologic soil group, and rainfall data with Sentinel-1 imagery. The model is trained using near real-time rainfall data. Subsequently, the trained model is applied to predict flood inundation in real-time scenarios by leveraging historical rainfall data and flood records to validate the accuracy of the predictions. The NRT flood prediction model achieves accurate flood inundation predictions at a spatial resolution of 10 meters. Cross-referencing with historical flood data demonstrated the model's effectiveness in capturing many historical floods, with an overall accuracy of 97.05%, F-1 Score of 92.49%, and AUC of 93% in the study area. The

proposed NRT pluvial flood prediction model addresses the common limitations in previous studies, i.e., relying on small input datasets (using a small number of satellite images or focusing on only major flood events or hurricanes rather than the entire range of rainfall records) or ignoring rainfall as a flood-influencing factor in model development. The study underscores the potential of the AI-powered NRT flood prediction model as a valuable resource for emergency management agencies, infrastructure management organizations, and urban planners. By providing rapid and accurate flood inundation predictions, the model enhances decision-making and preparedness efforts in flood-prone regions.

28. Daniel Munoz, *"Solar Cells For Space Applications: Novel Hole Transport Material In Laminated Perovskite Solar Cells"*

Solar photovoltaics cells are at the forefront of extracting energy from the sun light. Furthermore, in space, where other opportunities are scarce, solar panels are essential to many applications from life in space, for instance by powering the international space station, to communications by powering communication satellites. To increase our efficient solar harvesting both on Earth and in space, there is a strong demand for novel methodologies that reduce the cost of manufacturing, improve scalability, enhance solar cells stability is critical. One of the most promising technologies involves perovskites, part of a class of materials that benefit from stability and high efficiency in solar photovoltaics. However, the most successful perovskite solar cells incorporate organic transport materials which inhibit device lifetime, provided that organic molecules experience degradation resulting from oxidation, polymerization, vaporization, or sublimation. Space applications further require increased resilience due to harsh conditions, including radiation exposure and wide temperature fluctuations. A feasible approach towards space application involves combining lamination using roll-to-roll processing with the substitution of organic materials with more durable inorganic alternatives. In this line, the replacement of the organic hole transport materials in favor of a more robust inorganic material is crucial to improving the durability and stability of perovskite solar cells. Copper Oxide (Cu2O) has exhibited significant potential, resulting in notable power conversion efficiencies when incorporated as inorganic hole transport layers (HTL). Herein, we present the performance of inorganic Cu2O as a hole transport layer in laminated perovskite solar cells with initial characterization data of the Cu2O material.

29. H M Nayem, *"Estimating The Population Mean With Confidence: A Simulation Study Under Different Distributional Conditions And Including Outliers"*

This paper presents a comprehensive review and comparison of methods for estimating the mean using confidence intervals. The analysis considers both symmetric and asymmetric distributions while accounting for outliers. It evaluates 21 different estimators within classical and modified-t approaches, covering both symmetric and skewed distributions. A simulation study is conducted to compare their performance of the interval estimators under different parametric conditions. The results of the simulation reveal that the proposed Wizard-t and Wizard-t from median are particularly robust for large sample sizes and asymmetric populations with outliers. Conversely, Student-t emerges as the top performer for small sample sizes. Additionally, the Chen-t, Median-t, T1, AADM-t, and Median-t estimators show promise for skewed distributions. Findings indicate that the ordinary t estimator performs optimally for symmetric distributions and small sample sizes, exhibiting a superior coverage rate and minimum width compared to other estimators. For skewed distributions without outliers, the Median-t, AADM-t, Median T1, Chen-t, and YY-t statistics are proposed as effective options for mean estimation. Notably, for large sample sizes (>70) containing outliers, the newly proposed Wizard-t and

Wizard-t from median methods consistently demonstrate higher coverage rates and smaller confidence interval widths, surpassing other test statistics. Real-life data analysis further supports these findings. This study contributes valuable insights for practitioners by offering a comprehensive overview of available estimators for estimating the mean across various distributional scenarios.

30. Olutobi Ogunbiyi, *"Dispersion And Stratification Of Per-And Polyfluoroalkyl Substances (Pfas) In Surface And Deep-Water Profiles: A Case Study Of The Biscayne Bay Area"*

Per-and polyfluoroalkyl substances (PFAS) are group of synthetic chemical compounds known for their persistence, bioaccumulation, and toxic characteristics in all environmental compartments. As industrial and domestic applications of PFAS increases, their discharge into water bodies becomes of human and ecological concerns. Our research focuses on providing better understanding on the occurrence, vertical distribution, and dispersion of PFAS compounds in surface and bottom water from inshore and coastal area of Biscayne Bay, Miami, Florida. We screened a total of 30 PFAS compounds from inshore (N= 38) and offshore (N=48) water samples using a semi-automated solid phase extraction (SPE) followed by instrumental analysis using liquid chromatography-mass spectrometry techniques (LC-MS/MS). Our findings show a general surface-enrichment and depth-depletion pattern from inshore to coastal area. Average ∑PFAS loadings inshore (surface vs bottom; 29.52 ± 15.26 ng/L vs 21.45 ± 7.85 ng/L) is significantly greater than offshore (surface vs bottom; 5.18 ± 2.68 ng/L vs 2.42 ± 2.11 ng/L). ∑PFOS had the highest concentration both inshore (120.78 ng/L) and offshore (13.23 ng/L). The most frequently detected (D.F = > 91%) PFAS congeners are PFOS, PFOA, PFHpA, PFHxA, PFBA, PFBS and PFHxS in surface water samples. PFOS/PFOA > 1 suggests that point sources are the major contribution to PFAS burden in the Biscayne Bay. An innovative Inverse distance weighted interpolation(IDW) special modelling approach was implemented to predict the potential contribution of oceanic current on the dispersion of ∑PFAS loadings in surface and bottom profiles from canals (inshore) to offshore areas. This will provide insights into transport mechanisms of PFAS compounds from source emissions, and risk assessments of potential impacts on human and aquatic life in the Bay.

