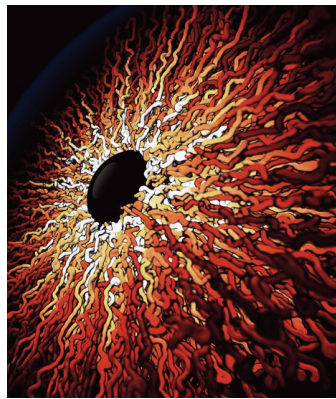
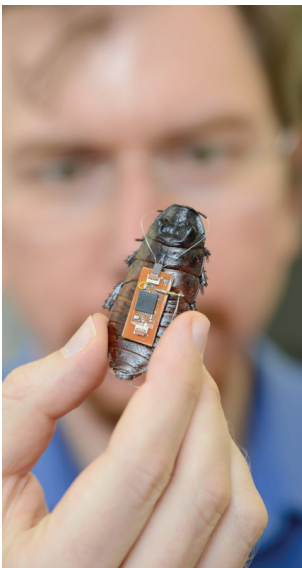


19th Annual

# Graduate Student Research Symposium | Abstracts



Wed. April  
8, 2026

*McKimmon  
Center*



19th Annual  
Graduate Student Research Symposium  
North Carolina State University

**ORGANIZERS OF SYMPOSIUM**

**Graduate School**

Dr. David Shafer – Assistant Dean (Primary Organizer and Symposium Lead)  
Bridget Foy – Administrative Assistant  
Gregory Hedgepeth – Director of Marketing and Communications  
Todd Marcks – Fellowship and Grants Administrator  
Darren White – Webmaster

**Graduate Student Association**

Harshit Bhatt – Mathematics (GSA VP for Academic Affairs/Symposium Lead)  
Tim Boston – Animal Science  
Jackson Cooper – Plant Pathology  
Ryden Crowther – Chemical and Biomolecular Engineering  
Helen Paola Velasquez Duron – Biological and Agricultural Engineering  
Kate Everly – Bioinformatics  
Jared Franges – Biology  
Md Rabiul Hasan – Industrial and Systems Engineering  
Yujin Kim – Design  
Austyn Kobs – English  
Ayush Kohade – Engineering Management  
Liz Kreick – Horticultural Science  
Shourya Nanda Kumar – Civil and Environmental Engineering  
Aeron McConnell – Physics  
Jacob Norman – Operations Research  
Melika Osareh – Biomedical Engineering  
Taft Stevens – Physiology

**Abstract Book Cover**

Lea Klissouras - Electrical Engineering

## AGENDA

- 12 - 1 p.m.            Poster Set Up (All set up their posters)..... Area 1
- 1:15 - 1:30 p.m.    Welcoming Remarks and Symposium Overview ..... Area 1  
Mr. Shubham Rawat, GSA President  
Dr. Peter Harries, Dean of the Graduate School  
Dr. David Shafer, Assistant Dean of the Graduate School
- 1:30 - 4 p.m.        Poster Session and Competition ..... Area 1
- 4:15 - 5:30 p.m.    Announcements of Awards and Reception ..... Room 2  
Dr. Peter Harries, Dean of the Graduate School  
Mr. Shubham Rawat, GSA President  
Dr. David Shafer, Assistant Dean of the Graduate School

## TABLE OF CONTENTS

### College of Agriculture and Life Sciences

Jarin R. Arline .....	6
Talha Ashraf .....	7
Amelia Brady .....	8
Rebekah Brown .....	8
Emma Coogan .....	9
Jackson Cooper.....	10
Kara Credle .....	10
Rachel Dykes.....	11
Greg Ferraro .....	11
Jade Fluharty .....	12
Ashlee George .....	12
Kai J. Goble .....	13
Kendall Godwin .....	14
Kashish Grover.....	15
Ajah Haskell .....	15
Sofia Jauregui .....	16
Alena P. Jones .....	16
Samantha C. Kisthardt.....	17
Jenna Kraemer.....	18
Teagan Kuzniar.....	18
Jane Londoño .....	19
Thaciane Amaral.....	20
Lillian Lower .....	20
Ryan Lundquist .....	21
Jade Lyons .....	21
Holly A. McInnes.....	22
Mohammad Nooshzadi Motlagh.....	22
Christopher C. Oates .....	23
Rekha Pandey .....	24
Alden Sears.....	24
Skye Sgouridis.....	25
Kaira Sidhwa .....	26
Madison Lawson Sullivan .....	27
Kairi Tanaka .....	28
Noah Totslin.....	29
Asher Utz .....	29
Katie Vollen.....	30
Muhammad Wajeel Ul Hassan .....	30
M.C. Williams .....	31
Seung Hyun Yoo.....	32

