A VIRTUAL EVENT

20th ANNIVERSARY

KALMAN

RESEARCH SYMPOSIUM

SATURDAY, APRIL 17, 2021

Bucknell UNIVERSITY

KALMAN RESEARCH SYMPOSIUM

INTRODUCTION

SPRING 2021

Welcome to the twentieth annual Kalman Research Symposium.

An important central element of the Bucknell experience is to offer our students in all disciplines the opportunity to engage in substantive out-of-the-classroom research and creative projects with faculty. As stated in the mission statement for Bucknell's Program for Undergraduate Research, these opportunities *allow students and faculty to participate in collaborative learning processes designed to dissolve the distinction between teaching and research, and to create a community of learners in which scholarship serves as the basis for teaching and learning.*

This symposium showcases the breadth and variety of undergraduate research taking place at Bucknell, as is evidenced by the abstracts of the projects contained herein. Visitors are encouraged to visit the Kalman Symposium website, containing students' posters, slides and recorded presentations, and to attend virtually the live symposium on April 17, 2021 to observe both the poster and oral presentations, as well as the poster sessions to interact with the student scholars and to learn more about their work.

This symposium is named in honor of Ernest Kalman, who graduated from Bucknell in 1956. In addition to his service as a University trustee, Ernie's generosity to his alma mater has taken many forms, one of which was a significant gift in support of undergraduate research.

The ***Kalman Research Symposium*** features projects sponsored or supported by the following:

- Bobko-Dennis Fund for Undergraduate Student Research
- California Healthcare Undergraduate Research
- Clare Boothe Luce Research Scholarship
- College of Engineering
- Culliton Family Fund for Undergraduate Research
- David Burpee Endowment
- Dean's Fund for Summer Undergraduate Research in STEM
- Degenstein Foundation Susquehanna Watershed Aquatic Ecology Research
- Department of Biology
- Department of Biomedical Engineering
- Department of Chemistry
- Department of Electrical & Computer Engineering
- Department of Geology & Environmental Geosciences
- Department of Geology & Environmental Geosciences Marchand Fund
- Diane Hymas Undergraduate Research
- Douglas K. Candland Undergraduate Research Fund
- Drs. Anthony and Joyce D. Kales Undergraduate Research Fund
- Emerging Scholars Program
- Fund for Undergraduate Research in Biological and Chemical Sciences
- Gary A. and Sandra K. Sojka Fund for Research, Teaching and Scholarship in Developmental Disabilities, Neuroscience & Human Health
- Graduate Summer Research Fellowship
- Grand Challenges Scholars Program

The ***Kalman Research Symposium*** features projects sponsored or supported by the following: (continued)

- Harold W. Heine Undergraduate Research Fund in Chemistry
- Helen E. Royer Undergraduate Research Fund
- James L.D. and Rebecca Roser Research Fund
- Joann E. Walthour Undergraduate Research Fund
- John C. Hoover Undergraduate Math Research
- John M. Hustler Undergraduate Research Fund
- Juliet Shield-Taylor Fund for Undergraduate Research
- Kalman Fund for Biomedical Research Fellows
- Kalman Fund for Undergraduate Research in the Sciences
- Leanne Freas Trout Fund for Research and Teaching in French and Francophone Studies
- Manning Intern Botanical Science
- Mayfield and Johnson Scholarship
- Michael Baker Jr. Summer Research Program
- NASA Astrobiology Institute
- National Institutes of Health
- National Program for Playground Safety, University of Northern Iowa
- National Science Foundation Grant (NSF)
- (National Science Foundation) NSF ADVANCE
- Organic Syntheses Summer Research Grant
- PA Wild Resource Conservation Program
- PIC Math, a Mathematical Association of America (MAA) program funded by the National Science Foundation (NSF) and the National Security Agency (NSA)
- PPL Undergraduate Research Fund
- Presidential Fellowship
- PricewaterhouseCoopers Research Fund
- Program for Undergraduate Research
- Reed-Garman Award Fund for Engineering Entrepreneurship
- Robert P. Vidinghoff Memorial Summer Internship
- Schotz Family Fund
- Scott AE - Research Fund
- Senior Design and Research Sponsorship
- Sigma Xi Grant-in-Aid of Research
- Slonaker Fund
- STEM Scholars
- Stephen Glenn Hobar Memorial Research Award
- Susquehanna River Heartland Coalition for Environmental Studies
- Susquehanna River Research Program - Degenstein Foundation
- Tague Family Fund for Undergraduate Research in Biomedical, Biological and Biochemical Sciences
- The Katherine Mabis McKenna Environmental Internship Program
- The Tom Greaves Fund for Research and Curricular Development
- Thomas Spitzer Undergraduate Research Fund
- Undergraduate Research in Animal Behavior

Akil Atkins '22
Faculty Mentor: Professor Christopher Dancy, COMPUTER SCIENCE
Funding Source: National Science Foundation Grant (NSF)
Catch The Pig! Understanding the Interaction Between People and AI

Genevieve Block '22
Faculty Mentor: Professor Shaunna Barnhart, GEOGRAPHY
Funding Source: American Association of Geographers
Homelessness Awareness and Response in Shamokin, PA

Emily Brandes '21
Faculty Mentor: Professor Scott Meinke, POLITICAL SCIENCE
Funding Source: Honors Thesis in Political Science
To Believe or Not to Believe: A Closer Look at the Impact of Sexual Assault in Politics

Ryan Bremer '22
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Funding Source: Dalal Innovation and Creativity Grant for Student-Faculty Collaboration
Brakhage's Adjacents

Ella Carlander '22 and Michael Bolish '23
Faculty Mentor: Professor Katharina Vollmayr-Lee, PHYSICS & ASTRONOMY
Funding Source: National Science Foundation Grant (NSF)
Computer Simulations of Granular Media

Edward Chen '22
Faculty Mentor: Professor Joshua Stough, COMPUTER SCIENCE
Funding Source: Ciffolillo Healthcare Technology Inventors Program
Assessing the Generalizability of Temporally Coherent Echocardiography Video Segmentation

Weiru Chen '21
Faculty Mentor: Professor Hava Turkakin, PHYSICS & ASTRONOMY
Funding Source: Undergraduate Research Advisory Council
Investigations of Kelvin-Helmholtz Instability (KHI) and Associated Magnetosonic Wave Emission in the Solar Corona: New Impacts on Coronal Heating

Ian Coates '21
Faculty Mentor: Professor Kenneth Mineart, CHEMICAL ENGINEERING
Funding Source: College of Engineering; National Science Foundation Grant (NSF)
Assessing the Impact of Block-Selective Homopolymers on the Diffusion of Payload Through Polymeric Organogels

Julian Cohen '21
Faculty Mentor: Professor Christopher Daniel, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: Program for Undergraduate Research
Determining the Metamorphic Conditions of ca 1.4 Ga Rocks from the Sierra Estrella Mountains, Arizona USA: An Application of Raman Thermobarometry

Michael Duncan '23
Faculty Mentor: Professor Douglas Collins, CHEMISTRY
Funding Source: Presidential Fellowship
Gas-Phase Chemical Ionization Orbitrap Mass Spectrometry

Olivia Dyer '22
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: The John P. & Mary Jane Swanson Professorship in Engineering & the Sciences
Visual and Mechanical Characterization of the Muscle to Aponeurosis Junction

Gari Eberly '21
Faculty Mentor: Professor Katherine Hays, ENGLISH; CREATIVE WRITING
Funding Source: N/A
Synthesis

Caroline Eckert '21, Amber Coleman '21, Alexis Faria '22, Clara Han '21, Makenna Luzenski '23, Lauren Shearer '22 and Grace Wilder '21
Faculty Mentor: Professor Chris Boyatzis, PSYCHOLOGY
Funding Source: Program for Undergraduate Research
Native Danish Mother's Intersection Between Parenting Approach and Religion

Kyle Ferguson '21
Faculty Mentor: Professor Thomas Solomon, PHYSICS & ASTRONOMY
Funding Source: NSF Grant DMR-1806355, NSF Grant CMMI-1825379
Noise-Driven Aggregation of Swimmers in the Kolmogorov Flow

Mackenzie Flynn and Bree McCullough '22
Faculty Mentor: Professor Ben Hayes, WATERSHED SCIENCES AND ENGINEERING PROGRAM
Funding Source: United States Forest Service
Little Arnot Run: An Evaluation of Groundwater-Surface Water Interactions with Regard to Hyporheic Exchange and Temperature

Maya Freeman '23
Faculty Mentor: Professor Cecilia Bove, BIOLOGY
Funding Source: Department of Biology
Fluoroquinolone-based Therapy and Onset of Functional Gastrointestinal Disorders in Human Subjects

Keith Grega '21
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: Bucknell-Geisinger Research Initiative
Impact of Screw Type on Torque During SCFE Screw Removal

Jacob Feuerstein '22
Faculty Mentor: N/A
Funding Source: N/A
The Choppy Purple Surf: Understanding the 2020 Election in Rural Pennsylvania

Emily Haas '21
Faculty Mentor: Professor Ellen Chamberlin, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: Kalman Fund for Undergraduate Research in the Sciences
Evaluating the Impact of Stream Restoration Techniques on Bank Erosion, Stream Morphology, and Soil Carbon at an Unnamed Tributary of Pine Creek near Woodward, central Pennsylvania

Jeffrey Heim '21
Faculty Mentor: Professor Christopher Martine, BIOLOGY
Funding Source: Department of Biology; Program for Undergraduate Research
A Population Genomics Approach to Understanding the Role of Indigenous Foragers in the Distribution and Genetic Diversity of an Australian Wild Bush Tomato *(Solanum diversflorum)*

Cameron Hong '21
Faculty Mentor: Professor Kenneth Mineart, CHEMICAL ENGINEERING
Funding Source: National Science Foundation Grant (NSF)
Assessing Solvent Viscosity Impact on the Physical Characteristics of Polymeric Organogels

April Hurlock '23
Faculty Mentor: Professor Douglas Collins, CHEMISTRY
Funding Source: STEM Scholars; Alfred P. Sloan Foundation - Chemistry of Indoor Environments
Effect of Self-Oxidation on Deposited Cigarette Smoke Composition and Third-Hand Smoke

Valerie Justice '21
Faculty Mentor: Professor Christopher Daniel, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: Department of Geology & Environmental Geosciences
U-Pb Isotope Dating of Monazite in the Sierra Estrella Mountains of Arizona: Evidence for ca. 1.4 Ga Metamorphism and Deformation

Ariel Kelly '2022
Faculty Mentor: Professor Mihai Banciu, ANALYTICS & OPERATIONS MANAGEMENT
Funding Source: Program for Undergraduate Research
Does Global Trade Help or Hinder Economic Inequality?