31. Kazue Orikasa, *"Smart Foams: Boron Nitride-Graphene Nanoplatelet Foams For Tunable Radiation Shielding And Strain Sensing"*

As space exploration progresses, the demand for lightweight, versatile materials has increased significantly. We have created hybrid two-dimensional (2D) material foams with varying ratios of boron nitride nanoplatelets (BNNP) to graphene nanoplatelets (GNP), serving dual purposes as neutron radiation shields and strain sensors. Through systematic investigation, we explored the relationship between foam composition, processing, microstructure, and their resulting properties in neutron shielding and strain sensing. By adjusting the BNNP: GNP compositions (1:0, 3:1, 1:1, 1:3, and 0:1), we can finely tune the properties of the hybrid foams. Regarding neutron radiation shielding, the mass absorption coefficient of hybrid foams increased with higher BNNP content, reaching a peak of 14.9 cm2/g for pure BNNP foam. This coefficient is 1.6 times greater than that of pure GNP foams and 575 times greater than aluminum. Utilizing Geant4, a Monte Carlo-based platform, simulations demonstrated an average accuracy of 90%. The strain-sensing properties of hybrid foams, measured by gauge factor, showed exponential growth with increasing GNP concentration. Starting from electrically insulating BNNP foam, the gauge factor rose to 66.4 with 25% GNP concentration and reached 871.3 for pure GNP foams. These findings underscore the adaptability of our hybrid 2D material foams for space

exploration, offering tailored solutions for both neutron radiation shielding and strain sensing applications.

32. Ivan Oyege, *"Application Of Deep Learning For Early Identification Of Stalk Borers And Armyworms In Corn"*

Corn, a crucial crop worldwide, faces substantial challenges from pests such as maize stalk borers, African armyworms, and the invasive fall armyworm in Africa. The recent fall armyworm invasion adds pressure to farmers already grappling with forty years of existing maize stalk borers and African armyworms, leading to significant economic losses and threatening regional food security. This study addresses the critical issue of early pest identification by training deep learning models to detect and classify the larvae of maize stalk borer, fall armyworm, and African armyworm. The objective is to empower farmers to identify these pests independently, enhancing the sustainability of food production. Image datasets of maize stalk borers, African armyworms, and fall armyworms were sourced from Kaggle (www.kaggle.com) and used to train three deep learning models: Convolutional Neural Network (CNN), YOLOv8, and ResNet50. The models were then compared to determine the most effective model for pest identification. All three models exhibited strong performance, achieving over 83% accuracy and high precision in classifying the caterpillars. YOLOv8 emerged as the best model with an accuracy exceeding 88%. This study represents the first attempt to use deep learning to classify and detect maize stalk borers and African armyworms through image analysis. The research bridges the gap between rural farmers and agricultural extension workers, enabling independent early pest identification. Empowering farmers to identify pests early contributes to sustainable food production. By addressing the challenges posed by multiple pests simultaneously, this research offers a holistic approach to pest management, safeguarding crop yields and economic resources.

33. Nimasha Pilippange, *"A Spatial-LDI Δ-Σ LNA Design In 65nm CMOS"*

Low noise and maximum linearity are critical for aperture array receivers. Receiver sensitivity and resilience to jamming are fundamentally limited by LNA noise figure (NF) and linearity, respectively. This paper describes the preliminary design of a wideband 65 nm CMOS LNA and signal processing circuits for spatial $\Delta - \Sigma$ noise shaping to improve both NF and linearity when used in array apertures. The design exploits the 2D spatiotemporal frequency domain properties of plane-waves for noise and distortion shaping. MATLAB simulations indicate an NF improvement of 3.9 dB over a 5 GHz bandwidth for 20 dB LNA gain and 2× spatial over-sampling. Transistor-level simulation results of the 65 nm CMOS blocks are also provided.

34. Rodrigo Restrepo, *"Modulation Of Host-Guest Complexation Of Pfas With Ph Ionizable B-Cyclodextrin Derivatives"*

Poly- and perfluoroalkyl substances (PFAS) are pollutants of serious concern due to their adverse health effects, widespread use, and resistance to degradation. Current adsorption methods for PFAS remediation require frequent replacement of the adsorbent and the disposal or further treatment of the bound pollutants. Hence, the development of PFAS remediation methods with adsorbent regeneration and pollutant recovery could be transformational. β-cyclodextrins (β-CDs) form strong β-CD:PFAS complexes with a wide variety of PFAS. We herein report the incorporation of pH ionizable functional groups on the primary rim of β-CD, to control the complexation of PFAS as a function of solution pH. The association constants between β-CD and PFAS were determined using 19F-nuclear magnetic resonance

(NMR). The binding constants (KCD:PFAS) of short-chain and long-chain legacy PFAS by amino-β-CDs and thiol-β-CDs decrease by 46 to 98 % with a change in solution pH from neutral to alkaline conditions. The observed reduction in KCD:PFAS with increased pH is assigned to be the electrostatic repulsion between negatively charged functional group amended to the β-CD (host) and negatively charged PFAS polar head group (guest). The inclusion of two pH-dependent ionizable groups in 6-(3-hydroxybenzylamino)-6-deoxy-β-cyclodextrin [(3-OH)BnNHβ-CD], phenol and amino, allows the β-CD host to be converted from positive charge to negative charge. (3-OH)BnNHβ-CD exhibits strong pH-modulated binding of long-chain perfluorocarboxylic acids (PFCAs). The association constant for (3-OH)BnNHβ-CD with hexafluoropropylene oxide dimer acid (HFPO-DA), a branched perfluoroether carboxylic acid (PFECA), however, exhibits lower susceptibility to pH effects and only 50 % of the decrease in binding measured for mono-amino-β-CD. The incorporation of multiple ionizable groups in the β-CD host, specifically employing heptakis-(6-mercapto-6-deoxy)-β-cyclodextrin, lead to a decrease of 23 % for complexation of PFOA when going from neutral to alkaline pH, compared to the mono-thiol-β-CD (95 % decrease). Steric effects due to chain branching within PFAS in combination with size and number of substituents on β-CD reduce the pH effects on binding. This study demonstrates derivatization of β-CD with pH ionizable functional groups can be used to control the β-CD binding of PFAS as a promising strategy for the removal and recovery of PFAS from contaminated water streams.