### College of Design

Raja Manikam Bandari .....	33
Kimaya Chougule.....	34
Heather Hennessey .....	34
Seungmin Lee .....	35
Rosa McDonald .....	35
Grace McNabb.....	36
Colin McNeill .....	36
Christopher E. Mismash .....	37
Ijeoma Njaka.....	37
Cornelius Ojo.....	38

Laura Próspero .....	38
Aisha Raja .....	39
Tess Stogner .....	39
Qionglan Wang .....	40
Caleb Zander .....	40
Chengchen Zhang .....	41

### **College of Education**

John Hensley .....	41
Dhruva Mathur .....	42
Rachel Waltz .....	42

### **College of Engineering**

Paul Acuña .....	43
Muhammed Ziauddin Ahmad Ebrahim .....	44
Ali Akbari .....	45
Omar Alsaeed .....	46
Hari Kiran Balachandran .....	46
Vasishta Burugula .....	47
Michael Carter .....	47
John Cheadle .....	48
Peng Chen .....	48
Nisan Chhetri .....	49
Sina Dehghan-Toranposhtia .....	50
Joseph Deneke .....	50
Omar Eldaly .....	51
Katherine Eltz .....	51
Daniel Engstrom .....	52
Corey E. Febo .....	52
Vasuki Garg .....	53
Matthew Gleason .....	53
Teresa Groton .....	54
Kayla Hahn .....	54
Linda Hargrove .....	55
Mahmoud Hawary .....	55
Farhan Ishrak .....	56
Nisarg Joshi .....	56
Robert Kempin .....	57
Donghyun Ko .....	57
Aline C. K. Nascimento .....	58
Jacob Leff .....	58
Nicholas Mecham .....	59
Austin L. Mituniewicz .....	59
Tristan Mullins .....	60
Hiruni Niwunhella .....	60
Liwen Du .....	61
Regan Richardson .....	61
Fardin Saad .....	61
Sultanus Salehin .....	62
Abolfazl Shahrooei .....	62
Yousif Shwetar .....	63
Aldina Sultana .....	63
Alireza Velayati .....	64
Cormak Weeks .....	64
Ory Wickizer .....	65

Xiaoran Yang .....	65
--------------------	----

## **College of Humanities and Social Sciences**

Paul Agada .....	66
Taibat Amoke Akinsanya-Ibrahim .....	66
Talia Brenner .....	67
Karina Burbank .....	67
Reyyan Can .....	68
Lily Cavanaugh .....	68
Mahashweta Chakraborty .....	69
Alexa Clymer .....	69
April Davidson .....	70
Jenny Elander .....	70
Jaida Ellis .....	70
Syd Fryer .....	70
Naomi Garcia .....	71
Leah Harrell .....	71
Jessica F. Khan .....	72
Austyn D. Kobs .....	72
Gabrielle Lopez .....	73
Linnea Murthy .....	73
Raquel Olvera .....	74
Nell Pietri .....	75
Luke I. Priest .....	75
Jinzhe Qiao .....	76
Emily Robinson .....	76
Andrea Ryan .....	77
Elle Thigpen .....	77
Swathi Vepachedu .....	78
Kyle Walker .....	79
Madeline Wessels .....	80
Cullen Wiggins .....	81
Ann Sloan Wilson .....	81

## **College of Natural Resources**

Phoebe Anderson .....	82
Sweta Dixit .....	83
Maria Gonzalez .....	84
Ann Morgan Hawthorne .....	85
Jing Hu .....	85
Molly Irvin .....	86
Courtney L. Johnson .....	86
Taylor Kanipe .....	87
Lokesh Kumar .....	87
Sierra McMurry .....	88
Pratikshya Regmi .....	88
Mariangeles Salas .....	89
John H. Sanders .....	89
Titilayo Tajudeen .....	90
Aakash Upadhyay .....	90
Emma M. Wilson .....	91