Taiba Khan '22
Faculty Mentor: Professor Benowitz-Fredericks, BIOLOGY
Funding Source: Department of Biology
Relationship between aggression, body condition, and parental feeding in chicks of the seabird species Black-legged kittiwakes *(Rissa tridactyla)*

Shane Kozick '23
Faculty Mentor: Dr. Vanessa Troiani, (ADMI lab director), NEUROSCIENCE
Funding Source: Summer Autism and Neurodevelopmental Disorders Internship (SANDI)
Measuring Concordance of Subtype Sulcogyral Patterns in Monozygotic and Dizygotic Twin Pairs

Klaudia Kulawska '21
Faculty Mentor: Professor Judith Grisel, PSYCHOLOGY
Funding Source: N/A
The Implications of Socioeconomic Status on Maternal Language Input and Child Language Outcomes

Wutt Hmone Thin Kyi '22
Faculty Mentor: Professor Karlo Malaga, BIOMEDICAL ENGINEERING
Funding Source: Program for Undergraduate Research 2020
Effect of White Matter Stimulation on Clinical Outcomes in Thalamic Deep Brain Stimulation for Essential Tremor

Lainey Lavelle '22
Faculty Mentor: Professor Lara Dick, MATHEMATICS
Funding Source: James L.D. and Rebecca Roser Research Fund
A Study of Teacherpreneurs Who Create Elementary Mathematics Curricular Resources

Camillo Lazarczyk and Simon Behr '21
Faculty Mentor: Professor Vivienne Wildes, MANAGEMENT
Funding Source: Senior Design and Research Sponsorship; Conducted within a class for the College of Management using Qualtrics and with the support of Vivienne Wildes of the College of Management, and Agnes Jasinska of Bertrand Library's Research Help
Reducing Food Waste In The Restaurant Industry

Jaden Lee '22
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: John P and Mary Jane Swanson Professorship in Engineering & the Sciences
Using Finite Element Modeling to Investigate the Effect of Mechanical Loading on Muscle Extracellular Matrix Microstructure

Kaelyn Long '21
Faculty Mentor: Professor Lara Dick, EDUCATION; MATHEMATICS
Funding Source: Research was for course credit
My Experiences Re-immersing into "Introduction to Mathematical Thought"

Catherine MacKay and Brooke Echnat '21
Faculty Mentor: Professor Anjalee Hutchinson; Professor Bryan Vandevender, THEATRE & DANCE
Funding Source: Bucknell Department of Theatre and Dance
The Show Must Go On!

Margaret Anne MacNeille '21
Faculty Mentor: Professor Lara Dick, MATHEMATICS
Funding Source: Helen E. Royer Undergraduate Research Fund
What's Out There? Investigating Online Teacher Created Activities

Claire Marino '23
Faculty Mentors: Professor Christopher Martine; Dr. Tanisha Williams, BIOLOGY
Funding Source: David Burpee Endowment; Department of Biology
Solanum "Deaf Adder" a New Bush Tomato Species from the Australian Monsoon Tropics

Thomas Matsumura '22
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: Bucknell-Geisinger Research Initiative
Measuring Lower Limb Muscle Activity and Kinematics in Variable Foot Strike Gaits

John Mirsky '23
Faculty Mentor: Professor David Rojas, LATIN AMERICAN STUDIES; SOCIOLOGY & ANTHROPOLOGY
Funding Source: Douglas K. Candland Undergraduate Research Fund;Presidential Fellowship
Housing Illness in a PA Mushroom Town

Philip Onffroy '22
Faculty Mentor: Professor Katsuyuki Wakabayashi, CHEMICAL ENGINEERING
Funding Source: College of Engineering; Presidential Fellowship
Ray'cycle Initiative: Characterizing and Productizing Community-Sourced Plastic Waste

Anthony Orlando '24
Faculty Mentor: Professor Kenneth Mineart, CHEMICAL ENGINEERING
Funding Source: Presidential Fellowship
Mechanical Testing of Wax-based Polymer Gels

Nicholas Passantino '21
Faculty Mentor: Professor Joshua Stough, COMPUTER SCIENCE
Funding Source: Presidential Fellowship
Domain Adaptation in Machine Learning for Medical Imaging

Lucas Rankin, Graduate Student
Faculty Mentor: Professor Kenneth Mineart, CHEMICAL ENGINEERING
Funding Source: National Science Foundation Grant (NSF)
Establishing the Independent Tunability of the Mechanical and Transport Properties of Polymer Gels

Coco Sachs '21 and Lily Shorney '22
Faculty Mentor: Professor Chris Boyatzis, PSYCHOLOGY
Funding Source: N/A
The Psychological Impact of COVID-19 and Social Distancing

Jake Schaefer '24
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: John P and Mary Jane Swanson Professorship in Engineering & the Sciences
The Mechanical Properties of Ramming Animal Horn Shapes

Bryan Scutari '23
Faculty Mentor: Professor Tom Geurts, ACCOUNTING & FINANCIAL MANAGEMENT
Funding Source: IMA Research Foundation
The Financial Impact of an ISO14001 Certification

Julia Tokish '22
Faculty Mentor: Professor Meenakshi Ponnuswami, ENGLISH
Funding Source: Presidential Fellowship
Uncovering South Asian-American Playwrights

Tung Tran '23
Faculty Mentor: Professor Joshua Stough, COMPUTER SCIENCE
Funding Source: HTIP
Bayesian Optimization for 2D Echocardiography Segmentation

Ben Travis '22
Faculty Mentor: Professor Mark Haussmann; Dr. James Greenberg, BIOLOGY; Chief of Gynecology, Brigham and Women's Faulkner Hospital - Associate Professor, Harvard Medical School
Funding Source: Bucknell Public Interest Program Fund
A Comparison of Estimated and Quantitative Blood Loss in Childbirth, and Investigation of Risk Factors for Postpartum Hemorrhages

Emily Tully '21
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: Engineering Data Generation Grant
Location Dependent Mechanical Behavior of Aponeurosis Tissue Under Uniaxial Tensile Stretch

Anurag Vaidya '21
Faculty Mentor: Professor Joshua Stough; Professor Benjamin Wheatley, COMPUTER SCIENCE; MECHANICAL ENGINEERING
Funding Source: Presidential Fellowship
Perceptually Improved Medical Image Translations Using Conditional Generative Adversarial Networks

Ruoying Zhang '21
Faculty Mentor: Professor Jasmine Mena, PSYCHOLOGY
Funding Source: Program for Undergraduate Research
Chinese International Students in the US: The Influence of Discrimination, Acculturation and Coping on Psychological Wellbeing

Diamanda Zizis '23
Faculty Mentor: Professor Christopher Martine, BIOLOGY
Funding Source: David Burpee Endowment;Presidential Fellowship
What Happens When you Cross Plant Species with Two Distinct Sexual Systems?: An Ex Situ Hybridization Approach

Akil Atkins '22
Faculty Mentor: Professor Christopher Dancy, COMPUTER SCIENCE
Funding Source: National Science Foundation Grant (NSF)

Catch The Pig! Understanding the Interaction Between People and AI

Our study sought to investigate the ways in which people would interact with an AI Agent, based on how the agent was racialized. To investigate this we modeled a game after the stag hunt task, where participants were tasked with gaining as many points as possible. Participants could gain points by either cooperating with an AI agent to capture a pink game piece, which represented a pig or exiting the game through the black squares on either side of the board. The study was a true experiment in which participants were randomly assigned to one of three conditions. Participants were either assigned to a condition where the AI was racialized as Black, where the AI was racialized as white, or a condition where the AI wasn't racialized at all, which represented the control condition. After completing the game participants were asked three survey questions to assess how they perceived the AI's strategy when playing the game. So far our results have shown that participants in the control condition were more likely to believe the AI was working with them to capture the pig than participants in both the Black and white treatment groups. Moreover, the participants in the white treatment group were more likely than those in the Black treatment group to believe the AI agent was working them to capture the pig. The results do suggest that there is a relationship between the racialization of AI and how people interact with AI Agents.

Genevieve Block '22
Faculty Mentor: Professor Shaunna Barnhart, GEOGRAPHY
Funding Source: American Association of Geographers

Homelessness Awareness and Response in Shamokin, PA

This semester, I am participating in a research internship studying homelessness in Shamokin, PA. I am working to understand the rise of homelessness in the area and the resources that need to be created to support this population. The research internship will culminate in a list of suggestions to the local PA government with ideas to support homeless people and help to alleviate poverty.

Emily Brandes '21
Faculty Mentor: Professor Scott Meinke, POLITICAL SCIENCE
Funding Source: Honors Thesis in Political Science

To Believe or Not to Believe: A Closer Look at the Impact of Sexual Assault in Politics

Since the viral 2017 #MeToo movement, public opinion on cases of sexual misconduct have been shaped by the mainstream media coverage of high profile stories. A changed culture has allowed more victims to come forward and share their stories, many detailing harrowing events perpetrated by successful businessmen and politicians. Credible accusations continue to come forward, and while some end in legal action, many do not, and perpetrators face little to no consequences. I examined how individuals respond to issues of sexual misconduct and assault in politics, and based on the severity of the accusation, how they respond. Through my survey data research, I was able to isolate responses to see the influence that party affiliation and gender have on individuals opinion formation. The research reflects a consistent partisan difference between Republicans and Democrats in terms of reaction, with Democrats consistently being in favor of harsher consequences, both when Democratic, and Republican perpetrators are involved. These responses indicate a strong partisan bias in individuals, and additionally I found that when a history of sexual misconduct was present, individuals also reacted more harshly as opposed to politicians with no history.

Ryan Bremer '22
Faculty Mentor: Professor Ken Eisenstein, English - Film/Media Studies
Funding Source: Dalal Innovation and Creativity Grant for Student-Faculty Collaboration

Brakhage's Adjacents

The goal of Brakhage's Adjacents is to better understand the working methods and aesthetic decision making of the avant-garde filmmaker Stan Brakhage (1933-2003). By focusing upon his use of montage (the complex way in which he combined shots in his non-narrative and almost entirely silent 16mm films), we learn more about Brakhage's editing habits as well as the messaging behind these very challenging films. This is done by viewing splice-adjacent frames on an actual film strip, showing the literal cuts that were made when the films were produced decades ago. Brakhage's Adjacents draws from wider histories of narrative filmic editing [notably the advanced montage ideas of Sergei Eisenstein (1898-1948)] while adapting these notions to the under-realized realm of avant-garde cinema.