35. Andrés Sebastián Román Molina, *"Business Plan For The Development Of The Ecuadorian Steel Company – SIDECA"*

Sideca is a novel and revolutionary project that seeks to change part of the country's productive matrix, making it focus more on the industrial area and stop depending on agriculture as the main source of income, thus improving the quality of life and income of Ecuadorians. The idea of ""Siderúrgica del Ecuador SIDECA"" is to be a company dedicated to the production of steel coils of ASTM A36 quality, which is the most commercial type of steel in the country, and to satisfy the local demand for flat steel, since to date there is no company dedicated to the manufacture of coils in Ecuador, so all of them must be imported mainly from China and Brazil. These mills are also known as ""steel mills"". The coils to be produced will be hot rolled, cold rolled, galvanized and pre-painted steel, which will lay the foundations for the development of other companies such as automotive, shipping and construction companies, thus contributing to the development of the country through the diversification and industrialization of its economy. For the development of the business plan, a market analysis, operational analysis and financial analysis are presented in order to reach a conclusion as to the feasibility of the project. Annexes are also presented at the facilities of companies dedicated to the steel industry in the country, such as Adelca and IPAC, leaders in steel processing.

36. Himaddri Shakhar Roy, *"Tissue Curvature Correction Using Monte Carlo Simulation For Nirs Imaging"*

Diabetic Foot Ulcers (DFUs) cause serious risks to patients with diabetes, which include infections, amputations, and potentially death. Tissue oxygenation promotes the cellular formation of tissue and very crucial for wound healing. To assess the healing progress of DFUs, optical imaging techniques are being widely used to measure tissue oxygenation within the wounds. However, optical detectors capture signals from focused flat-plane surfaces, and DFU are often curved, particularly in cases of foot amputation. This curvature can distort tissue oxygenation measurements, leading to an inaccurate assessment of the wounds. The tissue oxygenation measurement can be affected by tissue physiology or

tissue curvature. Therefore, it is crucial to remove the effect of tissue curvature to accurately measure tissue oxygenation changes in DFUs. In this study, the objective is to address irregular curved geometries and develop a correction model using Monte Carlo simulated diffuse reflected signal measurements. Two different tissue models have been simulated, mimicking deep and protruded tissue, and the simulation was run with a uniform and gaussian light source. By applying height and angle corrections to the diffuse reflectance signals, we found that the correction factor improves the signal and reduces errors up to 11% caused by differences in wound depth and surface angle. Our ongoing research focuses on implementing this correction factor for irregular curved geometries and determining the threshold for depth and angle corrections requiring correction when imaging curved tissue geometries.

37. Rahmina Rubaiat, *"A Comparison Of Speech-Based Digital Biomarkers For Traumatic Brain Injury And Neurodegeneration"*

Changes in various speech features have been linked to various neurological and mental health-related pathologies; often these changes can be detected many years before a definitive clinical diagnosis has been made. With the growing interest in using speech analysis for detecting a myriad of health conditions and the growing number of patients with multiple health problems, it will be increasingly important to demonstrate that speech analysis can differentiate between these conditions, to provide reliable and accurate diagnosis and assessment. Toward this end, this study takes a first step in this direction by examining the speech biosignatures of two common neurological conditions: (1) mild traumatic brain injuries (such as concussions) and (2) neurodegenerative diseases, particularly focusing on amyotrophic lateral sclerosis (ALS) and Parkinson's Disease (PD). Further, this study utilizes two specific types of speech tests well-known to and frequently used by speech-language pathologists: PaTaKa and Sustained Vowel tests. This work investigates data from over 230 participants and examines 25 temporal and 12 spectral features of sound. The results show that out of these 37 features, over 20 show statistical significance in differentiating between concussions, neurodegenerative diseases, and healthy controls. The paper further compares the performance of different classification models using these features.

38. Joarder Jafor Sadique, *"Designing Massive Multiple Antenna Wireless Communication over Riemannian Manifolds"*

In today's digital age, wireless communication enables us to connect, share, and engage with the world around us. Imagine trying to have a private conversation in a room full of people talking simultaneously; it becomes difficult to distinguish one voice from another. Similarly, in busy shopping malls and stadiums, the wireless channels between the base station and our devices (referred to as user equipment or UEs) become highly similar to each other, causing the base station to struggle to clearly "hear" and differentiate the signals from closely spaced devices. This prevalent issue underscores the critical need for an innovative solution that can improve the efficiency of communication networks by reducing the similarity between signals from closely spaced devices. Addressing this, our main objective is to introduce a statistical beamforming strategy that pivots on shaping the channel covariance matrices of each UE to enhance the data rate in massive multiple-input-multiple-output (MIMO) wireless communication system. This novel approach includes modeling the concept over a curved surface (Riemannian manifold), which enables the representation of channel covariance matrices as points over the manifold. Thus, the idea is to design a beamforming strategy that separates the represented points of each individual UE far apart. To formulate the process, our model employs an unsupervised machine

learning strategy, K-means clustering, to effectively optimize matrix shapes over manifolds. Our comprehensive analysis and simulation results highlight the ability of our proposed scheme to achieve convergence at an accelerated pace compared to conventional Euclidean-based methods, without compromising computational complexity. Specifically, in scenarios involving two UEs, our approach asymptotically reaches full capacity, while in multi-UE contexts, it attains over 96% of the theoretical upper bound. The significance of this research lies in its pioneering covariance shaping scheme that enhances network throughput and reliability under challenging conditions, marking a substantial advancement over existing techniques. Moreover, the broader impacts of this work are far-reaching, promising to influence the future design of wireless networks by optimizing communication links. This could pave the way for more efficient and reliable communication systems, thereby contributing significantly to the advancement of wireless communication technology.