## **College of Sciences**

Md Arifuzzaman .....	92
----------------------	----

Azka Arshad .....	92
Mehdi Ashrafganjoie .....	93
Harshit Bhatt .....	93
John Britt .....	94
Adira Cohen .....	95
Natalie Davis.....	95
Shuvrarghya Ghosh.....	96
Carter Hall .....	96
Thao “Tina” Luu.....	97
Javier I. Madariaga .....	97
Julie Matheny .....	98
Matthew Nuyten .....	98
Jisu Oh .....	99
Daniel Piasecki.....	99
Ananya Roy.....	100
Prajima Sapkota.....	100
Irene Silvernail.....	101
Abdul-Rahman Sweilam .....	101
Puja Thapa.....	102
Cristhian Valladares .....	102
Anqi Zhao .....	103
Zihao Yu .....	103

### **College of Veterinary Medicine**

Emma Atwood.....	104
Ashley E. Cave.....	105
Rahul Kumar.....	106
Juan Pesantez-Valdivieso.....	107
Aditi Vigneshwar .....	108
Elyse Wood.....	109

### **Poole College of Management**

Rui Chang .....	109
-----------------	-----

### **Wilson College of Textiles**

Avishek Das Gupta.....	110
Jessica Guadalupe Estrada.....	110
Kaleah Gaddy.....	111
Xiaorui Guo.....	111
Fatema Tuj Jahura.....	112
Mahtab Khodadadi .....	113
Dengyu Luo.....	114
Mahsa Nazem.....	115
Mohammed Kayes Patoary.....	115
Md Abul Shahid .....	116
Yiming Yuan .....	116
Lumana Shakya.....	117



# ABSTRACTS

## College of Agriculture and Life Sciences

**Jarin R. Arline**

**Graduate Program:** Plant Pathology

**Advisor:** Adrienne M. Gorny

**Poster Number:** 10

### **Getting Into Hot Water: Managing An Established Pathogen Within Sweetpotato Production Systems**

Hot water treatment (HWT) has been used for over a century to manage plant pathogens in plant parts including roots, bulbs, tubers, seeds, and rootstocks. The focus of this study was to investigate whether HWT may be suitable for treating sweetpotato storage roots to eradicate the guava root-knot nematode, *Meloidogyne enterolobii*, within the roots. *Meloidogyne enterolobii* is a virulent nematode that was identified in the U.S. in 2001 and more recently in North Carolina, the top producer of sweetpotatoes for consumption and propagation in the country. A series of experiments were conducted to evaluate combinations of temperatures (ranging from 50 to 65°C) and exposure times (ranging from 5 to 20 min), in fully crossed experiments. Three *M. enterolobii*-infected roots were used per treatment group. *Meloidogyne enterolobii*-infected roots exposed to room temperature water, and non-infected roots were used as controls. After the hot water treatment, groups of roots were air dried to cool. Effects on nematode survival were evaluated through greenhouse bioassays. Sweetpotato roots were cut into 2.5 cm pieces, then incorporated into soil placed in a pot, and a tomato bioassay plant potted. At 60 days after potting, tomato plants were destructively harvested and root gall severity rating and eggs per gram of root from the tomato were quantified. Differences among treatment groups were explored using generalized linear mixed models (GLMMs), including Poisson and Negative Binomial distributions for the egg counts, and the Beta distribution model, for gall ratings. While complete eradication of *M. enterolobii* from the roots was not observed in the experiments, decreased root galling and egg production was observed in the most intensely treated roots. Results of the study will support further investigation of non-chemical management of *M. enterolobii* in sweetpotato.

