2022

SUMMER UNDERGRADUATE & GRADUATE EXPERIENCES IN RESEARCH

STUDENT RESEARCH PRESENTATIONS

BOOK OF ABSTRACTS

2022 SUGER STUDENT RESEARCH PRESENTATIONS

Hall of Science T07

AUGUST 3, 2021

SESSION SCHEDULE

12:00 - 12:10 PM **Welcome Remarks**

COMMUNICATIONS/NASA GODDARD

12:10 - 12:20PM **Emily Watkins**
Video Production for the NASA Earth Science Team

PHYSICS/CHEMISTRY

12:20 - 12:30 PM **Caleb Dando-Haenisch**
Unsupervised Machine Learning Method to Identify Solar Coronal Holes on Satellite Images

12:30 - 12:40 PM **Valencia Parker**
Flash Joule Heating of Metal Organic Frameworks to Prepare Cobalt- and Nitrogen-doped Porous Carbon Catalysts

12:40 - 12:50 PM **Izaiah Brown**
Voltammetric Characterization and Co-Detection of Homovanillic Acid

12:50 - 1:00 PM **Yarden Mor**
Synthesis of Urea-Based Fragment Kinase Inhibitors

BIOLOGY/NEUROSCIENCE

1:00 - 1:10 PM **Talia Mitre**
Protein Extraction of *H. mephisto*

1:10 - 1:20PM **Annastelle Cohen**
The role of estrogen and thyroid hormone signaling crosstalk in BPA-induced visual system deficits

1:20 - 1:30 PM **Emily Barnes**
Cerebellar Involvement in Autism Spectrum Disorder

1:30 - 1:40 PM **Robby Jones**
Assessment of the Rewarding and Aversive Effects of Eutylone

MATHEMATICS & STATISTICS/AUDIO TECHNOLOGY

1:40 - 1:50 PM **Jaehee Lee**
Classifying Text Data using the Dowker Complex

1:50 - 2:00 PM **Lia Dolive**
Iron Handling in Tumor Microenvironment

2:00 - 2:10 PM **Noah Deetz**
Acoustic Auto-calibration Methodologies

2:10 - 2:30 PM **Closing Remarks/Networking/Socials**

COMMUNICATIONS/NASA GODDARD

Emily Watkins

Video Production for the NASA Earth Science Team

Adviser: Jefferson Beck

In collaboration with the Earth Science Video Production Team, internship participation involved on-site tasks including filming, publishing videos, and assisting with the James Webb Space Telescope (JWST) First Light Broadcast. My role at NASA Goddard included application of effective science communication to products that myself and the production team created while assisting with JWST endeavors. The production workflow proved essential in creating engaging stories from idea conceptualization to publication and in assisting producers. Prior knowledge of science communication skills was utilized after finalizing a concept, brainstorming components that make an engaging video for a wide audience while being scientifically comprehensive. Participation in the JWST broadcast resulted in a historic live stream showing NASA's potential for space exploration. The internship has revealed the ins and outs of scientific communication, allowing skill expansion in production for a government agency and immersion into the realm of live broadcasting for a once-in-a-lifetime production.

PHYSICS/CHEMISTRY

Caleb Dando-Haenisch

Unsupervised Machine Learning Method to Identify Solar Coronal Holes on Satellite Images

Advisers: Dr. Silvina Guidoni & Dr. Jessica Uscinski

Coronal holes (CH) are regions of the sun's surface and lower atmosphere where the plasma is colder and less dense than the surrounding plasma. They appear as dark areas in solar images taken with satellites in extreme ultraviolet (EUV) and soft x-ray wavelengths and originate in open magnetic field lines rooted at the sun, which extend to interplanetary space. High-speed streams of solar wind from CHs may interact with the Earth's magnetosphere and produce geomagnetic storms. Determining CH location and evolution is essential to predict such space weather events. Historically, the identification of coronal holes in solar images has been done manually. However, machine learning tools can make this task more efficient. For this project, we downloaded and stitched solar images from NASA satellites (SDO/AIA and STEREO) with different points of view to create synchronic maps (plane maps). As a first step, we used a machine learning technique called K-means on these synchronic maps to automatically detect CHs and other features. Future plans include the use of advanced unsupervised techniques to identify CHs.

Valencia Parker

Flash Joule Heating of Metal Organic Frameworks to Prepare Cobalt- and Nitrogen-doped Porous Carbon Catalysts

Adviser: Prof. Shouzhong Zou

Cobalt- and nitrogen-doped porous carbons are being explored as alternative hydrogen fuel cell catalysts in place of platinum due to platinum's scarcity. These catalysts have been prepared by pyrolyzing precursors to high temperatures in a tubular furnace, which is energy inefficient and time consuming. In this research, we explore another approach, flash joule heating (FJH), to prepare the porous carbons from metal organic frameworks in efforts to reduce the energy consumption and preparation time. Electron microscopy will be used to verify the structure and composition of synthesized materials. We will also compare the catalytic activity of cobalt active sites made from the tube furnace pyrolysis versus the FJH method using electrochemistry. If successful, this study will demonstrate how to prepare doped porous carbon catalysts efficiently and sustainably.