39. Dabasish Kumar Saha, *"Multiscale Modeling Of The Influences Of Arteriolar And Capillary-Driven Signaling On Blood Flow Control In The Brain"*

Neurovascular communication (NVC) plays a critical role in normal brain function and is impaired in brain disorders. Due to their proximity to every neuron, capillaries are ideally positioned to monitor neuronal activity and recent evidence suggests that can sense activity and initiating vasoactive signaling. However, the coordination of blood flow distribution in the microvascular network through arteriolar and capillary mediated NVC remains unclear. The structural complexity and challenges of experimental observation make modeling necessary to gain insights into these mechanisms. In this study, we integrate detailed cell-level models into multicellular vessel segments to provide an in silico representation of capillaries and arterioles within a reconstructed large-scale vascular network. Biomechanical models of arterioles and capillaries translate electrical and calcium signals into changes in vessel diameter and predict network hemodynamics in macroscale tissue volumes. Hemodynamic simulations predict pressure (P), flow (Q), and hematocrit (HD) distributions along the dynamically changing network. The models incorporate rheological properties of the red blood cells and non-continuum effects via empirical formulas accounting for the Fahraeus-Lindqvist and plasma skimming effects. We conduct simulations to explore the impact of local stimulation by applying a hyperpolarizing K+ stimulation to an arteriole or capillary segment, inspecting electrical conduction along the network and resultant changes in blood flow distribution. At low levels of stimulatory current, the hyperpolarizing signal was confined to the vicinity of the stimulated region, inducing a modest increase in the local blood flow perfusion as electrical signal dissipates at branching points. Higher stimulation is required for the vasodilatory signal to travel over significant distances and reach upstream feeding vessels. Furthermore, simulations examined the role of K+ as a NVC mediator in arterioles and/or capillaries by increasing K+ concentration around SMCs and/or cECs. The spread of the electrical signal depends on Kir channel density, which serves a dual role as a K+ sensor and an amplifier of propagating electrical signals. The model investigates the biophysical determinants of capillary and arteriole-initiated vasodilatory signaling and their contributions to blood flow control in the brain.

40. Rishabh Sahani, *"Solar Photovoltaics: Spray Deposition Strategies For Improving Stability In 3d/2d Perovskite Films"*

The quest for solar-derived electricity translates into finding highly efficient, sustainable, scalable, and stable solar photovoltaics, as current solar technologies fail to satisfy at least one of these important criteria. The class of halide perovskite comprises the most promising candidates for this endeavor, being

both efficient and sustainable, but currently lacking on stability due to their sensitivity to moisture. This inadvertently impacts their scalability, hampering their entry to the commercial market. Thus, developing perovskite films that are both scalable and stable is vital for making solar power more affordable. The main objective of the present study was to develop a spray-assisted sequential deposition technique, toward creating large area perovskite films comprising both three-dimensional (3D) and two-dimensional (2D) layers. The research methodology involved applying large organic molecules onto the 3D perovskite layer using a customized spray system. This new technique allowed creating a multidimensional (3D/2D) structure with the optimized stoichiometry to shield the perovskite grains from moisture, thus rendering them stable in air. Our analysis, including methods like X-ray diffraction (XRD) and scanning electron microscopy (SEM), confirmed the formation of this unique passivating layer made of 2D perovskite. This innovative multidimensional perovskite structure showed greater stability compared to the conventional 3D perovskite. This breakthrough paves the way for producing solar cells that not only boost high efficiency but also promise long-term reliability, thus contributing to the overarching goal of clean energy generation.

Keywords: Scalable printing technique, 2D-perovskite, bulky-cation, morphology, stability.

41. Miguel Santos, *"Structural Characterization Of Syanodin I Using Hydrogen-Deuterium Exchange, Trapped Ion Mobility Spectrometry, And Electron Capture Dissociation, And Tandem Mass Spectrometry."*

Syanodin I is a lasso peptide found across the bacteria domain characterized by a mechanically interlocked structure, where the C-terminal tail of the peptide is threaded and trapped within an N-terminal macrolactam ring. Little is known about the folding process of lasso peptides. In the present work, solution phase HDX, trapped ion mobility spectrometry (TIMS), electron capture dissociation (ECD), tandem mass spectrometry (HDX-TIMS-q-ECD-ToF MS/MS) are employed for the study of Syanodin I and its unthreaded topoisomer. Syanodin I and the corresponding branched-cyclic topoisomers were diluted in H2O and D2O respectively and incubated at 4oC for 24 hours for solution-phase hydrogen-deuterium exchange. A custom-built nESI-TIMS-q-EMS-CC-ToF MS/MS instrument was used for all experiments. Complementary UVPD MS/MS experiments were carried out on the Syanodin I lasso and unthreaded conformations as well. Tandem UVPD MS/MS and ECD MS/MS experiments on Syanodyn I and its branched-cyclic topoisomer, respectively resulted in a high sequence coverage and signature MS/MS profiles. A higher sequence coverage was observed for the branched cyclic topology because of the tail being more accessible and not stabilized by the loop region. The lasso IMS profile showed different deuterium uptakes in the four mobility bands (e.g., 18D, 15D, 16D, and 16D, from low to high CCS) for the [M+2H]2+ (m/z 705.4) ion species. Complementary mobility selected ECD MS/MS allowed for amino acid level quantification of the number of deuterium atoms. The fragmentation of this precursor ion mainly yielded fragment ions located near the C-terminal part except for the residues responsible for trapping the tail inside the macrolactam ring, suggesting those amino acids are less easily accessible than the rest. Comprehensively profiling the key characteristics of lasso peptides enabled the generation of 3D candidate structures highlighting the intramolecular interaction that stabilizes the lasso structure.