**Talha Ashraf<sup>1</sup>, Brittney Santamaria-Cortez<sup>1</sup>, Carlos Lima<sup>1</sup>, Mady Justiniano<sup>1</sup>, Allyson McCarty<sup>1</sup>, Megan Bahr<sup>1</sup>, James Clothier<sup>2</sup>, William Farmer<sup>3</sup>, Paul Gonzalez<sup>4</sup>, Ashley Robbins<sup>5</sup>, and Felipe A. C. C. Silva<sup>1</sup>**

**Graduate Programs and Institutions:** Animal Science<sup>1</sup>; Entomology and Plant Pathology<sup>2</sup>; Department of Agricultural and Biological Sciences, University of Mount Olive, Mount Olive<sup>3</sup>; Extension Agent, Agriculture-Livestock, NC Cooperative Extension Sampson County Center<sup>4</sup>; Area Specialized Agent-Dairy, NC Cooperative Extension<sup>5</sup>

**Advisor:** Felipe A. C. C. Silva

**Poster Number:** 12

## **Evaluating the Efficacy of Extension-based Artificial Insemination Training on Knowledge Gain, Satisfaction Level, and Behavioral Intent**

In cattle, artificial insemination (AI) is an effective technique to improve productivity and reproductive efficiency in cattle herds. However, only 11.6 % of the beef females are bred by artificial insemination in the United States. Thus, our goal was to train producers, extension agents, and students on AI techniques and breeding management. The outcomes of a 2-day AI training program (16 hours) on perceived knowledge gain, workshop satisfaction level, and intent to adopt the practices were measured among 82 participants (43 producers, 33 students, and 6 extension agents) using a Likert scale pre- and post-training evaluation. Participants belonged to 18 North Carolina counties and 5 universities. The topics covered bovine reproductive anatomy and physiology, AI techniques, semen handling, estrous detection, and estrous synchronization protocols. The workshop was composed of lectures and hands-on training. The GLIMMIX procedure of SAS was used to analyze the fixed effects of topic, time (pre- and post-training), and their interaction, and the random effect of participant. Overall, improvements varied across topics within participants ( $P = 0.0002$ , topic  $\times$  time), with the greatest improvement in the hands-on AI technique (Odds ratio: 186,  $P < 0.0001$ ), followed by handling AI equipment and semen (OR: 122,  $P < 0.0001$ ). The lowest improvement was regarding cattle anatomy and physiology (OR: 31,  $P < 0.0001$ ), where participants with no previous biological background still find the amount of information and the nomenclature a little daunting. The participants' confidence and knowledge about the heat detection principles and applications was significantly enhanced (OR: 41.54,  $P < 0.0001$ ), that shows a critical prerequisite for improving the reproductive management by early estrus detection and timed AI of the animals. An absolute gain was seen in participants' understanding about the estrus synchronization protocols (OR: 55.12,  $P < 0.0001$ ), that highlight a crucial step in implementing synchronization protocol and timed AI. Overall, there was a high satisfaction rate among participants, where 96.3% being very satisfied with the training quality of the workshop. Among participants, 61% were planning to develop a reproductive management program at their operation, and 23.2% already had an established breeding management program. In addition, 52% were planning to incorporate estrous synchronization and artificial insemination, and 20% were already utilizing the practice. Altogether, these results indicate that AI training effectively increased the participants' knowledge and willingness to implement assisted reproductive technologies in beef and dairy operations, ultimately encouraging the adoption of practices that improve reproductive efficiency, genetic selection, and profitability. These outcomes highlight the significance of extension-based training in bridging the gap between research and field implementation to improve reproductive efficiency and productivity in cattle herds.

**Amelia Brady**

**Graduate Program:** Horticultural Science

**Advisor:** Melinda Knuth

**Poster Number:** 18

### **Consumer Expectations and Preference for the Packaging of Muscadine Grape Hybrid Products**

Muscadines, *Vitis rotundifolia*, are fresh grapes native to the southeastern United States that offer superior disease resistance compared to common table grapes, *Vitis vinifera*. However, muscadines have thicker skins and seeds, limiting consumer appeal. Recent breeding efforts have created hybrids between *V. vinifera* and *V. rotundifolia* that combine disease resistance with desirable consumer traits like thinner skin, seedlessness, and aromatic flavor. These hybrids take a novel position in the fresh grape market, distinct from both muscadines and table grapes. Different grape varieties utilize varying packaging types, formats, and sizes which influence consumer purchasing decisions. The optimal packaging strategy for these new products remains unknown. To address this, an online survey (n = 1962) using Qualtrics assessed consumer expectations and preferences for packaging type, size, and format for the hybrid products. Consumers most commonly expected the hybrid products to be presented in plastic clamshell packaging followed by plastic bag packaging. Notably, clamshell expectations were lower for the hybrid products compared to typical muscadine purchase habits, while plastic bag expectations were lower compared to typical table grape purchase habits. Consumers also expected the hybrid product to be sold by the pound, with a preference for 2 lb quantities, consistent with table grape purchasing norms. Regarding the presentation format, a forced choice comparison revealed a majority preferring grapes off of the bunch; however when asked hypothetically about bunch packaging for muscadines, respondents leaned towards bunches, suggesting openness to novel bunch presentation if technically feasible. These findings provide producers and marketers of these hybrid grapes with guidance for optimizing product retail presentation. By aligning packaging and format with consumer expectations, growers can maximize market acceptance of these new products. This research demonstrates how consumer preference studies can inform commercialization strategies for new horticultural products, potentially accelerating market adoption and supporting their economic viability.

