OURI Annual Summer Student Showcase
August 13th, 2024, 9am – 10:15am
Schmidt Family Complex - Lobby

Effects of Aging on the Deformability and Mechanical Fatigue of Mouse Erythrocytes

Author: **Jacob Askins**
Faculty Mentor: *Sarah Du, College of Engineering and Computer Science*
Funded by: College of Engineering and Computer Science

This study investigates the mechanical fatigue of mouse erythrocytes using Electro-Deformation method in a microfluidic system, with a focus on the age of mice from which the cells were derived. Sinewave with a magnitude of 1.5 V and frequency of 5 MHz were modulated by the amplitude-shift-keying technique at a frequency of 250 mHz which generates a cyclic stretching of cells over a one-hour duration. Microscopy images of the cells were captured every ten minutes. ImageJ was used to identify single cells, fit each cell with an ellipse, and measure the major and minor axes for calculating the elliptical shape factor (ESF). Observations revealed the ESF value decreased over time, indicating a reduction in the cell's deformability and the progression of mechanical fatigue. The results are useful to detect differences in erythrocyte elastic properties along the aging of mice, providing insights into how aging affects cell deformability and fatigue behavior.

Advanced Machine Learning Based Feature Extraction for Improved Scientific Data Compression

Author: **Nathan Bagby**
Faculty Mentor: *Rohit Deshmukh, College of Engineering and Computer Science*
Funded by: College of Engineering and Computer Science

Recent launches of exascale supercomputers, such as the Aurora and Frontier systems, have enabled scientists to model physical systems at unprecedented scales. However, this new capability is accompanied by the challenge of storing, transferring, and analyzing the extremely large, generated data. FAU has developed a data compression and analytics framework to address this issue. This summer project explores deep learning techniques to improve feature extraction within the framework with the aim of eventually increasing the compression capabilities.

Advanced Dataset Builder Development for the Unitree Go1 Robot Dog

Authors: **Jefferson Charles** and **Christina Pappachan**
Faculty Mentor: *Hari Kalva, College of Engineering & Computer Science*
Funded by: College of Engineering and Computer Science

This project aims to create a comprehensive dataset builder and a detailed knowledge base for the Unitree Go1 Robot Dog. This provides robotic researchers and industry professionals with a strong tool to capture and analyze new data. The dataset will contain temperature readings, CPU usage, system diagnostics, network statistics, and video streaming data from the robot's five cameras. This tool will lead to the development of intelligent and autonomous solutions, enhancing the utility of the Unitree Go1 Robot Dog in practical applications and the areas of advanced research. Data and video streaming data was successfully collected from Go1, and the documentation provides guidance on getting started with Go1 and talks about the features that Go1 has.

"Without them we would be lost": Detective Experiences and Perceptions of Violent Crime Victim Advocates

Authors: **Colette Content** and Seth Fallik
Faculty Mentor: *Seth Fallik, College of Social Work and Criminal Justice*
Funded by: Office of Undergraduate Research and Inquiry

Criminal justice policy is continually evolving, and recent efforts seek to align justice with victim wellbeing. Evidence-based approaches, including trauma-informed and victim-centered frameworks, are at the forefront of these discussions. As experts in these practices, victim advocates are a force for good in the criminal justice system; however, prior victim advocacy research and practice has been limited to certain victims (e.g., youths) and crime types (e.g., domestic violence,

sexual assault, and human trafficking). To understand deputy experiences and perceptions of working with victim advocates in violent crimes, 48 detectives in the Violent Crimes Division (VCD) of the Palm Beach County Sheriff's Office were surveyed. Victim advocates were found to 1) bring trauma-informed and victim-centeredness to their cases, 2) aid detectives in their communication, and 3) allow detectives to focus their attention on the case. Substantively, victim advocates were highly valued by VCD detectives.