42. Tej Sharma, *"Investigations Of The Effects Of Ctd Mutations On Plasma Membrane Association Of The Marburg Virus Protein VP40"*

Marburg virus, a member of the Filoviridae family, causes hemorrhagic fever and is notorious for high fatality rates in human and non-human primates. The virus buds out and is released from the host cell as enveloped virions containing an RNA that encodes seven different proteins. Each protein plays a crucial role throughout the virus's lifecycle. VP40 forms matrix layers below the plasma membrane (PM), giving the virus its cylindrical shape. For this, the mVP40 is first trafficked towards the membrane, interacting with the lipid head groups through its basic charged residues at the C-terminal domain (CTD) at the interface. Therefore, VP40-membrane interactions are critical for the virus' ability to form a virion and egress from the cell. Mutations at the membrane-binding interface may significantly alter the way VP40 assembles at the plasma membrane and the virion morphology. Such mutations, especially in the C-terminal domain, are important for understanding the Marburg virus assembly. In this work, we investigated the effects of different VP40 mutations identified in Marburg virus outbreaks, including D184N, G188R, and E260K, on the plasma-membrane association of VP40 and compared to the results from the wild type (WT). We find that mutations to the basic residues enhance the membrane interactions and the stability of the VP40 at the membrane surface.

43. Anurag Sharma, *"Unmasking The Unseen: Journey Into The Subsurface Of Florida's East Coast Using InSAR"*

Florida's densely populated east coast faces significant environmental challenges, including rising sea levels and potential coastal subsidence. While the coastal subsidence remains less visible, it can exacerbate the effects of rising sea levels, leading to increased flooding and infrastructure damage. Despite its potential impact, a comprehensive understanding of coastal subsidence in Southeast Florida is lacking. This knowledge gap hinders effective planning and mitigation strategies to safeguard coastal communities. This study aims to unveil the hidden threat of coastal subsidence to monitor and quantify land subsidence along Florida's east coast. We employed InSAR time-series analysis on Sentinel-1 satellite data from 2016 to 2023, generating a high-resolution velocity map of vertical land motion (VLM). Additionally, Global Navigation Satellite System (GNSS) data was incorporated for verification and comparison. Our analysis revealed localized subsidence patterns across the study area, with varying rates ranging from 3-12 mm/yr. Notably, these subsiding areas appear to be concentrated near critical infrastructure, including high-rise buildings and airport runways, potentially posing a significant threat to their stability. The comparison of InSAR-derived velocities with GNSS data demonstrated good agreement, validating the reliability of our findings. This study provides crucial insights into the spatial distribution and rates of coastal subsidence along Florida's east coast. By identifying vulnerable areas, this research contributes significantly to coastal management strategies, informing infrastructure maintenance, development planning, and ultimately enhancing community resilience in the face of rising sea levels. By shedding light on the "unseen," this research contributes to building a more resilient and sustainable coastal future for Florida. Furthermore, this research establishes a crucial link between subsidence and the socioeconomic consequences associated with rising sea levels, providing a roadmap for informed decision-making and adaptive strategies in the face of evolving environmental challenges.

44. Hellen Shita, *"Unveiling Key Factors Influencing Injury Severity In Work Zone Related Crashes Along Florida Freeways: A Statistical Analysis"*

Work zones play a vital role in the maintenance and enhancement of transportation infrastructure, yet they present substantial challenges, particularly on high-speed roadways like freeways, where safety and societal impacts are heightened. Despite their importance, the presence of work zones on freeways

introduces complexities that demand a closer examination of their safety implications and broader social and economic consequences. Florida has experienced a total of 50,423 crashes along its work zones between 2018 and 2022. Among these, 332 were fatal, 1,281 resulted in incapacitating injuries, and 4,325 were non-incapacitating injuries. This study uses data from the Signal Four Analytics Database to analyze the injury severity of work zone related crashes along Florida freeways. A multinomial logistic regression (MLR) approach is used to examine the main contributing factors to crash injury severity. Findings indicate that out of twenty-three variables analyzed related to roadway, environmental, human, and crash characteristics, eleven were found to be statistically significant in influencing injury severity at a 95% confidence level. The type of crash impact was identified to have the highest influence in work zone injury severity. Late night hours, the number of vehicles involved in a work zone crash, higher speed limit, unpaved shoulders, aggressive and distracted driving, and driving under the influence of alcohol or drugs were all found to have a positive association with crash injury severity. The study findings can be used to inform targeted interventions aimed at reducing injury severity in freeway work zones, thereby enhancing safety for both workers and road users. By understanding the significant factors influencing injury severity, transportation agencies and policymakers can prioritize resources and implement evidence-based strategies to mitigate risks and improve overall work zone safety. Such insights are invaluable for the development of proactive measures that address the unique challenges associated with work zones, ultimately contributing to both safer and more efficient transportation systems.

45. Diana Son, *"Behavior Of Solutions To The Generalized Korteweg de-Vries Equation With Low Power Nonlinearity"*

We study solutions to the two versions of the generalized Korteweg-De Vries equation, both with fractional powers and one of them with an absolute value incorporated into the nonlinearity and one without. We recall the well-posedness of these equations in a certain class of initial data. In this research, I analyze and compare numerical simulations of solutions to both of these equations. I look at the soliton resolution and the interactions of solitary waves, considering different types of initial data decay, including polynomial, exponential, Gaussian, and super Gaussian-types of decay. This research was done as part of the NSF REU program ""AMRPU @ FIU.