**Rebekah Brown**

**Graduate Program:** Food Science

**Advisor:** Jonathan Allen

**Poster Number:** 21

### **Elemental Analysis of Consumer Sweet Potato Products: Exposure Assessment and Analytical Considerations**

Sweet potatoes are the sixth most important food crop in the world, and contribute significantly to food security in developing countries. Orange-fleshed sweet potatoes are a rich source of beta-carotene and other healthy nutrients. However, as a root storage vegetable, it is at risk of contamination from pollution and heavy metal uptake under variable soil conditions. Heavy metals may affect vulnerable populations, such as children undergoing brain development, or accumulate in adult tissues, thereby contributing to chronic health conditions. With the FDA's goal of reducing dietary exposure to contaminants, we investigate whether sweet potato, as a highly nutritious root storage vegetable, poses a risk. In this study, over 100 samples of consumer-facing orange-fleshed sweet potato products were analyzed for arsenic, lead, cadmium, zinc, copper, and selenium. The samples included 30 unique food products from 5 categories across two production years. Samples were dehydrated to a constant weight using a freeze-drier before being ground to a homogenous powder. The powder was then processed using the FDA Elemental Analysis Manual 4.7 for microwave-assisted acid digestion and analyzed with Inductively Coupled Plasma Mass Spectrometry. Results showed that the majority of samples were within acceptable exposure limits for lead, cadmium, zinc, copper, and selenium, regardless of the product type. In the process, arsenic results appeared to exceed the FDA-set limits due to matrix effects and polyatomic ion formation in plasma generated from argon and chloride. This artifact was confirmed to be the cause by using a stepwise increase in sodium chloride-spiked samples. By analyzing and monitoring current levels of heavy metals in a globally significant food crop, we can understand the associated risks and identify strategies to reduce exposure, thereby protecting the health of vulnerable populations. This study also identified limitations in existing methods for arsenic determination and offers recommendations for future analyses.

**Emma Coogan<sup>1</sup>**, Julieta Sherk<sup>1</sup>, and James Clothier<sup>2</sup>

**Graduate Programs:** Horticultural Science<sup>1</sup>; Entomology and Plant Pathology<sup>2</sup>

**Advisor:** Julieta Sherk

**Poster Number:** 37

**Assessing Trade-offs Among Visual Preference, Maintenance Intensity, Pollinator Activity, and Plant Performance Across Urban Designed Herbaceous Plant Communities: Bridging ecological performance, public preference, and maintenance efficiency through evidence-based planting design**

Designed herbaceous plant communities are intentionally assembled, dynamic groupings of vegetation that co-occur along site-specific environmental gradients. These communities provide a range of ecological services, aesthetic qualities, and biodiversity support. As climate change, biodiversity loss, and resource scarcity intensify, perceptions of nature and approaches to urban greenspace management are shifting. There is a growing movement toward embracing more naturalistic plantings that reconcile ecological performance with visual and cultural expectations.

Integrating ecological function with artistic expression is widely recognized as an effective strategy for regenerating urban landscapes. However, achieving this balance presents challenges, as the criteria for success often differ between ecological objectives and human preferences. Designed herbaceous communities can deliver significant ecological benefits, yet they are not always publicly preferred and may pose management difficulties. Discussions surrounding visual appeal, maintenance intensity, pollinator support, and plant performance are often treated as separate considerations rather than interconnected factors.