Ella Carlander ‘22 and Michael Bolish ‘23

Faculty Mentor: Professor Katharina Vollmayr-Lee, PHYSICS & ASTRONOMY

Funding Source: National Science Foundation Grant (NSF)

Computer Simulations of Granular Media

We will summarize the research we conducted under Katharina Vollmayr-Lee this past summer in the field of Granular Media. We built, ran, and analyzed molecular-dynamics simulations that modeled the behavior of this compelling type of material. Our talk will give a brief definition of Granular Media, explain the tools we used to build our simulations, display some results, and justify why research in this field is relevant and important.

Edward Chen ‘22

Faculty Mentor: Professor Joshua Stough, COMPUTER SCIENCE

Funding Source: Ciffolillo Healthcare Technology Inventors Program

Assessing the Generalizability of Temporally Coherent Echocardiography Video Segmentation

Existing deep-learning methods achieve state-of-art segmentation of multiple heart substructures from 2D echocardiography videos, an important step in the diagnosis and management of cardiovascular disease. However, these methods generally perform frame-level segmentation, ignoring the temporal coherence in heart motion between frames, which is a useful signal in clinical protocols. In this work, we implement temporally consistent video segmentation, which has recently been shown to improve performance on the multi-structure annotated CAMUS dataset. We show that data augmentation further improves results, which are consistent with prior state-of-art works. Our 10-fold cross-validation shows that video segmentation improves the automatic comparison to clinical indices including smaller mean absolute errors for left ventricular end-diastolic volume (8.7 mL vs 9.9 mL), end-systolic volume (6.3 mL vs 6.6 mL), and ejection fraction (EF) (4.6% vs 5.3%). In segmenting key cardiac structures, video segmentation achieves mean Dice overlap of 0.93 on left ventricular endocardium, 0.95 on left ventricular epicardium, and 0.88 on left atrium. To assess clinical generalizability, we further apply the CAMUS-trained video segmentation models, without tuning, to a larger, recently published EchoNet-Dynamic clinical dataset. On 1274 patients in the test set, we obtain absolute errors of 6:3% ± 5:4 in EF, confirming the reliability of this scheme. In that the EchoNet-Dynamic videos contain limited annotation only for left ventricle endocardium, this effort extends at little cost generalizable, multi-structure video segmentation to a large clinical dataset.

Weiru Chen ’21

Faculty Mentor: Professor Hava Turkakin, PHYSICS & ASTRONOMY

Funding Source: Undergraduate Research Advisory Council

Investigations of Kelvin-Helmholtz Instability (KHI) and Associated Magnetosonic Wave Emission in the Solar Corona: New Impacts on Coronal Heating

Previous studies have observed that Kelvin-Helmholtz Instability (KHI) and Magnetohydrodynamics (MHD) wave emissions along various shear flow boundaries in Solar-Terrestrial environment may transport energy between different regions of the sun. We expand upon these previous studies to investigate the nonlinear evolution of KHI and MHD waves along the boundaries of coronal mass ejections (CMEs), large eruptions of the corona that have a significant effect on satellites, earth’s power grids, and humans in space. We measure the strength of KHI growth and MHD wave emission, and the efficiency of energy transportation by these MHD waves using 2-D/3-D magnetohydrodynamic modeling software in order to first, identify KHI growth, and second, calculate the strength of the energy that these waves transport to the solar corona. The code we use is component-based parallel computer code written in Fortran90 and C programming languages. Our preliminary results demonstrate KHI and wave emission development along the boundary over time, showing that in real life conditions along the CME boundary, KHI and MHD emission is possible.

Ian Coates ’21

Faculty Mentor: Professor Kenneth Mineart, CHEMICAL ENGINEERING

Funding Source: College of Engineering; National Science Foundation Grant (NSF)

Assessing the Impact of Block-Selective Homopolymers on the Diffusion of Payload Through Polymeric Organogels

The goal of this project is to investigate the impact of a gel-miscible polymer additive on gel nanostructure, gel mechanical behavior, and sodium bis(2-ethylhexyl) sulfosuccinate (AOT) release rate. Characterizing gels’ mechanical behavior and release of AOT through these gels will benefit future applications like transdermal drug delivery through informed structure-property (i.e., nanostructure-diffusion) relationships. Previous work in our group has shown that gel nanostructure

is tuned by varying the amount of gel-forming SEBS copolymer. The purpose of this project is to further investigate methods of gel nanostructure tuning by identifying the impact of a discrete phase-selective polymer on organogel properties. Specifically, the impact of additive polymer concentration of gel nanostructure, mechanical response, and diffusivity will be studied. The current work uses Fourier-transform infrared spectroscopy (FTIR) to track changes in gel AOT concentration over time for gels with ranging homopolymer concentrations. The acquired data is modeled using Fick's laws to yield a diffusion coefficient for each gel formulation. We hypothesize that the aforementioned nanostructure trends are the culprit for our observation that diffusion of AOT decreases with increasing polystyrene additive polymer concentration. Understanding these relationships will provide key insight for biomedical and agricultural payload delivery applications.

Julian Cohen '21
Faculty Mentor: Professor Christopher Daniel, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: Program for Undergraduate Research

Determining the Metamorphic Conditions of ca 1.4 Ga Rocks from the Sierra Estrella Mountains, Arizona USA: An Application of Raman Thermobarometry

Meijer (2019) reported what is likely the first known occurrence of Mesoproterozoic granulite facies rocks in Arizona. However, the temperatures and pressures of metamorphism are unknown. To better constrain the conditions of metamorphism, metapelitic rocks were collected from the north end of the Sierra Estrella mountain range and are characterized by Grt-Bt-Pl-Qtz-Ky-Sil with significant retrograde Ms-Chl-Ep, and Grt-Bt-Pl-Qtz-Ky-Sil-Kfs with very little retrograde overprint. Preliminary thermodynamic modeling of these two samples was performed with Theriak- Domino and the H&P-98 data set. The Sil inclusions within Grt suggest Sil growth possibly during subsolidus St-breakdown or Ms-melting in both samples. The presence of Ky bearing melt textures in both samples may reflect prograde growth of Ky from Ms- or Bt-melting suggesting minimum PT conditions > 7.5 kbar and > 700 °C. A significant amount of retrograde Ms in sample implies in-situ melt crystallization during retrograde cooling.
To further constrain pressures of metamorphism, Raman spectroscopy was employed to measure peak positions of quartz inclusions in garnet (QuiG). The results of this work show peak shifts ranging from 0 to -0.1 cm-1. This equates to metamorphic pressures of 8-9 kbar at about 750-800 °C.

Previously reported zircon ages for the area suggest partial melting near 1.4 Ga (Meijer, 2019). The timing and P-T conditions of metamorphism in the Sierra Estrella mountains are similar to high-grade metamorphic rocks in northern New Mexico and southern Colorado; these rocks likely represent the southwestern extension of the Picuris orogenic belt

Jacob Feuerstein '22
Faculty Mentor: N/A
Funding Source: N/A

The Choppy Purple Surf: Understanding the 2020 Election in Rural Pennsylvania

The 2020 election was a point of inflection for Democratic candidates across the United States. Securing tossup states like Pennsylvania and Arizona along with parts of the industrial Midwest, the performance of Joe Biden and other down ballot candidates raises serious questions about the future of the Democratic Party. In particular, the geographic distribution of voters in the 2020 election surprised many in election-watching circles.

While many have analyzed Biden's over-performance in suburbia and underperformance with Hispanics in Texas and Florida, few have attempted to break down the results of the election in rural Pennsylvania. Because it is at such a unique intersection of the class, race, and conservative-liberal divide, understanding the rural election results is crucial to developing strategies for improving Democratic performance in the Midwest and South.

As the Campaign Manager for a Democrat in 85th District of Pennsylvania (Lewisburg, Selinsgrove, Mifflinburg), I had the opportunity to interact with thousands of voters and develop strategies to improve outcomes in a R +32 district. The statewide data tells us that the 2020 election in Pennsylvania was, as local organizer Jordi Comas coined, an example of the "choppy purple surf." In other words, the Republican turnout was unusually large, but slightly over-crested by Democratic voter turnout.

I will review the results of the election for my campaign in both a historical and geographical context and answer the question, "How did the 'choppy purple surf' play out in the the 85th District and other parts of rural Pennsylvania?"

Michael Duncan ’23
Faculty Mentor: Professor Douglas Collins, CHEMISTRY
Funding Source: Presidential Fellowship

Gas-Phase Chemical Ionization Orbitrap Mass Spectrometry

The most common method of analysis for trace gases in air employs chemical ionization time of flight mass spectrometry (CI-TOF-MS). Transportable CI-TOF-MS instruments have relatively low mass resolving power (m/Î”m < 10,000), meaning it is difficult to distinguish molecules with the same integer mass, but with different elemental composition. Orbitrap mass spectrometry, however, can routinely achieve resolving powers > 50,000, allowing for the exact monoisotopic mass to be determined. However, Orbitrap instruments are most commonly designed to analyze sprayed liquid samples. Atmospheric chemists commonly need to analyze the molecular composition of gases that include a variety of large organic molecules that have similar mass to charge ratios as one another, making it difficult to accurately identify them using a CI-TOF-MS. This project set out to design an chemical ionization apparatus for Orbitrap mass spectrometry and allow for the analysis of gaseous samples. The design has been focused around low costs, modularity, and adaptability, all in order to keep the horizon of users and use cases as broad as possible. Analyte ions will be formed by ion-molecule reactions within a cone-shaped flow reactor. Reagent ions will be supplied to the ion-molecule reactor using a continuous soft x-ray photoionization process. Computer-aided design in Solidworks along with rapid prototyping with 3D-printing has allowed for conceptualization, realization, and testing of key components before fabrication. The first machined prototype is the next major step which will provide the opportunity to test the concept.

Olivia Dyer ’22
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: The John P. & Mary Jane Swanson Professorship in Engineering & the Sciences

Visual and Mechanical Characterization of the Muscle to Aponeurosis Junction

Aponeurosis is a tendinous sheath-like tissue found in many muscle-tendon units, and the muscle-aponeurosis junction is poorly understood. We want to determine the structure of the transition from muscle to aponeurosis and how it may be similar or different from the myotendinous junction. Imaging and visually characterizing the muscle-aponeurosis junction using SEM imaging of tissue samples will show how the tendon and muscle fibers interact with one another in the transition zone. It has been observed that there is a non-uniform strain placed on the aponeurosis, and so imaging of the tissue will reveal how force affects the alignment of the collagen fibers found in aponeurosis tissue. Examining how the waviness of collagen fibers changes as the tissue is placed under force will allow for better understanding of the material and structural properties of aponeurosis tissue. Evaluating these characteristics will help us better understand how damages to the tissues occur, how those damages can be repaired and rehabilitated, and how to properly develop computer models of the musculoskeletal system. Sample images using the SEM have been taken to develop a general understanding of aponeurosis morphology.