46. Alan Sosa, *"Influence Of Polarization Direction In B1 Extraction For Deuteron"*

To learn how atomic nuclei (and the protons and neutrons within) are built from the fundamental quark and gluon particles, the nuclear physics community probes this substructure in scattering experiments carried out at accelerator facilities. In charged lepton-deep inelastic scattering, a charged lepton scatters off a target and is used to probe the target's internal structure. If the target is a spin 1 hadron, four additional structure functions are introduced compared to the spin ½ nucleon, namely the b1, b2, b3, and b4 structure functions. These structure functions can provide further insight into the quark and gluon structure of the target. Jefferson Lab (JLab) has an upcoming experiment in which it will measure the tensor polarized asymmetry of a deuteron target. This asymmetry is related to the four structure functions listed above. Which leaves us with one equation with four unknowns. To extract the b1 structure function from the asymmetry we do approximations which leave us with the tensor polarized asymmetry as a function of only b1. The polarization direction enters as a parameter in the eventual value of the measured asymmetry and choosing a different direction affects the error made in the extraction of b1 from the asymmetry. We present a theoretical study using a convolution model for deuteron structure where we investigate the influence of the polarization direction on the extracted b1

values and associated uncertainties. The results can help guide the choices made in the upcoming Jlab experiment.

47. Eman Taher, *"Investigating The Effect Of Pbtx-2 On The Human Thioredoxin System And Its Modulation By Brevenal"*

The Florida red tide dinoflagellate, Karenia brevis produces a group of neurotoxins known as brevetoxins (PbTxs). PbTxs can cause a variety of neurological symptoms in humans who consume PbTx-contaminated shellfish and respiratory distress through aerosol exposure notably in asthmatics. It has also been found that PbTxs induce oxidative stress in treated cells or animals exposed to red tide. Our group has further demonstrated that PbTx-2, the most abundant of the PbTxs, can inhibit the thioredoxin-thioredoxin reductase system (Trx/TrxR system). Trx/TrxR system is one of the major antioxidant systems that combat oxidative stress in cells. However, it remains unknown how PbTx2 exhibits inhibitory effects on the human Trx/TrxR. We hypothesize that PbTx-2 inhibits hTrxR-1 through the formation of Michael adduct on the C-terminal Sec residue. To investigate our hypothesis, we assessed the impact of PbTx-2 on the activity of both hTrxR-1 and its Sec residue-deficient mutant. Our findings revealed that PbTx-2 exerted an inhibitory effect on hTrxR-1 activity across the tested substrates. These results suggest a specific targeting of Sec by the toxin, as evidenced by the distinct response observed in the mutant. Efforts to counteract PbTx-2's inhibitory activity involve competitive assays with naturally occurring compounds. Notably, our data reveal that K. brevis also produces a non-toxic compound (brevenal). Brevenal not only inhibits the PbTx-2 's effect on hTrxR-1 but enhances its activity. These findings offer valuable insights into the mechanism of PbTx-2 action on hTrxR-1, which may contribute to the prevention and treatment of PbTx-2-related oxidative stress.

48. Deepanshu Trivedi, *"Anomalies In Light Scattering: A Circuit Model Approach"*

In experimental physics, it is essential to understand electromagnetic (EM) wave scattering across EM spectrum, from radio waves to X-rays, and is pivotal in driving photonics innovations. Recent advancements have uncovered phenomena like bound states in the continuum (BICs) and parity-time (PT) symmetric systems, which are closely associated with the characteristics of the scattering matrix and are governed by passivity and causality. The emergence of complex frequency excitations has transcended the constraints imposed by passivity and causality in a system, revealing effects such as virtual critical coupling and virtual gain. However, applying the concepts of complex frequency excitation in more complicated systems remains challenging. In this work, we demonstrate the extension of the lumped element model of circuit theory to the analysis of anomalies in light scattering in the complex frequency domain. We demonstrate that the circuit model approach can facilitate design and analysis of effects such as virtual perfect absorption, BICs, real and virtual critical coupling, exceptional points, and anisotropic transmission resonances (ATRs). These findings broaden comprehension of EM wave phenomena and pave the way for significant advancements in photonics, offering new methods for designing and optimizing optical devices and systems with broad-ranging applications.

49. Collins N. Vaye, *"Working-In-Progress: Technology Integration: Exploring The Current State Of Information Communication Technology (Ict)-Enhanced Teaching In Undergraduate Engineering Education In Liberia"*

This study focuses on the integration of information and communication technology (ICT) in undergraduate engineering education in Sub-Saharan Africa (SSA), with a focus on Liberia. The relevance

of this research is amplified by the increased adoption of digital technologies in education, a trend accelerated by the COVID-19 pandemic and aligned with the African Union's Agenda 2063, which underscores technology's vital role in the continent's future. Despite the growing presence of ICT in education globally, there remains a notable research gap in its application in SSA's unique educational landscape. The primary objective of this dissertation is to explore the perspectives of key stakeholders, such as university faculty, regarding the use of ICT in engineering education in Liberia. This inquiry is two-folded: it examines the diffusion of ICT policies in SSA, analyzing the goals and strategies in national policy documents for education. Simultaneously, explore the various perceptions of engineering faculty in Liberia about ICT-enhanced teaching. Using a phenomenography case study method in a qualitative research design, the study will show how different ICT stakeholders experience and understand ICT in education. This will help researchers understand how these stakeholders make sense of ICT in education. Preliminary findings indicate a mixed scenario for ICT in education within SSA. Across the sub-continent of Africa, there's an upward trend in access to essential ICT infrastructure, with national and continental ICT policies aiming to cultivate a well-educated populace through science, technology, and innovation. However, the readiness and resource availability for ICT vary significantly among SSA countries, demanding tailored strategies for its integration. Particularly in least-developed countries like Liberia, the adoption of ICT in education is in its nascent stages, presenting unique challenges and necessitating innovative approaches for effective implementation. Despite facing challenges like insufficient infrastructure, Liberian faculty members are resourceful, using battery-operated devices or grouping students for internet access to ensure ICT integration into their teaching for a more interactive and practical learning experience. The usage of ICT among these faculty is multifaceted, aiming to simplify complex concepts, provide immediate feedback, and equip students for a tech-centric professional landscape.