Izaiah Brown

Voltammetric Characterization and Co-Detection of Homovanillic Acid

Adviser: Prof. Alexander Zestos

Fast scan cyclic voltammetry (FSCV) is an electrochemical technique used for the rapid detection of neurotransmitters with subsection temporal resolution. Recently, catecholamine co-detection has been a significant area of focus for electrochemical neurotransmitter detection, as compounds with a structural resemblance are typically difficult to differentiate on cyclic voltammograms (CV). This is particularly important for in vivo applications of FSCV, where sensitivity towards catecholamines causes an overlap of CV peak oxidative currents. One compound bearing structural similarity to catecholamines is homovanillic acid (HVA), a dopamine metabolite. In the current experiment, we optimize waveform parameters and investigate polyethyleneimine (PEI) deposition on carbon fiber microelectrodes to facilitate the detection and characterization of HVA. We apply this methodology with the goal of reliably detecting and quantifying HVA with other catecholamines. These waveform developments have the potential to be applied for further research on functions, mechanisms, and implicated diseases related to HVA.

Yarden Mor

Synthesis of Urea-Based Fragment Kinase Inhibitors

Adviser: Prof. Monika Konaklieva

There is a pressing need for the development of effective therapeutics such as antivirals. This study involves the design, synthesis, and testing of a fragment-based (FBDD) library of compounds designed as antivirals against a panel of different viruses. Our work is innovative because of the application of “fragments,” which are designed to target host enzymes involved in viral replication to an in vitro antiviral assay, which determines both activity and cell toxicity. Our aim is to assess the utility of in vitro biological assays to FBDD(1) for antiviral compounds (2). We hypothesized that “fragments” small enough to bind to multiple sites are more likely to be accepted as substrate analogs of a wider set of enzymes, which could lead to a new approach for preventing viral replication (3). Our intention is to identify a new molecule for the future synthesis of effective drugs and the design of another generation of more active compounds.

(1) Scott, D. E., Coyne, A. G., Hudson, S. A., Abell, C. Fragment-based approaches in drug discovery and chemical biology. Biochemistry, 2012, 51, 4990–5003. doi: 10.1021/bi3005126
(2). Credille, C. V.; Yao Chen, Y.; Seth M. Cohen. Fragment-Based Identification of Influenza Endonuclease Inhibitors. J. Med. Chem. 2016, 59, 6444−6454. DOI: 10.1021/acs.jmedchem.6b00628
(3). Schulze, J.; Baukmann, H.; Wawrzinek, R.; Fuchsberger, F. F.; Specker, E.; Aretz, J.; Nazaré, M.; and Rademacher, C. CellFy: A Cell-Based Fragment Screen against C- Type Lectins. ACS Chem. Biol. 2018, 13, 3229−3235. DOI: 10.1021/acschembio.8b00875

Talia Mitre

Protein Extraction of *H. mephisto*

Adviser: Prof. John Bracht

I have been researching the nematode *Halicephalobus mephisto* in Dr. Bracht's lab this summer. This organism, the deepest living animal on earth, has been found living up to 2 kilometers underground. Unique biological qualities of *H. mephisto* include its ability to withstand high temperatures and low amounts of oxygen. My research in Dr. Bracht's lab focuses on better understanding the physiological role of heat shock factor-1 (HSF-1), a regulatory gene, in the physiology of *H. mephisto*. I have performed HSF-1 knockouts with RNAi in order to evaluate the functional aspects of *H. mephisto*. The primary experiments I have been performing this summer have been in an attempt to extract proteins from *H. mephisto* using a technique previously shown to work for *C. elegans*. The technique has been successful so far and I have been able to detect proteins in *H. Mephisto* by performing the first western blots of the organism.

Annastelle Cohen

The role of estrogen and thyroid hormone signaling crosstalk in BPA-induced visual system deficits

Adviser: Prof. Victoria Connaughton

Estrogen and thyroid hormones are critical regulators of the visual system. We reported that transient developmental exposure to BPA, an estrogen mimic and environmental contaminant, caused changes in the adult zebrafish retina. Using a low [BPA] (0.001μM) also decreased thyroid hormone receptor beta (THRβ2) expression. To assess this effect, we used a pharmacological approach to explore if 1) BPA binds to THRβ2 directly, or 2) activated estrogen receptors (ERs) interact with TH target gene promoters to alter THRβ2 transcription independent of THRs. Zebrafish aged 72 hours postfertilization (hpf) were co-exposed to BPA+ICI, an ER antagonist, or BPA+MSNB, a THRβ2 antagonist. Larvae 2- and 4-weeks postexposure were used in RT-qPCR and Western Blotting to assess estrogen and TH targets. If low [BPA] acts independent of THRs, we expect decreases in the expression of THRβ2 and TH-responsive genes with MSNB but not ICI. This work will help elucidate BPA-induced visual system deficits.