Hiligaynon Voicing: A Comparative Analysis with Tagalog
Author: **Ty Craaybeek**
Faculty Mentor: *Michael Hamilton, Dorothy F. Schmidt College of Arts and Letters*
Funded by: Dorothy F. Schmidt College of Arts and Letters

Hiligaynon is part of the Central-Philippine branch of the Austronesian language family, closely related to Ilokano, Tagalog, Cebuano, and other languages. Although spoken by 7.3% of the population, the language has remained relatively understudied. Hiligaynon uses symmetrical voicing, a voicing system in many Austronesian languages requiring the topicalization of a noun and an agreeing affix on the verb, and it uses four voices. As Hiligaynon is understudied, this project seeks to provide a clearer description of Hiligaynon voicing and explore its structures compared to Tagalog. Sentences were taken from Hiligaynon grammar books and modified to have variants for each voice and provided to a participant for a grammatical judgement test, which were compared to literature describing Tagalog voicing. It was found that the underlying syntax in Hiligaynon and Tagalog are the same, with differences being in the number of voices and the following semantic changes.

Evaluation of Flow Features Responsible for Extreme Events at a Potential Ocean Current Energy Extraction Locations within the Gulf Stream
Authors: **Marina DaSilva**, Louis DeVito, James VanZwieten, and Yufei Tang
Faculty Mentor: *James VanZwieten, College of Engineering and Computer Science*
Funded by: College of Engineering and Computer Science

The entirety of the open-ocean current based electricity production potential available to the continental U.S. can be found off the southeast U.S. coastline, with the most energy dense areas found off Florida's east coast. By using bottom mounted acoustic Doppler current profiler (ADCP) data, this study identifies extreme ocean current events (5 strongest and 5 weakest currents) that have affected proposed ocean current energy production sites over the past 15 years. Prior studies do not provide a good understanding of the flow features associated with the extreme current events identified within these data sets and therefore do not provide a strong basis for the forecasting of extreme events. Understanding these features' progression will lead to a better understanding of extreme events, enabling the correlation between flow features and their impacts on the ocean current resource and helping lay the foundation for extreme ocean current event prediction.

Using Bimetallic Pyridazine Ligands to Promote Electrocatalytic Carbon Dioxide Reduction
Author: **Jordan Deblasis**
Faculty Mentor: *Zhu-Lin (Sam) Xie, Charles E. Schmidt College of Science*
Funded by: LEARN

We aim to create a bimetallic Schiff-base pincer system with pyridazine, incorporating two metal centers and R groups. The anticipated outcome is an enhanced electrocatalytic CO_2 reduction, producing valuable chemicals like methane and ethanol and contributing to the process of creating a total artificial photosynthesis system. Using previous research, we were able to draw out a synthesis route for the system we are trying to make. We are continuing to work on these initial reaction steps and have not synthesized the complete system as of yet. The implications of our research, once complete, will help combat rising CO_2 levels in our atmosphere and ultimately help preserve the planet.

Taking a Closer Sniff at Shark Noses: Analyzing Elasmobranch Olfactory Morphology Through Scanning Electron Microscopy
Authors: **Nicole Demaras**, Aubrey Clark, Marianne Porter, Tricia Meredith, and Lauren E. Simonitis
Faculty Mentor: *Marianne Porter, Charles E. Schmidt College of Science*
Funded by: Office of Undergraduate Research and Inquiry

Sharks smell by detecting odorants as water passes into the incurrent nares, through the olfactory rosette, and out the excurrent nares. The olfactory rosettes are composed of lamellae— plates of tissue with both sensory and non-sensory epithelium. Previous research found differences in lamellar structure based on position along the length of the rosette. We aim to describe blacktip shark (*Carcharhinus limbatus*) lamellar morphology. We hypothesize that the lamellar microstructure of blacktip sharks would vary depending on its location along the rosette, like other shark species. Using scanning electron microscopy (SEM), we describe lamellar morphometrics, including total surface area, degree of secondary folding, and percentage of sensory surface area. Our preliminary findings show variation in lamellar morphology throughout the rosette. This project adds significantly to our understanding of how shark noses are optimized for chemical detection to the aquatic environment.

Algae-Derived Activated Carbon Adsorbent Materials to Prevent Harmful Algal Blooms
Author: **Shannon Egger**
Faculty Mentor: *Masoud Jahandar Lashaki, College of Engineering & Computer Science*
Funded by: College of Engineering and Computer Science

Algae are important contributors to the aquatic environment, however, elevated nutrient levels and warm temperatures in surface waters can lead to the overgrowth of certain alga types. Florida often experiences annual harmful algal blooms (HABs) that can cause a wide range of health issues in people, animals, and the ecosystem. This project aimed to mitigate HABs through an industrial ecology approach, by converting waste algal biomass into Activated Carbon (AC) adsorbent material for the removal of aqueous-phase phosphate to prevent HABs in surface waters. While numerous biomass precursors were previously examined for synthesizing ACs, this research used sargassum seaweed biomass. AC pyrolysis and activation with lanthanum chloride, a modification agent to improve AC affinity for phosphate adsorption, was conducted using microwave heating. The findings from this research will inform further investigation in future research grants and aid in preserving water bodies, contributing to enhanced air and water quality in communities.