50. Vagheeswari Venkadesh, *"Development Of A Novel Electrochemical Sensor To Measure Macro-Nutrient From The Soil Runoff"*

Agriculture is one of the more widespread users of synthetic chemicals than any other production sector. The green revolution, which ensured food security, unintendedly affected soil health and the environment. The overuse of synthetic chemicals in the form of fertilizers, especially nitrates, phosphates and potassium, to meet the global demands have steered agriculture toward a fertilizer-dependent soil. Concurrently the natural soil tends to lose its physical and biochemical properties due to acidification, reduced soil organic matter content, the decline in the microbial interaction, and increased pest activity which questions the sustenance of modern agriculture. The exploitation of electrochemical sensors for measuring the soil parameters has been recognized as a viable tool in engineered precise agricultural systems. In this study, a highly conductive polymer, poly-pyrrole (Ppy) is employed that imprints the molecule of interest to achieve selectivity and sensitivity of the target. With the help of printed carbon electrode, the polymer is electrodeposited along with the target to achieve a functional template that complements the structure of the analyte and help in characterizing the chemical composition. This molecularly imprinted polymer has shown sensitivity and selectivity toward nitrates, phosphates and potassium ions compared to the unmodified electrode. The enhanced charge capacity is achieved, and the electrochemical current output can reach the microampere level per micromole concentration. The fabricated sensor is then applied to study the leaching potential of the nutrients for different soil types. By engaging these highly specialized devices in agriculture more precise fertilization can be achieved without degrading the soil health for a sustainable future.

51. Justin Wisby, *"Domination In The Tensor Product Of Path Graphs"*

The domination number is the cardinality of the smallest set of vertices, called the dominating set, such that all vertices not in the set are adjacent to a vertex in the dominating set. We examine the disconnected nature of the tensor products of path graphs, denoted $P_n \times P_n$, and analyze the structure of I_n, O_n, and E_n, which are graphs that represent some of the connected components for each tensor product of path graphs. In particular, we define constructions and tilings over tensor products of these graphs to find upper and lower bounds for their domination numbers, as well as potential configurations for minimal dominating sets of these graphs. We show that as n grows, you only need roughly $\frac{1}{5}$ of the vertices in $P_n \times P_n$ to dominate it, or that $\lim\limits_{n \to \infty} \frac{\gamma(P_n \times P_n)}{|V(P_n \times P_n)|} = \frac{1}{5}$. Similarly we obtain an analogous bound for total domination, where all vertices must be adjacent to a vertex in the dominating set, to be $\lim\limits_{n \to \infty} \frac{\gamma_t(P_n \times P_n)}{|V(P_n \times P_n)|} = \frac{1}{4}$.

52. Thinnapong Wongpakdee, *"Development Of Electrochemical Detection And Surface-Enhanced Raman Spectroscopy Based On Screen-Printed Electrode Surface Enhancement For Rapid Analysis Of Gunshot Residue And Low Explosive"*

Rapid and effective analytical tools play a crucial role in onsite forensic investigations. This study focuses on the development of two distinct analytical systems utilizing electrochemistry and surface-enhanced Raman spectroscopy (SERS) for the rapid identification of gunshot residue (GSR) and low explosives. In the electrochemical sensing approach, screen-printed carbon electrodes (SPCEs) were developed for detecting signature metals (Pb, Sb, and Zn), as well as nitrate/nitrite frequently found in the GSR. Gold electrodeposition was applied to enhance sensitivity for metal detection, while copper modification amplified nitrate/nitrite signals in GSR and various forms of low explosives. In the portable SERS system, a screen-printed gold electrode (SPGE) was modified with gold deposition for an active SERS surface. Different target molecules, including potassium nitrate, potassium perchlorate, sodium benzoate, ethyl centralite, diphenylamine, and its nitro derivatives containing N-nitroso-diphenylamine and 4-nitroso-diphenylamine, were explored to obtain SERS fingerprints crucial for evidence identification. These two analytical techniques have been successfully developed to offer versatile, rapid, accurate, and precise systems for crime scene examinations of GSR and low explosive samples. The implementation of these tools not only enhances the efficiency of forensic investigations but also contributes to the broader impacts of advancing forensic science, aiding law enforcement agencies worldwide in their pursuit of justice.

53. Aida Yahyavi Rahimi, *"Impacts Of Data Resolution And Availability On The Delineation Of Directly Connected Impervious Areas In Urban Watersheds"*

Expanding impermeable surfaces due to urban development has increased stormwater runoff management challenges in built areas. Models predicting runoff volume and stormwater infrastructure designs rely on accurate determination of impermeable surfaces contributing to runoff generation. In this study, various indicators of impervious cover characterization including Total Impervious Area (TIA) and Directly Connected Impervious Area (DCIA) were determined and compared with Effective Impervious Area (EIA) using various combinations of data types and resolutions to investigate the limitations of the available data and the impact of their resolution on the accuracy of the estimated TIA and DCIA values and spatial distributions. To this aim, using spatial programming, surface runoff was

tracked, from originated to discharged locations, in nine urban catchments (ranging from 16 to 2035 ha) in Minnesota, USA, to delineate TIA and DCIA under multiple scenarios centered around availability and resolution of spatial data like digital elevation model, Land Cover (LC) (from local and national sources), modified high-resolution LC (by removing tree canopy shades on impervious surfaces) and sewer inlet points. Later, rooftops connectivity to sewer system and road network as an alternative runoff collection system were also investigated among the scenarios for DCIA delineation.