Gari Eberly ’21
Faculty Mentor: Professor Katherine Hays, ENGLISH; CREATIVE WRITING
Funding Source: N/A

Synthesis

Synthesis is a collection of poetry that explores how gender relations and race amalgamate to impact the maturation of an individual. These poems are scientifically-aware and influenced by my concurrent education in both Creative Writing and Biomedical Engineering. For the past four years, I have sought to bridge the gap between my two academic commitments: poetry and science. Both poetry and science exist as a means to ask and answer questions about the messy interactions that shape personalities and relations with the broader world. To be successful, both tools require dedication to detail, creativity, and exploration. On the page, poets mold language to reveal startling truths about how we engage with the world. In a lab, engineers leverage scientific theories to build technological innovations. Despite these similarities, I have noticed that interactions between poetry and science remain faint: a missed connection at the train station, an asymptote that never opens its mouth. Through this collection, I instead seek to converge these two disciplines at a single point by melding personal experience with scientific observations, as explored through a variety of poetic forms.

Caroline Eckert '21, Amber Coleman '21, Alexis Faria '22, Clara Han '21, Makenna Luzenski '23, Lauren Shearer '22 and Grace Wilder '21
Faculty Mentor: Professor Chris Boyatzis, PSYCHOLOGY
Funding Source: Program for Undergraduate Research

Native Danish Mother's Intersection Between Parenting Approach and Religion

This study investigated Danish mothers' beliefs about parenting and the role of religion in family practices and discussions. Denmark is famous as one of the most secular nations in the world (Zuckerman, 2008), yet religion is, perhaps surprisingly, a component of family discussion, especially about death and morality (Zajac & Boyatzis, 2020). In this study, 15 native Danish mothers, all fluent in English with at least one child between ages of 4 and 14, were interviewed about mothers' religious beliefs and how they were incorporated into family discourse and practices, especially on issues of morality, religious holidays, death, and the afterlife. Transcripts are being coded by a team creating a coding system using inductive and deductive thematic analysis. Team members individually analyzed transcripts and then met to work toward a shared coding system for interpreting themes in the mothers' views. Coding is in progress, with these preliminary themes: mothers' respect for children's autonomous beliefs (i.e., reluctance to impose their own beliefs), promotion of the child's character, tolerance for diverse religions (and mothers' lack of strong commitment to any one faith), mothers' ongoing reflection and growth, and concern for children's age-appropriate exposure. Preliminary analyses suggest Danish mothers have a distinctive orientation to the role of religion in the family, one quite disparate from most American families (Boyatzis et al., 2015).

Kyle Ferguson '21
Faculty Mentor: Professor Thomas Solomon, PHYSICS & ASTRONOMY
Funding Source: NSF Grant DMR-1806355, NSF Grant CMMI-1825379

Noise-Driven Aggregation of Swimmers in the Kolmogorov Flow

We investigate theoretically the dynamics of ellipsoidal microswimmers in an externally imposed, laminar Kolmogorov flow. Through a phase-space analysis of the dynamics without noise, we find that swimmers favor either cross-stream or rotational drift, depending on their swimming speed and aspect ratio. When including noise, i.e. rotational diffusion, Langevin simulations of our model show a transition from swimmer aggregation in low-shear regions of the flow to aggregation in high-shear regions as the parameters are varied. We find that rotational diffusion tends to drive swimmers into certain parts of phase space. We characterize the dependence of this noise-driven phase-space aggregation on a swimmer's speed, aspect ratio, and rotational diffusivity. The properties of the swimmer trajectories with noise explain the transition from high-shear to low-shear aggregation. (KS Ferguson, SA Berman, KA Mitchell, TS Solomon, 2020)

Mackenzie Flynn and Bree McCullough '22
Faculty Mentor: Professor Ben Hayes, WATERSHED SCIENCES AND ENGINEERING PROGRAM
Funding Source: United States Forest Service

Little Arnot Run: An Evaluation of Groundwater-Surface Water Interactions with Regard to Hyporheic Exchange and Temperature

Little Arnot Run is a second-order stream in the Allegheny National Forest, Pennsylvania that has been historically altered by logging and oil and natural gas wells. In many areas, the stream was dredged, straightened, and converted to a narrow, deep, single-thread channel, which continues to be disconnected from the floodplain. This project is part of a larger stream restoration study by the United States Forest Service (USFS) and Bucknell University currently underway working to characterize the factors controlling geomorphic processes operating within the watershed in order to direct restoration activities set to take place later in the year. Our preliminary analysis of groundwater piezometers, stream temperature gauge station data, and weather station data suggests significant hyporheic exchange to the channel. We are currently assessing both shallow and alluvial aquifers as well as in deeper sections of the stream in order to quantify groundwater-surface water exchange and potential for reconnecting abandoned side channels and vernal pools on the floodplain. We will be using precipitation to look at the rate and direction of the hydrostatic driven hyporheic exchange caused, in part, by changes in the ground and surface water elevation and analyzing variations in temperature throughout the system.

Maya Freeman '23
Faculty Mentor: Professor Cecilia Bove, BIOLOGY
Funding Source: Department of Biology

Fluoroquinolone-based Therapy and Onset of Functional Gastrointestinal Disorders in Human Subjects

Fluoroquinolones (FQs) are a broad class of antibiotics typically prescribed for several infectious diseases, including common infections for which the use of FQs is discouraged. Indeed, the FDA has proposed the existence of a permanent disability (Fluoroquinolone Associated Disability; FQAD), which, despite being fairly common after FQs use, has yet to be formally recognized by healthcare professionals worldwide. Previous studies suggest that FQs act as selective inhibitors of GABAA receptors, preventing the binding of the inhibitory neurotransmitter GABA in the central nervous system. GABA is a key regulator of the neural circuit regulating gastrointestinal function. In order to assess whether there is a correlation between the use of FQs and the onset of functional gastrointestinal (GI) disorders, a questionnaire was sent to 367 individuals who were prescribed FQs addressing their gut health in the last year. Survey participants were divided into three groups based on the type of FQ they were prescribed. Chi-square analysis revealed that while all participants had a significant degree of functional GI disorder, certain FQs are associated with more severe and more frequent gastric pain, difficulty producing a bowel movement and harder stools. Lastly, a significant portion of respondents also reported frequent swelling or bloating. In conclusion, these data indicated that permanent functional GI disorders may present after FQs administration, and that certain FQs produce more severe symptoms than others. Our study highlights the need to revisit current guidelines for the administration of FQs for individuals already potentially at risk to develop functional GI disorders.

Keith Grega '21
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: Bucknell-Geisinger Research Initiative

Impact of Screw Type on Torque During SCFE Screw Removal

Slipped Capital Femoral Epiphysis (SCFE) is a disorder that occurs in adolescents in which the femoral head slips with respect to the femoral neck. SCFE can lead to abnormal hip mechanics which may result in the need for realignment of the femoral head through surgery. Percutaneous in situ fixation is the most common treatment for SCFE, where the femoral head is realigned on the neck through screw insertion to prevent further deformity during adolescence. The topic of screw removal is quite controversial. If the screws are left in the patient, there is the potential that fractures may occur later in life due to stress risers, yet screw removal requires a second surgical operation. In addition, there is no standard screw that is used for the procedure. Different physicians prefer various types of screws including titanium vs. non-titanium, cannulated vs. non-cannulated and threaded vs. partially-threaded. Therefore, the purpose of this research project is to determine the amount of torque required to remove various types of orthopaedic screws after closure of the physis. This analysis will quantify how various screws perform during screw removal and provide insight into tissue damage that may occur due to screw removal. The ultimate goal of this study is to determine the optimal screw to use during the procedure that will cause the least amount of damage after bone growth has occurred around the screw.

Emily Haas '21
Faculty Mentor: Professor Ellen Chamberlin, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: Kalman Fund for Undergraduate Research in the Sciences

Evaluating the Impact of Stream Restoration Techniques on Bank Erosion, Stream Morphology, and Soil Carbon at an Unnamed Tributary of Pine Creek near Woodward, central Pennsylvania

Live staking is a stream restoration technique in which live cuttings and stems taken from native species of trees and shrubs are placed into stream banks, eventually growing into new plants which aids in riverbank protection by increasing soil cohesion. Because of the growing use of live staking in stream restorations, there is a growing need for research on the link between live staking and geomorphic resiliency. Here we investigate the impact of live staking on bank erosion, stream morphology, and soil carbon (SC) at an unnamed tributary of Pine Creek near Woodward, Pennsylvania.

In this study, we collected baseline data for a long-term study of the impact of live stakes on the floodplain and channel geomorphology, and we investigated the baseline SC distribution. Preliminary results from stream channel surveying indicate undercut banks, channelization, very low stream velocity, and silt and clay on the stream bed. Throughout the field site, the soils are silty loams with thin O-horizons and some local variability within transects. SC analysis shows carbon values between 0.36% and 3.32%, which is low for the expected

range of SC for degraded floodplain soils in this environment. We predict that in future years, as the live stakes vegetate the stream banks at this site, there will be an increase in soil carbon, changes in stream bed character and channel sinuosity, and more soil variability.

Jeffrey Heim '21

Faculty Mentor: Professor Christopher Martine, BIOLOGY
Funding Source: Department of Biology; Program for Undergraduate Research

A Population Genomics Approach to Understanding the Role of Indigenous Foragers in the Distribution and Genetic Diversity of an Australian Wild Bush Tomato *(Solanum diversflorum)*

The Indigenous foragers of Australia's Western Desert, known as the Martu people, have a rich and deep connection to the landscape that is evident through their culturally significant pathways of movement. In creating this connection, we wonder how these pathways have shaped the distribution, abundance, and dispersal of wild plants, specifically the economically significant bush tomatoes of the genus Solanum (including Solanum diversiflorum, known locally as wamula). Currently, herbarium and field collected specimens have been sampled from across the range of Solanum diversiflorum. These samples are being used to understand genetic connectivity, as well as the potential impact of Indigenous users on S. diversiflorum's population structure. DNA has been extracted from each specimen using FastDNA kits and stored for future quality testing. We expect to find a correlation between the movement of the Indigenous people and the dispersal of the species along pathways of movement, as well as patterns that align with the historical distributions of language groups. This would imply that the activities of the Indigenous people profoundly shaped the distribution of the species and can give conservationists as well as anthropologists new insights on the relationship between the biogeography of plants in the Western Desert and the people who have lived there for thousands of years.