An Optimization of the Transformation of Lactobacillus Acidophilus ATCC 314: A Step Towards Probiotic Vaccines
Author: **Shant Faradyan**
Faculty Mentor: *Nwadiuto Esiobu, Charles E. Schmidt College of Science*
Funded by: Charles E. Schmidt College of Science

Lactobacillus acidophilus resides in the human gut microbiome and plays a role in aiding our immune system. The ability to effectively and easily transform *L. acidophilus* allows for possible usage for transformation with plasmids encoding antigens or therapeutic proteins that could be expressed in *L. acidophilus*. These antigens would be continuously expressed by the *L. acidophilus* in the gut, acting as a potential immunization vector. In this study, we transformed *L. acidophilus* with a plasmid encoding red fluorescent protein **(**pLEM415-ldhL-mRFP1) using electroporation to attempt to create an optimized protocol. *L. acidophilus* was cultured in anaerobic conditions on MRS media, then electroporation parameters were calculated along with usage of a buffer and lysozyme. Successful transformants have not yet been obtained, however the transformants should grow on erythromycin induced medium and be visualized under fluorescence microscopy to confirm RFP expression along with gel electrophoresis. A side study was done along, using DH5A *Escherichia coli* using the same approach and resulted in transformants.

A Preliminary Exploration of Nursing Students' Knowledge of Current Florida Health Policies Impacting Nursing Practice
Author: **Sydney Gibbons**
Faculty Mentor: *Louise Aurélien Buie, Christine E. Lynn College of Nursing*
Funded by: Office of Undergraduate Research and Inquiry

Nursing practice in Florida is guided by the Nurse Practice Act (Chapter 464 Florida Statutes), which is continuously updated through legislative action. The latest health policies impacting nursing practice are published on the Florida Board of Nursing website (www.doh.state.fl.us/mqa). The Institute of Medicine's 2010 Future of Nursing Report highlights that nurses are underrepresented and disengaged in health-policy decision-making, a situation that remains unchanged in 2024. As healthcare evolves, it is crucial to evaluate how well-prepared future nursing professionals are to

engage in policy development. This project assesses nursing students' awareness and knowledge of Florida's health policies. Online surveys were distributed to undergraduate and graduate nursing students at Florida Atlantic University's Christine E. Lynn College of Nursing. Initial data analysis is underway, with data collection extending to fall 2024. We aim to identify knowledge gaps, enhance curricula, boost students' interest in policy advocacy, and better prepare them for the workforce.

Optimization of Fluorescent Cholesterol and Ergosterol Probes
Authors: **Christopher Gomez** and Maciej Stawikowski
Faculty Mentor: *Maciej Stawikowski, Charles E. Schmidt College of Science*
Funded by: Charles E. Schmidt College of Science

Cholesterol, a crucial component of cellular membranes and a second messenger in various biological processes, has been effectively monitored using fluorescent naphthalimide cholesterol analogs. These analogs mimic cholesterol's behavior and mark cholesterol-containing lipid droplets. To expand the utility of fluorescent lipid probes, we developed and characterized a fluorescent ergosterol analog called END2 and three novel phthalic analogs, named CPD1, CPD2, and CPD8, each featuring different head group species: ethanolamine, piperazine, and hydroxyl, respectively. Initial evaluations revealed that CPD1 and CPD8 exhibited maximum absorbance values too low for practical applications, while CPD2, despite absorbing at an acceptable wavelength of 381 nm, displayed low fluorescence intensity. Due to these limitations, we revisited previous CND analogs, substituting cholesterol with ergosterol while retaining the original 1,8-naphthalimide fluorophore, anticipating improved spectroscopic properties. This study highlights the ongoing efforts to refine fluorescent lipid probes for better tracking and analysis of cholesterol dynamics within cellular membranes.