The results revealed that using low-resolution nationally available imperviousness dataset yielded TIA fraction not significantly different than those obtained from the modified high-resolution LC. The comparative analysis between DCIA and EIA uncovered that modified LC is preferable for accurate DCIA delineation in ungauged catchments. EIA represented 0.65 and 1.34 of DCIA under the assumptions of connected and unconnected rooftops, respectively, underlying the importance of rooftop connectivity. Adopting road networks as replacement of sewer inlets to collect the runoff yielded significantly different DCIA values, while employing modified LC provided comparable results. DCIA serves as an important imperviousness metric for estimating runoff in the absence of observed runoff data in most of urban watersheds (ungauged watersheds). Yet, high-resolution LC requirement for attaining accurate DCIA delineation necessitates management organizations being proactive in preparing and making such data available. This study has profound implications for the optimal and cost-effective placement and design of stormwater control measures in urban watersheds.

54. Nusrat Yasmin, *"Performance Of Some Improved Estimators and Their Robust Versions Under Multicollinearity and Outliers"*

The ridge regression estimator (RRE) is widely used as an improved estimator for estimating regression parameters in multiple linear regression models. However, an argument exists that in the presence of outliers, the dataset may adversely affect these improved estimators (Silvapulle,1991). This study proposes several improved estimators and their robust versions to address the multicollinearity problem, regardless of the presence of outliers. This paper aims to compare the performance of the estimators, namely, OLS, and some improved estimators, namely, ridge regression, Liu estimator, and Modified Liu estimator by Lukman et al. (2020), James-stein estimator, Kibria and Lukman (2020), M-estimation, and their robust version of these proposed estimators, namely, Robust ridge estimator, Robust Liu, Robust Modified Liu, Robust Kibria-Lukman estimator & Robust James-Stein estimator by using a Monte Carlo simulation and two real-life data. Based on the smaller MSE criteria, we recommend some good estimators for the practitioners in scenarios where no outliers or one or two outliers may be observed. Both Monte Carlo simulations and two real-life datasets were utilized to evaluate these estimators, considering various outlier scenarios: no outliers, one outlier, and two outliers. We consider the smaller Mean Squared Error (MSE) value as a performance criterion. The estimator performance depends upon sample size, degree of correlation among regressors, and the number of regressors. Across simulations and real-life examples involving one or two outliers or none, the robust Ridge Estimator (RRE) consistently yields the smallest MSE values in most conditions. Notably, all robust versions of improved estimators outperformed when outliers were present. However, in outlier-free scenarios, aside from RRE, the Modified Liu estimator (ML), Kibria Lukman estimator (KL), and Robust Kibria-Lukman estimator (RKL) provide smaller MSE values. Therefore, we recommend practitioners consider the robust ridge estimator as a preferred choice among the estimators. We can use these results for future studies in different regression models, for example, Poisson regression, Gamma regression, Negative binomial regression, Dimension reduction, Outliers, and Extreme values.

55. Shanté Hicks, *"SPAD Based CMOS Monolithic PPG Sensor"*

Photoplethysmography (PPG) sensors are used for a wide range of domains in medical and consumer health. TransformaNve research in PPG sensors has undergone an increase in popularity due to their integraNon in transportable wearable devices for heart rate and blood oxygen saturaNon (SpO2) monitoring. Since wearable devices are typically baUery powered and space efficient, it is essenNal that power consumpNon and design area is kept to a minimum. This design presents a novel scalable CMOS single photon avalanche diode (SPAD) based PPG sensor integrated with direct light to digital conversion using simple CMOS logic gates on a single chip. With single photon detecNon capability, a SPAD provides much higher light sensiNvity than a photodiode (PD) used in typical PPG sensors, reducing LED driving current significantly for the same receiving current than that with a PD. Moreover, the proposed PPG sensor eliminates the typical power and area intensive analog front end readout electronics associated with convenNonal PPG sensing, which makes it an aUracNve opNon for wearable consumer electronics.

For this prototype, a 2 X 2 SPAD based pixel array has been implemented in a standard 180 nm CMOS process. The final design features four SPAD based subpixels that have been combined to reduce dead Nme at the pixel level resulNng in increased photon detecNon capability.

56. Harry Brown, *"Small Molecule Library Screening Identifies A Novel Drp1 Inhibitor As A Potential Therapeutic For Parkinson's Disease"*

Parkinson's disease (PD) is the second most common neurodegenerative disorder, after Alzheimer's disease. Currently, there is no cure for PD, and disease-modifying therapies for this devastating disease are urgently needed. Levodopa is currently the best-in-practice medication for PD. However, after a long-term Levodopa prescription, patients typically reexperience parkinsonism symptoms. Levodopa is intended to manage PD motor symptoms; It does not prevent the death of dopaminergic neurons rather it acts as an alleviating suppressant. Therefore, developing more therapies that target disease progression mechanisms is imperative. Imbalanced mitochondrial dynamics (fission, fusion, and movement) and impaired autophagic flux are two pathogenic mechanisms involved in PD ultimately leading to increased inflammation and increased levels of protein aggregation. It is well established that Dynamin-related protein 1 (Drp1) is a regulator of mitochondrial fission. It has been shown that partial inhibition of Drp1 through genetic approaches improves mitochondrial function and autophagic flux while decreasing neurotoxicity and □-synuclein transmission between cells. We hypothesize that partial inhibition of Drp1 using small molecule compounds to inhibit its GTPase activity will reduce mitochondrial toxicity and autophagic impairment caused by □-synuclein but also the inflammation associated with perturbed mitochondrial dynamics. To identify novel compounds that inhibit the GTPase activity of Drp1, our lab has developed a drug screening assay using human Drp1. Through drug screening methods of small molecule compound libraries by Scripps Institute we identified compound KM as a promising partial inhibitor of Drp1 and a potential candidate for further drug development. Our preliminary data demonstrate that this compound is effective at reducing inflammation and □-synuclein aggregation in in vitro PD models. More work is needed but our data so far identifies this compound as a potential novel therapeutic for PD.