Cameron Hong '21

Faculty Mentor: Professor Kenneth Mineart, CHEMICAL ENGINEERING
Funding Source: National Science Foundation Grant (NSF)

Assessing Solvent Viscosity Impact on the Physical Characteristics of Polymeric Organogels

Traditionally, studies of polymeric organogels focus on the impact of polymer factors on the gels' mechanical and transport properties. Alternatively, this study seeks to assess the impact of altering solvent viscosity, while holding polymer factors constant. The gels in this study were composed of styrene-ethylene-butylene-styrene (SEBS) triblock copolymer, oleic acid (OA), and mineral oil. Samples were formulated at 10, 20, and 30 wt% SEBS copolymer for each mineral oil, varying in viscosity from ~30 mPa*s to ~500 mPa*s. Uniaxial mechanical testing was performed to determine Gc, the contributions of physical crosslinks, i.e., micelles, to stress, and Ge, the contributions of chain entanglements to stress. Modeling the data from these experiments showed that Gc and Ge only varied with polymer concentration. In a separate set of experiments, Fourier Transform Infrared Spectroscopy (FTIR) was used to track the diffusion of OA out of the gel. Through modeling the release of OA with time using a Fickian diffusion model, the diffusion coefficients for formulations at varying solvent viscosities were determined. Notably, the results of the FTIR experiments conform to behavior predicted by the Stokes-Einstein equation. The results from these two sets of experiments allows for a higher degree of tunability than previously available. The results from this study will be of particular use in development of transdermal drug delivery devices.

Valerie Justice '21

Faculty Mentor: Professor Christopher Daniel, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: Department of Geology & Environmental Geosciences

U-Pb Isotope Dating of Monazite in the Sierra Estrella Mountains of Arizona: Evidence for ca. 1.4 Ga Metamorphism and Deformation

U-Pb isotope dating of monazite from the Sierra Estrella mountains near Phoenix, Arizona, yield metamorphic ages between about 1.42 and 1.40 billion years ago (b.y.a). The timing is important to determine if the metamorphic rocks formed as part of the ca. 1.45 billion year old (b.y.o.) Picuris Orogeny. Multiple samples were collected from the Sierra Estrella mountains. Four of these samples were selected for

monazite U-Pb analyses. Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS) was used to measure U-Pb isotope ratios, which was done in a lab at the University of New Brunswick. The four samples are named CD20-14b, CD20-09, CD20-07Bb, and CD20-03Ba. Concordia plots for CD20-14b yield ages of monazite growth of 1420 +/- 6 Ma (MSWD = 0.18). Concordia plots for CD20-09 yield ages of 1410 +/- 10 Ma (MSWD = 0.74). Concordia plots for CD20-07Bb yield ages of 1410 +/- 4 Ma (MSWD = 0.25). Concordia plots for CD20-03Ba yield ages of 1400 +/- 5 Ma (MSWD = 0.13). All measured ages are near concordant, with MSWD values demonstrating degree of concordance. Samples CD20-03Ba and CD20-07Bb are located in the northern part, and CD20-09 and CD20-14b are located in the southern part. Metamorphism youngs northward with ages spanning about 20 million years across the range from north to south. Our measured U-Pb ages are similar to 1424-1409 Ma ages previously reported in the northern Taos Range in New Mexico, which suggests formation during the same Picuris orogenic event (1450-1400 Ma).

Ariel Kelly '2022

Faculty Mentor: Professor Mihai Banciu, ANALYTICS & OPERATIONS MANAGEMENT
Funding Source: Program for Undergraduate Research

Does Global Trade Help or Hinder Economic Inequality?

The issue of globalization and its perceived winners and losers has recently come to the forefront of international conversation. In this project, we seek to answer the following question: has global trade helped decrease economic inequality? To address this problem, we created a tool that could be used to quantify the effect of global trade over time. Using a graph-theoretical approach, we adapt the Page Rank algorithm to account for a country's importance in the trade network when considering financial flows that go in both directions, that is, both exports and imports. We then use the relative importance scores to quantify the economic inequality by computing the Gini coefficient of the world's economy, as well as the associated Lorenz curve. By measuring the evolution of the Gini coefficient over time, we can estimate whether international trade helped or hindered addressing economic inequality among the participants in the global trade network.

Taiba Khan '22

Faculty Mentor: Professor Benowitz-Fredericks, BIOLOGY
Funding Source: Department of Biology

Relationship between aggression, body condition, and parental feeding in chicks of the seabird species Black-legged kittiwakes *(Rissa tridactyla)*

Black-legged kittiwakes, *Rissa tridactyla*, are small gulls that exhibit biparental care and typically brood 1-2 chicks. First hatched chicks (A chicks) commonly display aggressive behavior towards the second hatched chicks (B chicks), sometimes resulting in the death of the B chick. Food availability may be a driving factor of chick aggression but questions remain regarding the relationships among chick behavior, growth and parental feeding. In this study, we test three competing hypotheses: H1) Stronger chicks display more aggressive behavior to monopolize more food. H2) Weaker chicks display more aggressive behavior because they need to obtain more food. H3) There is no relationship between aggressive behavior and body condition. To test these hypotheses, we used video footage to observe the behavior of 29 five day old A chicks. At half of the nests (fed nests), parents were provided with supplemental fish, while the remaining half (unfed nests) had to rely on natural means of foraging. 'A' chick aggression towards the B chick was categorized by pecking and squeezing or twisting of the neck; an attack series with pauses of less than five seconds counted as one demonstration of aggression. If H1 is true, we will see a positive correlation between aggression and body condition, and higher aggression rates in the fed group (chicks with more food availability). If H2 is true, there will be a negative correlation between aggression and body condition, and higher aggression rates in chicks in the unfed group (chicks that are not provided with supplemental food).

Shane Kozick '23

Faculty Mentor: Dr. Vanessa Troiani, (ADMI lab director), NEUROSCIENCE
Funding Source: Summer Autism and Neurodevelopmental Disorders Internship (SANDI)

Measuring Concordance of Subtype Sulcogyral Patterns in Monozygotic and Dizygotic Twin Pairs

The brain's surface is made up of sulci (grooves) and gyri (ridges) that together create the distinct folded (sulcogryal) appearance of the brain. It is known that individual differences in the sulcogyral pattern of the orbital frontal cortex (OFC) can lead to variation in

social behaviors and psychiatric pathology. Recent research has focused on the sulcogyral folding pattern variations in individuals, specifically within the OFC. Four pattern types have been identified based on the continuity of four distinct sulci, and subtypes within each pattern type have been defined that offer more fine-grained characterization of OFC structure. To date, there have been no analyses of OFC sulcogyral patterns (or subpatterns) and genetic associations. The goal of this project is to categorize the OFC pattern subtypes of monozygotic (MZ) and dizygotic (DZ) twin pairs to explore whether the development of OFC pattern types have a strong genetic component. The study is accomplished using a publicly available structural MRI data set from the Human Connectome Project (HCP). We used neuroimaging software to individually subtype 570 subjects in the data set and we are currently investigating the association with genetics. MZ twin pairs are expected to have more similar subtypes (increased concordance) than DZ twin pairs. The results of this project will lay the groundwork as the first study of the genetics of OFC sulcogyral patterns and may contribute to the early identification of preliminary markers of brain disorders.

Klaudia Kulawska '21
Faculty Mentor: Professor Judith Grisel, PSYCHOLOGY
Funding Source: N/A

The Implications of Socioeconomic Status on Maternal Language Input and Child Language Outcomes

Early language development is associated with children's socioeconomic status (SES). Specifically, children from lower SES backgrounds, on average, exhibit slower language development compared to their peers from higher-SES backgrounds. Even though SES is a multidimensional construct, research often relies on a single dimension or a composite measure when studying child language development. In this article, I investigate four dimensions of SES, including maternal education, income-to-needs ratio, financial security, and neighborhood SES. I examine relationships amongst these different dimensions of SES, the quantity and quality of maternal linguistic input, and child receptive language skills. Mothers and their 36-40 months old children (n=267 dyads) were video recorded during a 15-minute free play session. Three measures of maternal linguistic input were derived from verbatim transcripts, including one quantitative measure (number of words spoken) and two qualitative measures (lexical diversity and syntactic complexity). Children's concurrent receptive language skills were measured by a standardized measure of children's ability to receive, process, and execute oral instructions of increasing syntactic complexity. Results revealed that maternal education was the strongest predictor of both maternal linguistic input and child receptive language outcomes. Syntactic complexity of input was the only measure that mediated the relationship between maternal education and child receptive language skills. These findings critically identify which early environmental factors are mechanistically related to SES disparities in children's language development, and provide implications for reducing these disparities.

Wutt Hmone Thin Kyi '22
Faculty Mentor: Professor Karlo Malaga, BIOMEDICAL ENGINEERING
Funding Source: Program for Undergraduate Research 2020

Effect of White Matter Stimulation on Clinical Outcomes in Thalamic Deep Brain Stimulation for Essential Tremor

Deep brain stimulation (DBS) is a surgical procedure where electrodes are implanted in the brain before stimulating the tissue with electricity. DBS of the ventral intermediate (VIM) nucleus of the thalamus and the subthalamic nucleus (STN) are established treatments for the motor symptoms of essential tremor (ET) and Parkinson's Disease (PD), respectively. Motor outcomes, such as tremor, rigidity, and bradykinesia, after VIM and STN DBS can vary considerably across patients and strongly depend on the location of stimulation relative to the surgical target. Previous research suggests that stimulation of the white matter (WM) tracts lateral to the VIM, the gray matter (GM) target, results in better DBS outcomes. The objective of this retrospective study is to determine how the spread of stimulation to WM during VIM DBS relates to therapeutic and non-therapeutic outcomes in ET patients. For the first phase of this research, a MATLAB algorithm that can differentiate brain tissues, such as WM, GM, and cerebrospinal fluid, from medical imaging based on tissue anisotropy was developed. Patient-specific tissue anisotropy was derived from diffusion tensor imaging data acquired for individual patients who received DBS (n = 22). To evaluate the performance of the algorithm, it has been trained and tested across both ET and PD patient data sets. This algorithm can be used to differentiate brain tissues in any region of interest. The modeling framework utilized in this study could be used to identify optimal stimulation sites on an individual basis, thereby improving clinical outcomes.