Optimization of Single Red Blood Cell Analysis using MATLAB
Author: **Mohammad Hanif**
Faculty Mentor: *Sarah Du, College of Engineering & Computer Science*
Funded by: College of Engineering and Computer Science

Optical microscopy for cell counting and cell shape analysis demands a significant amount of time and skills. Although many image analysis software, such as ImageJ can be useful to measure and quantify the microscopic images, collecting data of single cells is often repetitive, tedious, and subjective, detracting from the essential task of analyzing and interpreting the results. To streamline and automate this process, MATLAB's image analysis toolboxes are leveraged. A custom MATLAB script is written to analyze cell shapes and measure their geometrical factors in the field view of the image, using human red blood cells as a cell model. The first part of this MATLAB code identifies single cells, measures red blood cell's elliptical shape factor (ESF) and organizes the data into an Excel sheet. The second part of the code then uses this data and calls for an electro-deformation spectroscopy function, an established optimization procedure in Dr. Du's lab to calculate three critical parameters pertaining to electro-deformation analysis of red blood cells: cell electrical conductivity, membrane permittivity, and membrane shear modulus. This code greatly reduces the time and effort it takes to analyze a data set, and importantly, reduces the subjectiveness associated with human analysis.

Identification of Neuronal Populations in the Anterior Cingulate Cortex Active During Chronic Pain
Authors: **Kaleigh Harbin**, Darian Peters, Lawrence Toll, and Akihiko Ozawa
Faculty Mentor: *Lawrence Toll and Akihiko Ozawa, Charles E. Schmidt College of Medicine*
Funded by: Office of Undergraduate Research and Inquiry

Chronic pain is a major health problem that negatively impacts the quality-of-life due to a combination of sensory and emotional components arising from cooperative activities of multiple brain regions. The anterior cingulate cortex (ACC) is a crucial brain area linked to various psychiatric disorders, including pain. This study aims to identify specific active ACC neurons that potentially drive pain behaviors during chronic pain, using immunohistochemistry. We employed multiple cellular markers to characterize neuronal subtypes, including both inhibitory and excitatory neurons. Our findings will enhance the understanding of ACC circuits involved in chronic pain by elucidating distinct neuronal circuits that regulate pain behaviors associated with chronic pain.

The Jeanes Supervisors of Palm Beach and Broward County, and Their Contributions Towards Teaching Curriculum and Personal Impact on Their Community
Author: **Abigail Jean Francois** and Melanie Acosta
Faculty Mentor: *Melanie Acosta, College of Education*
Funded by: College of Education

This research explores the contributions of the Jeanes Supervisors in Palm Beach and Broward Counties, answering, "Who were they, what was their impact, and what did they contribute?" These African American women served as teachers, principals, and community leaders in South Florida, innovating teaching methods, extracurricular activities, and health services. Their efforts extended beyond traditional roles to enhance their students' and communities' lives. The research utilized exhibits, literature, and field visits, gathering data through historical societies, museums and libraries. Findings revealed significant impacts, including mixed reactions to school integration, the positive influence of school sports, and health initiatives. The research highlights the resilience and influence of these supervisors in overcoming educational challenges, such as Blanche Ely's extended school year, which reduced sharecropping interruptions. Their legacy reflects the educational wisdom within black communities and offers a model for future engagement and policy development.

Evaluating Tidal Impact on Beach Morphology
Authors: **Hannah King**, Austin Scheinkman, and Allyson Wleklinski
Faculty Mentor: *Tiffany Roberts Briggs, Charles E. Schmidt College of Science*
Funded by: Charles E. Schmidt College of Science

Beach morphology refers to the shape of the beach which changes due to the movement of sediments caused by wind, waves, and currents. However, tides determine where on the beach these processes can or will operate. In microtidal regions (<2m tidal range) tidal impacts on beach morphology has been overlooked due to having a smaller water level variability compared to other regions. However, with rising sea levels and costal squeeze, tidal variability might actually play a more significant role. The goal of this project is to quantify tidal impacts on beach profile change in southeast Florida's microtidal region associated with high and low tidal oscillations. Using an RTK-GPS device, one transect was surveyed in an area with high urban development and two in an area with no urban development. Sediment samples were collected to analyze grain size variability at the dune toe, mid-beach, and shoreline.