Emily Barnes

Cerebellar Involvement in Autism Spectrum Disorder

Adviser: Prof. Catherine Stoodley

The cerebellum is part of the hindbrain, known most generally as a region involved in coordination and motor skills. However, the cerebellum has recently been identified as functionally connected to certain circuits involving the cerebral cortex that are behaviorally relevant to the characteristics of Autism Spectrum Disorder (ASD). Understanding whether the cerebellum plays a significant role in ASD and specific dysfunctions of these circuits could lead to innovation in biological therapies, as currently only behavioral interventions exist. Our study includes two cohorts of participants: individuals diagnosed with ASD and a typically developing population. We use transcranial direct current stimulation (tDCS) to modulate behavioral cerebro-cerebellar circuits relevant to ASD, and functional magnetic resonance imaging. Participants complete a series of social and cognitive tasks while in the scanner, with the tDCS applied. Our data collection is not yet complete, but we seek to better understand the role of the cerebellum upon analysis.

Robby Jones

Assessment of the Rewarding and Aversive Effects of Eutylone

Adviser: Prof. Anthony Riley

Recreational drugs have both rewarding and aversive effects. This investigation aimed to characterize the abuse potential of the novel synthetic cathinone eutylone through assessments of its rewarding and aversive effects in a combined conditioned taste avoidance and place preference assay. Female Sprague-Dawley rats were given 20-min access to a saccharin solution, injected with 0, 3, 10, 18 or 32 mg/kg of racemic eutylone (intraperitoneal; IP) and placed on one side of a place conditioning apparatus. The following day, subjects were given 20-min water access, injected with saline (IP), and placed on the opposite side of the apparatus. Following five two-day conditioning cycles, place preferences and saccharin avoidance were assessed. Eutylone induced dose-dependent taste avoidance and significantly increased the time subjects spent on the drug-paired side of the place preference apparatus. Understanding the effects of experiential and subject factors on these affective properties may be instrumental in predicting eutylone's abuse potential.

MATH & STAT/AUDIO TECH

Jaehee Lee

Classifying Text Data using the Dowker Complex

Adviser: Prof. Michael Robinson

This project aims to classify documents into specific topic categories based on relevant/common terms. Term Frequency-Inverse Document Frequency(TF-IDF), is being widely used to determine how relevant terms are to a given document. However, in some cases TF-IDF is not effective, so we used the Dowker Complex to explore how relevant the terms are between the documents. The Dowker Complex is an abstract simplicial complex based on word usage among documents. In this research, its application is used in a matrix format to represent the relationship between terms and documents using statistical software in R. We are still in the research process, but the current results show that the Dowker Complex separates the documents by their topics, as measured by the topic's probability, more efficiently than TF-IDF. This research can be applied to help search engines rank documents by relevant terms.

Lia Dolive

Iron Handling in Tumor Microenvironment

Adviser: Prof. Julia Chifman

The goal of this project is to build a computational model of iron metabolism at an intracellular level that concentrates on modeling iron trafficking among immune cells and cancer cells. Currently, the focus is on macrophages and, specifically, tumor associated macrophages (TAMs). Current literature finds that TAMs compose anywhere from 5% - 40% of a tumor's mass and can contribute to poor prognosis. The polarization of macrophages dictate the Iron phenotype by determining the expression of iron related proteins involved in the handling of iron. Different iron phenotypes are displayed by pro-inflammatory and anti-inflammatory macrophages, which decide whether the growth and progression of the tumor is being enhanced or inhibited.

Noah Deetz

Acoustic Auto-calibration Methodologies

Adviser: Prof. Braxton Boren

In room acoustic modeling, geometric room models are commonly created to aid acousticians in auditioning different room treatment methods. It is critically important to have the mathematical parameters of the room and simulation match in order to increase the translatability of room treatments created in the model. Traditionally, acousticians manually adjust absorption coefficients of planes in the model to align predicted values of reverb time (T30) and speech clarity (C50) with values measured from the real room. This presentation showcases an alternative procedure where a non-ML algorithm is used to expedite the calibration process. Previously, genetic machine learning algorithms have been implemented, however non-ML algorithms grant the acoustician greater end user flexibility due to their “white box” nature. A statistical database that includes mean and standard deviation measurements for acoustic coefficients is also showcased to account for material density deviation in the auto-calibration algorithm.