April Hurlock ’23

Faculty Mentor: Professor Douglas Collins, CHEMISTRY
Funding Source: STEM Scholars; Alfred P. Sloan Foundation - Chemistry of Indoor Environments

Effect of Self-Oxidation on Deposited Cigarette Smoke Composition and Third-Hand Smoke

While the implications of first-hand and second-hand tobacco smoke have been thoroughly studied, much less is known about the effects of so-called “Third-Hand Smoke” (THS) on the environment and human health. THS is a collection of chemicals from cigarette smoke that adhere to indoor surfaces (e.g., walls, flooring, furniture, clothing) and extend the exposure risks for bystanders. As THS chemicals stay on surfaces for long periods of time, we hypothesize that reactions between chemicals within the deposited THS film, with previously deposited materials, and with the surface itself may be occurring. In this study, the mechanisms and rates of the former two categories of reactions were probed. Cigarette smoke was collected on glass surfaces and incubated under fluorescent lighting for various periods of time, revealing changes in the chemical composition. The rates of chemical removal and product formation were determined. Notably, experimental data has indicated a decrease in nicotine concentrations and an increase in nicotine oxide concentrations over time, signifying that nicotine was removed by oxidation reactions occurring within THS films. Further experiments were conducted in which cigarette smoke was collected on glass surfaces that were pre-coated with chemical scavengers to help identify oxidant species that affect the composition of THS films. Future studies will look to include a variety of deposited films, different reactive substrate materials, and other environmental factors in order to obtain a better understanding about what goes on after the cigarette goes out.

Lainey Lavelle ’22

Faculty Mentor: Professor Lara Dick, MATHEMATICS
Funding Source: James L.D. and Rebecca Roser Research Fund

A Study of Teacherpreneurs Who Create Elementary Mathematics Curricular Resources

Online teacherpreneurs are teachers who use social media platforms to create, sell, and distribute educational resources to others. For many teachers, they have become the new curriculum developers in our virtually intensive world, but little is known about these teacherpreneurs. Therefore, as part of a larger study investigating the top 1000 elementary mathematics educational resources found on TeachersPayTeachers.com (TpT), I have sought to learn more about the teacherpreneurs who created these top resources. From their TpT pages, I have recorded each teacherpreneur’s teaching experiences, their educational background, what state or country they are from, the number of followers they have and how they market their resources. I compare this information to the number of their resources that are in the top 1000 and if they charge for these resources or not. Preliminary results show most teacherpreneurs have previous teaching experience with 17% reporting more than 20 years of teaching experience. The average number of followers for these teacherpreneurs is 17,721 with 50% having more than 20,0000 followers; this points to the popularity of these teacherpreneurs and leads to questions about how they promote themselves on social media. This question as well as further information related to additional teacherpreneur demographics and whether or not teacherpreneurs charge for these resources will be shared at the symposium.

Camillo Lazarczyk and Simon Behr ’21

Faculty Mentor: Professor Vivienne Wildes, MANAGEMENT
Funding Source: Senior Design and Research Sponsorship; Conducted within a class for the College of Management using Qualtrics and with the support of Vivienne Wildes of the College of Management, and Agnes Jasinska of Bertrand Library’s Research Help

Reducing Food Waste In The Restaurant Industry

Problem Statement: The US wastes nearly 40% of our food, creating 125-160 billion pounds of waste annually, leading to high emission rates, resource depletion, and food insecurity. Research Question: What are the most effective waste mitigation and management strategies in the restaurant industry that could be utilized to produce a more sustainable environment? A survey administered on campus to classmates to investigate habits, behaviors, knowledge, and potential solutions around food waste yielded significant differences in how much of a meal was thrown out between fast food restaurants, full service restaurants, and buffets. While 25% of respondents throw out 11% or more of their meal at fast food restaurants, the amount of respondents throwing out 11% or more of their meal swells to 37% at full service restaurants. Asked why they throw this food out common responses included: Too large portions, ordering too much, inconsistent appetite, and leftovers brought home being thrown out. Unlike at fast food restaurants, multiple sizes of

portions often do not exist at full service restaurants. Males said the portion size of their meal correlated to their appetite 69% of the time but females said the correlation only occurred 57% of the time. 92% of respondents said they were at least somewhat likely to purchase a smaller portion for less cost. Meanwhile, 55% of respondents are somewhat likely to order smaller food portions for the identical price of the larger meal. Therefor in order to reduce food waste we propose implementing multiple portion options at restaurants.

Jaden Lee '22
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: John P and Mary Jane Swanson Professorship in Engineering & the Sciences

Using Finite Element Modeling to Investigate the Effect of Mechanical Loading on Muscle Extracellular Matrix Microstructure

Clinical treatments for muscle conditions such as muscle atrophy and cerebral palsy require an understanding of the mechanical properties of the impaired tissue. The extracellular matrix (ECM) is a collagen-based, honeycomb-like structure present throughout muscle tissue that greatly influences muscle stiffness. Although many studies have investigated the mechanical properties of muscle tissue and the ECM, there is scarce literature on the effect of different loading conditions on the functionality of the ECM. The goal of this study is to develop a finite element model of a muscle fascicle unit in order to understand how muscle stiffness may be dictated by the ECM. We hypothesize that the geometric parameters and material properties of the ECM such as thickness, fiber alignment, and hyperelasticity impact the mechanical properties of muscle tissue subject to various mechanical loading conditions. A transversely uniform representative volume element of muscle tissue was developed in Solidworks using a Voronoi-based cross-section. The model was discretized into tetrahedral finite elements using an open-source meshing package. Using FEBio, we will simulate the effects of uniaxial and biaxial stretching on the element with variations in ECM geometric and material properties. This theoretical model will then be used to link tissue-level mechanical function (stiffness) to tissue microstructure, thus providing insight into how impaired muscle may differ mechanically and structurally from healthy muscle.

Kaelyn Long '21
Faculty Mentor: Professor Lara Dick, EDUCATION; MATHEMATICS
Funding Source: Research was for course credit

My Experiences Re-immersing into "Introduction to Mathematical Thought"

Throughout college, most students only have the opportunity to engage with course material once. As a senior, this past fall semester I had the opportunity to work with Dr. Lara Dick as a teacher assistant for the same elementary mathematics course I took my sophomore year. The ultimate goal was to re-immerse myself in both the math content and how children learn math concepts through the lens of a second-time learner, an observer, and a future elementary teacher. When attending classes, I learned both new and old concepts, formed new realizations about those concepts, and noted current students' struggles. In this poster, I share the methodology of conducting my self-study, the sub-categories that developed as a result of analyzing brain dumps I took after each class, and discuss how I will apply this experience to my future as an educator.

Catherine MacKay and Brooke Echnat '21
Faculty Mentor: Professor Anjalee Hutchinson; Professor Bryan Vandevender, THEATRE & DANCE
Funding Source: Bucknell Department of Theatre & Dance

The Show Must Go On!

The Theatre & Dance Department periodically awards the honor of an Individual Production Project to seniors who have demonstrated advanced work and a deep commitment to an area of theatre production. This project allows students to assume a leadership role for a mainstage production under the supervision of a faculty advisor. Brooke Echnat and Catherine MacKay were awarded Individual Production Projects to serve as the Director and Dramaturg for Bliss (or Emily Post is Dead) by Jami Brandli.

Bliss follows the Ancient Greek characters Medea, Clytemnestra, Antigone, and Cassandra, now pill-popping housewives, in 1960s NJ. Cassandra, a black woman, is gifted with the art of prophecy but cursed by Apollo that no one will believe her visions. She seeks to prove these women can have control over their lives in this modern era. Can we reclaim our fates or are our fates predetermined by societal structures set in place?

As Director, Brooke engaged in various mediums and methodologies as she navigated directing in a pandemic. She utilized both virtual and in-person rehearsal processes. Along with the efforts of her cast,

crew, and collaborators, she was able to create a piece of theatre at a time when many theaters in our country are still shutdown.

As the Dramaturg, Catherine researched many topics related to the play such as Greek Mythology and Emily Post's Etiquette to help the production team and actors better understand the world of the play. Catherine's research provided foundational material that informed the creative decisions of the play.

Margaret Anne MacNeille '21

Faculty Mentor: Professor Lara Dick, MATHEMATICS
Funding Source: Helen E. Royer Undergraduate Research Fund

What's Out There? Investigating Online Teacher Created Activities

Despite the popularity of online teacher-created resource-sharing sites, little is known about the scope and quality of elementary mathematics activities from these sites. Our research specifically focuses on Teachers Pay Teachers (TpT), a rapidly growing educator resource site where teachers can create and sell their own content to other teachers without the process of peer review. This leads to the question, are these high-quality activities?

To answer this question, we downloaded the top 500 free and top 500 less than $5 mathematics activities from TpT. Our findings are separated into two grade bands: K-2 and 3-5. Given the difference in learning styles for the two grade bands, we deemed it very necessary to look at the data in separate groups. We coded each activity for its intended grade level(s), Common Core domain(s), picture type (Brändström 2005), and level of cognitive demand (Smith and Stein 1998). Broadly speaking, our findings revealed a high dependency on price dictating the quality of the activity. We also saw finding quality activities for grades 3-5 is a very difficult task, unless money was involved. This poses a further question, is the marketing and potential payout putting children's learning in the shadows?

Brändström, Anna. 2005. "Differentiated Tasks in Mathematics Textbooks an Analysis of the Levels of Difficulty."; Dissertation. Lulea University of Technology.
Smith, Margaret S, and Mary Kay Stein. 1998. "Selecting and Creating Mathematical Tasks: From Research to Practice."; "Mathematics Teaching in the Middle School 3 (5): 344-50.

Claire Marino '23

Faculty Mentors: Professor Christopher Martine; Dr. Tanisha Williams, BIOLOGY
Funding Source: David Burpee Endowment; Department of Biology

Solanum "Deaf Adder" a New Bush Tomato Species from the Australian Monsoon Tropics

Australia is a unique island continent with many endemic species. Ongoing research and estimates suggest that over 70% of the flora and fauna have yet to be described across the continent. We are currently investigating one such potential new species currently known to field botanists as Solanum "Deaf Adder", which is named for its only known location in the remote Deaf Adder Gorge within Kakadu National Park. It is currently designated as a localized variant of Solanum asymmetriphyllum, and is a close relative to Solanum sejunctum. However, based on the numerous morphological differences between these three solanums, as well as their geographical separation within the national park, it is more than likely that "Deaf Adder" is a distinct and separate species. More than 30 morphological characters were measured on a greenhouse-grown female "Deaf Adder" specimen, including leaf length, prickle density of the calyces, and seed count per fruit, and then used to document the differences among "Deaf Adder", S. asymmetriphyllum, and S. sejunctum. Future research for this project will include using ImageJ to gather more information and measurements such as leaf area, and conducting data analyses between "Deaf Adder", S. asymmetriphyllum, and S. sejunctum, which will include principal components analyses (PCA), analyses of variance (ANOVA), and post-hoc testing. The objective of this research is to determine if Solanum "Deaf Adder" is its own species, and if so, to describe and name "Deaf Adder" in order to introduce it to the scientific community and to protect it.