Irish Language Songs: Documenting and Transcribing Endangered Language Songs
Authors: **Kylie Masters**
Faculty Mentor: *Stacie Rossow, Dorothy F. Schmidt College of Arts and Letters*
Funded by: Dorothy F. Schmidt College of Arts and Letters

All endangered languages reach a critical point where they must be preserved while there are enough speakers. Irish is at that point right now. However, it is also vital to document the art and history of culture due to the ties to linguistic information of the past. This study sought to document and preserve some of that vital information. Seven traditional Irish songs were identified, and then through research of the origin they were translated, transcribed, and documented. Along with an IPA (International Phonetic Alphabet) transcription appropriate for singing, an English translation is provided as well. All this information was compiled into a booklet for each song transcription which also included a description of the song's meaning and origin. There are three main Irish dialects explored in the research, including the Munster, Ulster, and Connacht dialects, which each have unique phonetic differences. This work will help preserve and promote the Irish language, not only in speech but in music as well, and serve as a beginning point for further research.

The Mechanical Optimization of Florida Atlantic Universities Wave Energy Converter
Author: **Joshua Masturzo**
Faculty Mentor: *James VanZwieten, College of Engineering & Computer Science*
Funded by: College of Engineering and Computer Science

The original goal for this project was to test Dr. James VanZwieten's project led Wave energy converter in a variety of wave conditions and to compare results with the simulation model WecSim, to assess its validity. Due to the state it was

received, mechanical and electrical optimization was needed. Mechanical model transformations included an enhanced retention system, consisting of a thicker and more corrosion resistant alloy design for retention rods and plates, a harder alloyed drive shaft, and the addition of a properly working strain gauge system to test mechanical power loss. Our team was able to reach a maximum output of 13 W in-lab and 4.4 W in Pool testing, a major upgrade from the previously tested system. Challenges met included motor pod leakage, proving the retention system needs further analysis before ocean testing. Potential solutions involve larger O'Rings or a redesigned retention system.

Challenges of Preparation of Gametocytes from Genetically Modified Parasites
Authors: Sabrina Islam, **Kaitlyn Morgan**, Irina V. Oleinikov, Jeff Dvorin, and Andrew V. Oleinikov
Faculty Mentor: *Andrew V. Oleinikov, Charles E. Schmidt College of Medicine*
Funded by: LEARN

Understanding gametocytogenesis in P. falciparum may result in development of transmission-blocking drugs and vaccines against malaria. We use biophysical techniques in the lab of Dr. Du at FAU to investigate the effects of the parasitic protein BLEB, a particular gametocyte protein, on the physiological state of gametocytes in cooperation with our colleagues in the Laboratory of Dr. Dvorin at Harvard University. To perform these studies, we need to expand a parasite line that was genetically modified (a) to switched ON and OFF a gene for BLEB protein and (b) to induce gametocytogenesis by specific compounds for each process. The genetically modified line is fragile for propagation and completion of gametocytogenesis process which takes 10-12 days in culture. I will outline our advancements and difficulties in achieving these two goals throughout the poster.

Security Enhancement of the FAU Tecore Lab Internet of Things (IoT) Testbed
Author: **Christofer Piedra**
Faculty Mentor: *Imadeldin Mahgoub, College of Engineering & Computer Science*
Funded by: Office of Undergraduate Research and Inquiry

My research focuses on the development and implementation of a secure login system, an interactive dashboard, and an Intrusion Detection System (IDS) for the FAU Tecore Testbed. The primary objective is to simulate, detect, then visualize various network attacks, specifically Distributed Denial of Service (DDoS), Port Scan, and ARP Poisoning. The login system ensures secure access to the testbed, while the dashboard provides a user-friendly interface for conducting and monitoring experiments. The IDS operates in the backend to identify and label different attacks. The dashboard enables users to simulate cyberattacks; the system then analyzes network packets to flag the attacks and visualize them. These visualizations provide key insights and data for analysis. This project works to develop a functional secure testbed, contributing to research in cybersecurity methodologies within FAU. By providing a multifunctional tool for studying common cyber threats, it enhances both academic and practical understanding of network security.