Thomas Matsumura '22

Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: Bucknell-Geisinger Research Initiative

Measuring Lower Limb Muscle Activity and Kinematics in Variable Foot Strike Gaits

Anterior knee pain affects roughly 23% of adults and 29% of adolescents, and many cases go untreated. Joint pain is a complex condition, but is influenced by morphology, kinematics (motion), and joint load imbalances, which are driven by muscle forces. To develop a better understanding of the interactions between kinematics and muscle activity patterns, non-invasive surface EMG sensors will be used on the

lower limbs of pain-free subjects to measure muscle activation during different activities and gait patterns, including normal walking, toe-in/toe-out walking, and box jumps. Sensors are placed on the subject's knee extensor muscles, hamstrings, dorsiflexors, and plantar flexors, which are the muscle groups that are most associated with knee loads. Data processing includes rectification, smoothing, and statistical analysis between different activities. Comparing these data will allow us to determine activities that lead to changes in surface EMG signals, and thus muscle forces, and how these changes may affect knee joint loads. We will then examine how those with no history of patellofemoral pain and those with a history of pain differ in muscle activation patterns. We hope that the data collected and subsequent analysis can help us determine how joint loads may be reduced in subjects with anterior knee pain may be reduced by gait retraining, physical therapy, or surgical interventions.

John Mirsky '23

Faculty Mentor: Professor David Rojas, LATIN AMERICAN STUDIES; SOCIOLOGY & ANTHROPOLOGY
Funding Source: Douglas K. Candland Undergraduate Research Fund; Presidential Fellowship

Housing Illness in a PA Mushroom Town

The relatively small PA borough of Kennett Square produces half of the fresh mushrooms for the entire United States. To accomplish this feat, the community relies predominantly on a Latinx immigrant workforce. In order to accommodate this labor source, the local government produced housing in the 1960s. Yet, due to health concerns surrounding abhorrent conditions (such as rodent infestation, gaps in walls and rooves, and exposed electrical wiring) the government-provided establishments were discontinued by law in the 1980s. Forty years later, this project investigates how non-government organizational workers in Kennett Square, PA perceive the current relationship between housing and health outcomes among Latinx community members under coronavirus conditions. The project consists of 21 semi-structured interviews with high and mid-level workers at non-governmental organizations (NGOs) that specialize in issues of immigrant health and housing. Through transcribing and coding the interviews with the software Atlas.ti, data revealed that my interlocutors believe that the Latinx population in Kennett Square suffers housing-related health outcomes due to low educational levels, relatively low income, and both explicit and structural racist elements. These findings approach a more thorough understanding of housing and health-related issues among the Latinx population in Kennett Square and highlight future areas of scholarship surrounding the region.

Philip Onffroy '22

Faculty Mentor: Professor Katsuyuki Wakabayashi, CHEMICAL ENGINEERING
Funding Source: College of Engineering; Presidential Fellowshi

Ray'cycle Initiative: Characterizing and Productizing Community-Sourced Plastic Waste

Certain everyday plastic waste products ranging from grocery bags to bottle caps and single-use coffee pods cannot typically be recycled in the United States due to municipality and recycling plant regulations. Driven partially by the COVID-19 pandemic, this campus sustainability initiative establishes a new community means of collecting plastic waste materials and reprocessing them into products in an innovative fashion. Post-consumer plastics made of high-density polyethylene (HDPE), low-density polyethylene (LDPE), and polypropylene (PP) are processed using the novel solid-state/melt extrusion (SSME) technique, which has previously been proven to compatibilize polymer blends and commingled plastic waste. Post-consumer plastic materials are often contaminated, non-uniform, and therefore lower quality than virgin plastics. However, SSME has the potential to yield recycled plastic materials with properties comparable to relevant virgin plastic pellets. The mechanical properties of these recycled HDPE, LDPE, and PP materials are measured by way of tensile testing and thermal characterization, such as thermogravimetric analysis and differential scanning calorimetry, and are benchmarked against as-received plastics as well as virgin analogs. Additionally, these community-sourced plastic materials are made into useable tools and memorabilia through injection molding as a sustainable end-use for the polymer material. This project showcases the actual recyclability of "difficult-to-recycle" plastic waste products while also making a broader impact on the local community through plastics recycling education and public sustainability awareness.

Anthony Orlando '24

Faculty Mentor: Professor Kenneth Mineart, CHEMICAL ENGINEERING
Funding Source: Presidential Fellowship

Mechanical Testing of Wax-based Polymer Gels

Wax-based polymer gels have the potential to vastly improve the shelf life of transdermal drug patches. It can be reasoned, and addressed with future testing, that diffusivity of wax-based gels in the solid wax phase is relatively negligible and only becomes significant once the material transitions to the gel phase. The gel phase

of this type of material is comparable to amorphous mineral oil-based gels. If the melting point of the wax-based gels is constrained between human body temperature and room temperature, diffusion of the payload in gels can be controlled to only occur when the patch is in contact with the human skin. Our first step in studying wax-based polymer gels is their mechanical behavior. Testing of both the solid wax and gel phases of the wax-based gels will provide foundational physical properties of the gels and aid in moving them towards application in the medical industry.

Nicholas Passantino '21
Faculty Mentor: Professor Joshua Stough, COMPUTER SCIENCE
Funding Source: Presidential Fellowship

Domain Adaptation in Machine Learning for Medical Imaging

Machine learning models do well in learning to classify images, but can undesirably learn features unique to the specific dataset they were trained on, and not to the desired content of the images themselves. In my work, I use various machine learning techniques to develop models that learn domain-invariant features between two popular datasets in medical imaging. These models take in images of the heart created via echocardiogram, and output a segmentation of the images into the different components of the human heart. The desired end-goal is to increase the model's accuracy on the secondary dataset while minimizing the decrease in accuracy on the initial dataset.

Lucas Rankin, Graduate Student
Faculty Mentor: Professor Kenneth Mineart, CHEMICAL ENGINEERING
Funding Source: National Science Foundation Grant (NSF)

Establishing the Independent Tunability of the Mechanical and Transport Properties of Polymer Gels

Polymer gels can be used to fabricate materials for filtering liquid and gaseous media, solid-state electrolytes, and transdermal medical patches. This diverse range of applications primarily relies on the transport and mechanical properties of polymer gels. Both sets of properties have shown excellent tunability, but typically in a coupled fashion. Establishing the independent tunability of the transport and mechanical properties of polymer gels (using simple, cost-effective methods) is paramount if polymer gels are to be used to their full potential. Specifically, block copolymer gels self-assemble into organized nanoscale networks within the gel solvent, which allows for facile control of material properties. Mechanical properties can be tuned by altering gel network connectivity, which does not have an effect on solute transport rate. Solute transport rate is affected by polymer concentration and solvent choice. Two formulation methods were used in this work to independently tune the mechanical and transport properties of block copolymer gels. Gel mechanical behavior was tuned independently of solute transport rate via exchanging triblock and diblock copolymers (to change network connectivity) at constant polymer concentration. Solute transport rate was tuned independently of mechanical behavior by editing solvent viscosity.

Coco Sachs '21 and Lily Shorney '22
Faculty Mentor: Professor Chris Boyatzis, PSYCHOLOGY
Funding Source: N/A

The Psychological Impact of COVID-19 and Social Distancing

During the period of March to August of 2020, college students across the country were asked to stay in place due to the COVID-19 pandemic. This unprecedented era of social distancing and sheltering in place presents the unique opportunity to explore how college students coped and fared psychologically. In 2021, Browning et. al assessed students from seven US universities and found high psychological impact due to sheltering in place, specifically for students who identified as female, people of color, and low income. Through a virtual MTurk survey administered to first-year Bucknell students in the fall of 2020, we intended to examine differences in students' reactions to and experiences in this quarantine period. This sample included 120 first-year Bucknell students, 70% female. Subject variables included family background, personality, and the perceived support felt by the student within their quarantine environment. Participants completed survey measures on some key outcomes such as parental relationships, loneliness, eating habits, and body image. We are beginning our data analyses and will conduct correlations and multiple regressions to learn which subject and home environment best predicted student outcomes. We hypothesize that students experienced significant psychological impacts, especially those already belonging to marginalized groups.

Jake Schaefer '24

Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: John P and Mary Jane Swanson Professorship in Engineering & the Sciences

The Mechanical Properties of Ramming Animal Horn Shapes

One of the most common, yet very dangerous, injuries in the world of sports are concussions, which are caused by brain cavity accelerations. Concussions can lead to serious health conditions such as Chronic Traumatic Encephalopathy or CTE, which is a degenerative brain disease that can be fatal. Unlike humans, male Bighorn Sheep are capable of, and frequently do, ram heads at high velocities repeatedly without exhibiting clear signs of CTE. It is apparent that the biomechanical structure and function of their skull and horns play an important role in ramming and possible prevention of CTE. It has been shown in previous studies that after impact, oscillations of the horns could dissipate kinetic energy and reduce brain cavity accelerations. As a result, it is hypothesized that the unique shape of the horns could be a contributing factor to this energy dissipation. In order to test this hypothesis, a drop test will be conducted with a loaded container. On it will be attached ram horn shapes as well as miscellaneous shapes. It is expected that when the horn models are attached to the cylinder, the max acceleration on the container will be less than when the other shapes are attached. Based on the findings, the efficacy of bighorn sheep-like horn shapes as a possible energy dissipating structure will be determined. If it is seen to be effective, such structures could lead to designs that will reduce accelerations due to impact in many cases, such as automotives, sports, and construction.

Bryan Scutari '23

Faculty Mentor: Professor Tom Geurts, ACCOUNTING & FINANCIAL MANAGEMENT
Funding Source: IMA Research Foundation

The Financial Impact of an ISO14001 Certification

It is of great importance that we further the knowledge about the financial impact of ISO14001 as numerous companies have carried out this certification in recent years. Because of this demand, we will provide a quintessential example that exemplifies the ISO14001 certification on financial metrics. We will be using return on assets and total assets to find company pairings that best show how the ISO14001 certification impacts from company to company. Finding these pairs can often be a struggle, as once we find a company that is ISO14001 certified, the SIC code should have the first two digits that are the same and the company should match an ROA of 90-110% and total assets of 70-113%. The data for these financial metrics are then pulled using EDGAR or Bloomberg for the two years before a company has been certified as the certification process takes about two years to be complete and that given year will be used to find other company pairings. The outcome will be to find same-industry company pairs that have been compiled through a literature review to compare financial metrics on a firm that have implemented ISO14401 and ones that have not yet achieved ISO14001 certification through a non-parametric test.