Spatio-Temporal Role of Dsd in Metabolism and Neuronal Regulation
Authors: **Joshua Reynolds**, Chantae Bennett, Fernanda Salomão Del Bianco, and Tanja A. Godenschwege
Faculty Mentor: *Tanja A. Godenschwege, Charles E. Schmidt College of Science*
Funded by: Charles E. Schmidt College of Science

Drosophila Distracted (Dsd) is a transmembrane protein and its mammalian homolog Attractin (Atrn) has been linked to obesity, diabetes, sleep disorders and neurodegeneration. Atrn homologs were shown to downregulate G-Protein Coupled Receptors through membranetethered ubiquitination. Atrn functions have only been characterized in regulation of Melanocortin Receptors, which do not explain several phenotypes, such as neurodegeneration. We established Drosophila as a valid model that mimics Atrn phenotypes. Here, we provide evidence that Dsd has functions in the nervous system, insulin producing cells (IPCs), and the midgut to modulate insulin release and behaviors, such as sleep and feeding behavior. In addition, we find that Dsd protein expression is predominantly regulated post-transcriptionally by miRNAs and its expression changes during daytime likely in response to intrinsic or extrinsic signals. In summary, our results suggest that Dsd plays a critical role in maintaining metabolic homeostasis by modulating insulin release and behaviors in a context-dependent manner.

Artwork Archive and Online Exhibitions in Higher Education
Author: **Kendall Richert**
Faculty Mentor: *Véronique Côté, Dorothy F. Schmidt College of Arts and Letters* and *University Galleries*
Funded by: Office of Undergraduate Research and Inquiry

The Florida Atlantic University Galleries collection was uploaded into the Artwork Archive database, with cross-disciplinary keywords researched through information and interviews from students and professors working with subsets of the collection. This research is focused on understanding potential stakeholders' needs for teaching with objects from the collection. A guide was created for the effective use of subject matter and tags for artwork. Useful thematic and technical keywords were compiled through user interviews, integrated into the database, and tested. An online exhibition was curated using the software, and a report was published, including a "How To" guide for curating from the database. This project aims to modernize Museum Studies by developing thematic object presentation, transforming university collections into research data, and fostering undergraduate involvement in museum studies, cultural preservation, and digital humanities.

Thermoreversible Micelles as Nanoreactors and Carries Through Immiscible Solutions for Transportation and Synthesis of Dyes, Drugs, and Nanoparticles
Author: **Nicolás Salas**
Faculty Mentor: *Renjie Wang, Charles E. Schmidt College of Science*
Funded by: Charles E. Schmidt College of Science

Micelle shuttles have attracted attention as they can be efficiently used as nanoreactors for different biochemical procedures and transportation between hydrophilic and hydrophobic solutions without damaging the integrity of the compound. By using Poly(1,2-butadiene)-b-ethylene oxide) (PB−PEO) block co-polymer and Pluronic F-127 dissolved in water and 1-butyl-3-methylimidazolium hexafluorophosphate ([BMIM][PF6]). We prove their effectiveness in nano molecule transport and function as a nanoreactor for SiO_2 nanoparticle synthesis. These block copolymers self-assemble into micelles in both polar and apolar solutions. Both compounds show a consistent thermoregulated and reversible phase shift which can facilitate drug administration, molecule dyeing, and effective nanoparticle synthesis located in otherwise, insoluble solutions. Fundamentally, this procedure permits the integration, reaction and extraction of the contents, regulating the dosage, concentration and time in solution of the desired procedure.

How much is Enough? Antecedents of Vertical Pay Dispersion in U.S Non-Profit Acute Care Hospitals
Authors: **Hadika Saqib** and Neeraj Puro
Faculty Mentor: *Neeraj Puro, College of Business*
Funded by: Office of Undergraduate Research and Inquiry

The wide divergence between nonprofit hospital CEO compensation and other nonprofit entities which prompted us to examine hospital pay equity. Equity is considered the fourth pillar in public management literature. This study introduces vertical pay dispersion, a prevailing equity issue in discussions of organizations and society, to public management research. The study seeks to identify mechanisms through which publicness influences organizational outcomes that have a public value. Focusing on US non-profit acute care hospitals, we use Moulton's (2009) realized publicness framework and investigate how regulative, normative, and cultural-cognitive publicness are associated with vertical pay dispersion as a public value outcome.

Exploring Amplitude-Induced Variability in Tree Shrew Visual Cortex: A Computational Approach
Author: **Abigail Shepard**
Faculty Mentor: *Rodrigo Pena, Charles E. Schmidt College of Science* and *Harriet L. Wilkes Honors College*
Funded by: Charles E. Schmidt College of Science

The visual cortex constitutes an integral part of the brain responsible for processing external visual stimulation. It is well known that neurons in this area have preferred responses to orientation, a phenomenon known as orientation selectivity. While gathering firing responses from the tree shrew cerebral cortex, collaborators from the Max Planck Florida Institute at the Fitzpatrick Lab observed a new avenue of response variability linked to the amplitude of the stimulation. We

propose that the network architecture coupled with selective activation of the specific neurons can explain this phenomenon. As a proof of concept, we aimed to develop a biophysical computational model to replicate the amplitude-induced response. Our findings show that specific populations targeted by stimulus activation replicate observed response patterns. We have also connected the patterns to specific connections drawn in simulation through artificial neural networks, and we expect that this framework will allow seamless identification of network architecture.

Understanding Bubble Growth Dynamics for Thermal Management: Effects of Fin Structures in Two-Phase Immersion Cooling
Authors: **Camron Smith,** Adib Nasrabadi, and Myeongsub Kim
Faculty Mentor: *Myeongsub Kim, College of Engineering and Computer Science*
Funded by: College of Engineering and Computer Science

The system temperature must remain within its desired range by effective thermal management for optimal performance of electronic devices and electric vehicle (EV) batteries. Two-phase immersion cooling, specifically nucleate boiling, is a novel technique that has shown the potential to improve the cooling efficiency of these systems. Nucleate boiling accompanies cyclic bubble growth driven by phase change while releasing significant heat generation. The bigger bubble size and more frequent bubble growth are preferred to increase the heat removal rate by modifying the geometry of cooling systems. A simple fin structure is often used as a cooling methodology, and therefore, understanding the nucleation process, bubble growth, and its departure from various fins is essential to achieve effective thermal management. This research aims to explore the effects of fin structure modification on bubble growth dynamics. The modified fin structures, including simple, dimple, hole, and coated fins, serve as an artificial nucleation site to facilitate bubble growth and departure. Findings from this study can be applied to model and predict bubble growth, which can be used in practice to improve the cooling of small electronics and EV batteries.

The Role of PTMs in AD Pathology
Authors: **Maria Vezzi**, Nancy Vela, Ramya Ayyalasomayajula, Ivet Boneva, Deepika Regimi, Deguo Du, and Maré Cudic
Faculty Mentor: *Maré Cudic, Charles E. Schmidt College of Science*
Funded by: Charles E. Schmidt College of Science

Eukaryotic cells rely on protein post-translational modifications (PTMs) as a vital process to enhance and diversify protein functions beyond the genetic code's instructions. Phosphorylation is among the most prevalent post-translational modifications of proteins that play a role in the pathology of Alzheimer's disease (AD). In this study, we took advantage of synthetic chemical strategies developed in our group to prepare APP peptide models with the site-specific glycan and/or phosphate group attachment to examine the consequences of these PTMs on the secondary structure of APP model peptides and proteolytic processing by α- and β-secretases. The mucin-type *O*-glycosylation site on the phenolic hydroxyl group of the tyrosine (Tyr681) in the proximity of α-secretase and the phosphorylation site at the Ser679 was explored. Additionally, APP glycopeptide models with *O*-GalNAc moieties attached to Thr663 or Ser667 were synthesized. The glyco(phospho)peptides were synthesized and characterized using HPLC and MALDI-TOF. Circular dichroism (CD) was used to assess the conformational alterations induced by the PTMs. The effects of PTMs on Aβ40 aggregation were studied by atomic force microscopy (AFM).

The Art of Adaptation: Inter-Asian Intertextuality in the 'Boys Over Flowers' Drama Universe
Author: **Saturn Vogeley**
Faculty Mentor: *Jacqueline Fewkes, Harriet L. Wilkes Honors College*
Funded by: Office of Undergraduate Research and Inquiry

Intertextuality, the complex web of relationships between texts, reveals how stories evolve and adapt across cultures and mediums. In the context of global media, studying intertextuality offers valuable insights into cultural exchange and the adaptation of narratives over time. Intertextuality plays a vital role in the "Boys Over Flowers" drama adaptations, which, due to their similarities, offer a unique opportunity to understand the various techniques used to create interconnected yet unique shows. This research, which is part of a larger study on the role of media in Asia, focuses on the various techniques of intertextuality which creates the "Boys Over Flowers" connected universe of shows. While each show is

based on the original Japanese manga, they draw inspiration from their predecessors and the romance drama genre across different countries. A focus on these shows demonstrates some of the various techniques of intertextuality and illustrates the significance of connections formed across Asia through popular media.