Julia Tokish '22

Faculty Mentor: Professor Meenakshi Ponnuswami, ENGLISH
Funding Source: Presidential Fellowship

Uncovering South Asian-American Playwrights

Mainstream American theatre is consumed by significant, but often ignored, issues of diversity. White male playwrights, for instance, dominate Broadway and the American theatre industry at large. Consequently, South Asian-American playwrights, especially women, achieve limited recognition and success. My research, in collaboration with Dr. Meenakshi Ponnuswami, spotlights first- and second-generation immigrant playwrights of South Asian descent in order to combat this injustice.

To uncover these largely unknown and unpublished playwrights, I scour old databases and community theatre websites for limited and scattered knowledge. I collate this dispersed information on the playwrights as well as details on their plays and productions, including their date, director, and location. Through this in-depth research, to date I have collected information on 48 playwrights and over 75 plays.

We are still in the midst of this project, but in the future we intend to create a searchable database of South Asian-American playwrights and their achievements. Furthermore, we plan to select a number of these plays, workshop them with the playwright, and publish their work in an anthology of South Asian-American theatre. With this work, we intend to bring these underrepresented artists the recognition and appreciation they justly deserve.

Tung Tran '23
Faculty Mentor: Professor Joshua Stough, COMPUTER SCIENCE
Funding Source: HTIP

Bayesian Optimization for 2D Echocardiography Segmentation

Bayesian Optimization (BO) is a well-studied hyperparameter tuning technique that is more efficient than grid search for high-cost, high-parameter machine learning problems. Echocardiography is an ubiquitous modality for evaluating heart structure and function in cardiology. In this work, we use BO to optimize the architectural and training-related hyperparameters of a previously published deep fully convolutional neural network model for multi-structure segmentation in echocardiography. In a fair comparison, the resulting model outperforms this recent state-of-the-art on the annotated CAMUS dataset in both apical two- and four-chamber echo views. We report mean Dice overlaps of 0.95, 0.96, and 0.93 on left ventricular (LV) endocardium, LV epicardium, and left atrium respectively. We also observe significant improvement in derived clinical indices, including smaller median absolute errors for LV end-diastolic volume (4.9mL vs. 6.7), end-systolic volume (3.1mL vs. 5.2), and ejection fraction (2.6% vs. 3.7); and much tighter limits of agreement, which were already within inter-rater variability for non-contrast echo. These results demonstrate the benefits of BO for echocardiography segmentation over a recent state-of-the-art framework, although validation using large-scale independent clinical data is required.

Ben Travis '22
Faculty Mentor: Professor Mark Haussmann; Dr. James Greenberg, BIOLOGY; Chief of Gynecology, Brigham and Women's Faulkner Hospital - Associate Professor, Harvard Medical School
Funding Source: Bucknell Public Interest Program Fund

A Comparison of Estimated and Quantitative Blood Loss in Childbirth, and Investigation of Risk Factors for Postpartum Hemorrhages

Blood loss is a major source of severe maternal morbidity and mortality during childbirth. In this retrospective chart review, we examined 22,000 deliveries at a tertiary care center in Boston to investigate methods used to measure blood loss and define the factors that contribute to the risk of a postpartum hemorrhage. First, when comparing visually estimated blood loss records to more accurate, technologically quantified blood loss records, our results found that physicians overestimate blood loss of cesarean deliveries, and underestimate blood loss of vaginal deliveries to a statistically significant degree. We identified quantitative measurements as a better guide for determining when hemorrhage interventions are necessary, and strictly utilized blood loss records obtained with this methodology for subsequent investigations. Continuing to examine maternal blood loss in childbirth, we found that in a mother's first childbirth, severity of laceration, birthweight, and length of 2nd and 3rd stages of labor are all associated with larger blood loss and likelihood of postpartum hemorrhage. Analysis of full-term vaginal deliveries showed that blood loss increased with each additional minute of the 3rd stage of labor, year of maternal age, and in vaginal births after prior cesarean section delivery, while women with previous vaginal births experienced less blood loss.

Emily Tully '21
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: Engineering Data Generation Grant

Location Dependent Mechanical Behavior of Aponeurosis Tissue Under Uniaxial Tensile Stretch

Aponeurosis is a connective tissue that serves as an extension of tendon, attaching to muscle fibers that do not fully extend to the tendon. The material properties of aponeurosis (and thus its mechanical function in the body) are poorly understood. The goal of this work was to perform uniaxial tensile testing to measure the mechanical response of aponeurosis tissue as a function of thickness and location from tendon to muscle. Ten samples measuring ~60mm by 10mm were cut with tissue fibers running lengthwise, and the thickness was measured every 5mm. Uniaxial tensile testing was completed on a custom planar biaxial material testing system with digital image correlation (DIC) to track sample strain. The average nominal (engineering) stress and Lagrange strain values were determined for two regions: the thinner section that connects to muscle fibers and the thicker section that connects to the tendon tissue. Linearized moduli were determined at each time point by dividing nominal stress by Lagrange strain. Paired t-tests ($p<0.05$) were performed on the Lagrange strain and linearized moduli at each time point. Statistical results indicated that there is no significant difference in the strain of an aponeurosis sample at different thicknesses, but that under greater tensile loads, aponeurosis may exhibit higher moduli corresponding to thinner sections. These results show the material properties of aponeurosis tissue are inhomogeneous and can be used to develop more accurate simulations of muscle-tendon unit mechanical function. Such simulations provide necessary insight

into how healthy versus impaired muscle drives the movement of vertebrates.

Anurag Vaidya '21
Faculty Mentor: Professor Joshua Stough;Professor Benjamin Wheatley, COMPUTER SCIENCE; MECHANICAL ENGINEERING
Funding Source: Presidential Fellowship

Perceptually Improved Medical Image Translations Using Conditional Generative Adversarial Networks

Magnetic resonance imaging (MRI) can help visualize various brain regions. Typical MRI sequences consists of T1-weighted sequence (favorable for observing large brain structures), T2-weighted sequence (useful for pathology), and T2-FLAIR scan (useful for pathology with suppression of signal from water). While these different scans provide complementary information, acquiring them leads to acquisition times of ~1 hour and average cost of $2,600 present significant barriers. To reduce these costs associated with brain MRIs, we present pTransGAN, a generative adversarial network capable of translating both healthy and unhealthy T1 scans into T2 scans. We show that the addition of non-adversarial perceptual losses, like style and content loss, improves the translations, especially making the generated images sharper. In previous studies, separate models have been created for healthy and unhealthy brain MRI. However, in a real world clinical setting, choosing between different models can become cumbersome for a medical professional. Moreover, we show that when pTransGAN is only trained on healthy data, it performs poorly on unhealthy data (and vice-versa). Thus, in this study, we also present a novel simultaneous training protocol that allows pTransGAN to concurrently train on healthy and unhealthy data. As measured by novel metrics that closely match perceptual similarity for a human observer, our simultaneously trained pTransGAN model outperforms the models individually trained on just healthy and unhealthy data as well as previous literature models. Thus, in this study we present a perceptually improved algorithm to translate both healthy and unhealthy T1 brain MRI into their corresponding T2 scans.

Ruoying Zhang '21
Faculty Mentor: Professor Jasmine Mena, PSYCHOLOGY
Funding Source: Program for Undergraduate Research

Chinese International Students in the US: The Influence of Discrimination, Acculturation and Coping on Psychological Wellbeing

Chinese international students have been reported to experience psychological distress, help-seeking stigma, language-based discrimination, and acculturative stress. With the increasing number of international students in the United States, the focus on their mental health is never greater. This study aims to investigate the influence of discrimination, acculturation and coping strategies on Chinese international students' psychological wellbeing. A survey was conducted via Qualtrics, which included 20 demographic questions and five measures. Participants who agreed to participate, were directed to the online survey. In addition to demographic questions, participants completed DASS-21 (Lovibond & Lovibond, 1995), College Students Stress Scale-Modified (Feldt, 2008), Perceived Ethnic Discrimination Questionnaire (Brondolo et al., 2005), The Suinn-Lew Asian Self Identity Acculturation (Suinn et al., 1992) and Coping Strategy Indicator (Desmond et al., 2006). From the preliminary data analysis, we can see that perceived discrimination influenced Chinese international students' psychological distress; that participants who scored higher in perceived discrimination also scored higher in general psychological distress. Ultimately, the pattern that was most apparent is that the college student stress associated with being othered seemed to be scored most highly and appears to be contributing to psychological distress. Problem solving is a beneficial coping resource if students have access to information and resources. However, problem solving is insufficient when stress escalates to psychological distress.

Diamanda Zizis '23
Faculty Mentor: Professor Christopher Martine, BIOLOGY
Funding Source: David Burpee Endowment; Presidential Fellowship

What Happens When you Cross Plant Species with Two Distinct Sexual Systems?: An Ex Situ Hybridization Approach

The transitions from the hermaphroditic sexual system to the andromonoecious and dioecious sexual systems have been an area of intrigue in biology since Darwin's time. While the vast majority of Angiosperms display the hermaphroditic sexual system, both dioecy and andromonoecy are observed in Australian Solanum,

in addition to hermaphroditism. Australian Solanum are therefore particularly useful for understanding the evolution of these sexual systems. Hybrid offspring of Solanum dioicum (dioecious) and Solanum ultraspinosum (andromonoecious) crosses were used to study hybridization boundaries within the two different sexual systems. Our main goal was to understand how the differing sexual systems manifest in hybrids, especially relative to their role as the pollen donor and pollen recipient. Morphometric analyses currently indicate that the pollen recipient exhibits the greatest influence on morphology in the F1 generation. In hybrids with S. ultraspinosum acting as the pollen donor, the andromonoecious breeding system manifested, indicated most importantly by the architecture of the inflorescence and the absence of inaperturate pollen in hermaphroditic flowers. The F1 generation was unsuccessful with S. dioicum acting as the pollen recipient. With the F1 generation appearing so similar to the pollen recipient, it is not yet possible to recognize early-generation hybrids, although hybridization is occurring. We are currently continuing crosses between the F1 generation hybrids to observe whether the pollen donor may have effects on hybrids in less immediate generations, particularly looking for whether inaperturate pollen will manifest, indicating changes in the sexual system incurred from the pollen donor.

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