Velocity and Yaw control of Autonomous Underwater Vehicles with Undulatory Motion
Author: **Erik White**
Faculty Mentor: *Oscar Curet, College of Engineering and Computer Science*
Funded by: College of Engineering and Computer Science

Many marine animals use undulatory motion to propel through the water. Knifefish use a ventrally placed undulating fin enabling agile multidirectional movements in a singular orientation (e.g. forwards, backwards, upwards). Inspired by the knifefish, this work aims to mimic undulatory propulsion in an Autonomous Underwater Vehicle (AUV). By propagating a sinusoidal wave from front to back at 1Hz we tested the velocity and ability to maintain heading, which we compared to previous versions of the AUV. The experiments were conducted in a recirculating flume tank which allows for propulsion against an oncoming flow and in stagnant water. We used gray scale imaging in MATLAB to detect two markers on each AUV to determine the heading of the vehicle while swimming against a current matching the speed of the AUV swimming at 1 Hz in stagnant water. This research demonstrates the benefits of mimicking fish to propel AUVs through water.

Augmented Reality in Installation Art and the Expansion of the White Cube
Author: **Carson Williams**
Faculty Mentor: *Melissa Sclafani, Dorothy F. Schmidt College of Arts and Letters*
Funded by: Office of Undergraduate Research and Inquiry

This research explores the theoretical and conceptual significance of utilizing augmented reality within three-dimensional installation artwork as an expansion of the physicality of the gallery. Conceptual analysis using the framework of Brian O'Doherty's 'white cube' and 'easel picture' vernacular is explored through theoretical investigation. The way that AR expands upon these conceptions is visually examined through the creation of a miniature scale gallery installation consisting of physical objects and digital pieces fabricated for AR experience. This research also shows the limitations of Adobe Aero, a 2D-based AR program, as opposed to Reality Composer Pro with its 3D object anchoring capabilities. The focus of this research project is building off historical methods of breaking down the gallery space in conjunction with contemporary uses of AR to create a gateway into the creative mind of the artist that feels even more real than the white gallery wall upon which it is anchored.

Development and Characterization of a Pectin-Based Hydrogel for Tissue Regeneration
Author: **Priscilla Xu**
Faculty Mentor: *Yunqing Kang, College of Engineering and Computer Science*
Funded by: College of Engineering and Computer Science

Pectin is a natural, inexpensive, and negatively charged polysaccharide found in the cell walls of terrestrial plants and fruits. Pectin has been widely developed into polymeric hydrogel for tissue regeneration due to its nature origin and biocompatibility. However, current crosslinking methods for pectin hydrogel are not controllable for in vivo applications. In this study, we modified pectin with aminoethyl methacrylate (PECAM), making pectin photo-cross-linkable under visible light rapidly and easily. Results showing PECAM quickly crosslinks in 30 seconds. This study covers mechanical strength, degradation rates, and swelling behaviors that can be finely tuned for potentially different applications according to crosslinking times (30s, 60s, 90s) and crosslinker concentrations (0.025%, 0.05%, 0.1). This study serves to develop a baseline discovery through the synthesis and characterization of pectin-based hydrogel. Preliminary analysis demonstrates pectin hydrogel as a major opportunity for the ecofriendly and low-cost polysaccharide with research supporting its active role in tissue regeneration.

Not Presenting Today

Machine Learning Based Compression of Large Scientific Data on Unstructured Grids
Student Fellow: **Guilherme Gazeti**
Faculty Mentor: Rohit Deshmukh, College of Engineering and Computer Science
Funded by: College of Engineering and Computer Science

Malaria Parasite Culture for Deformability Studies
Student Fellow: **Carter Nichols**
Faculty Mentor: Yufei Tang, College of Engineering and Computer Science
Funded by: College of Engineering and Computer Science

Occupancy Map Inpainting for Efficient Indoor Robot Navigation
Student Fellow: **Joshua Thaw**
Faculty Mentor: Minghan Wei, College of Engineering and Computer Science
Funded by: Office of Undergraduate Research and Inquiry