This study investigates the interaction among four dimensions: visual preference, maintenance demand, pollinator activity, and plant performance to identify strategies for optimizing designed herbaceous plant communities. The goal is to inform evidence-based planting design that performs successfully in terms of ecological function, sustainable management, and human experience.

**Jackson Cooper**<sup>1</sup>, Brooklynn Newberry Joyner<sup>2</sup>, Vicki Cornish<sup>1</sup>, Mary Anna Carbone<sup>1</sup>, James B. White<sup>1</sup>, Marc A. Cubeta<sup>1</sup>, Saleh Rahimlou<sup>3</sup>, Mohammad Bahram<sup>4</sup>, Carly Scott<sup>2</sup>, Charles Mitchell<sup>2</sup>, and Ignazio Carbone<sup>1</sup>

**Graduate Programs and Institutions:** Center for Integrated Fungal Research, Entomology and Plant Pathology<sup>1</sup>; Department of Biology, University of North Carolina at Chapel Hill<sup>2</sup>; Department of Ecology and Evolutionary Biology, University of Michigan<sup>3</sup>; Department of Ecology, Swedish University of Agricultural Sciences, Uppsala, Sweden<sup>4</sup>

**Advisor:** Ignazio Carbone

**Poster Number:** 38

### **Haplotype-Resolved Genomes Reveal Diversity at the Homeodomain Mating-Type Locus in *Rhizoctonia solani* AG1-IB**

*Rhizoctonia solani* is a genetically diverse fungal species complex. Within it, *R. solani* Anastomosis Group 1-IB (AG1-IB) causes brown patch disease on cool-season grasses and other diseases of bean, lettuce, and rice. To assess the evolutionary potential and population structure of AG1-IB on tall fescue (*Festuca arundinacea*), we used ddRAD sequencing to generate over 22,000 single-nucleotide polymorphisms from 55 isolates collected across six North Carolina field plots. Population-genetic analyses identified four populations: three primarily clonal, including one smaller group showing internal subdivision, and one recombining population with evidence of admixture. Comparative genome analyses showed conservation of homology and local synteny at homeodomain (HD) mating-related loci among AG1-IB isolates, as well as with *R. solani* AG1-IA and *Coprinopsis cinerea*, a basidiomycete with a well-characterized mating system in which HD genes regulate nuclear pairing and compatibility. Within AG1-IB, isolates encoded one to four HD genes and displayed allelic variation, including a putative allelic pair at the E-HD2 locus, consistent with patterns observed for basidiomycete mating-type genes. Clonal populations showed low within-population diversity, fixed HD profiles, and strong linkage disequilibrium indicative of long-term clonal reproduction, whereas the admixed population exhibited heterogeneous HD-allele combinations and reduced linkage disequilibrium, consistent with historical or ongoing recombination mediated by mating-type HD genes. Phased assemblies show the E-HD2 alleles on distinct haplotypes in a heterokaryotic isolate, whereas consensus or primary-only assemblies typically resolve only one allele. Preliminary comparisons of primary and alternate (haplotype) assemblies suggest that rapidly evolving loci, including mating-type genes and predicted effectors, can be masked when allelic variation is collapsed in consensus genomes or when using reference-based methods that rely on a consensus genome. Together, these results show that haplotype-aware assemblies uncover otherwise masked heterokaryotic haplotype variation in AG1-IB, especially at mating-type loci that govern compatibility and influence genetic exchange and recombination across populations.

**Kara Credle**

**Graduate Program:** Nutrition

**Advisor:** April Fogleman

**Poster Number:** 39

### **“You are always enough for your baby”: A Discourse Analysis of Low Milk Supply in Breastfeeding Parents on Reddit**

Following the birth of a child, the emotional highs and lows of the newborn period are closely intertwined with the challenges of the infant feeding journey. This study examines how breastfeeding women experiencing low milk supply seek information and engage in anonymous online forums during the newborn period. With discourse analysis as a methodological framework and a Foucauldian theoretical lens, this study approaches three breastfeeding forum posts (subreddits) from Reddit.com looking for how the discourse employed constructs subjectivities. This research is done through careful, discursive reading and analysis of high-engagement Reddit forums discussing low milk supply, followed by line-by-line, inductive, thematic analysis to systematically capture what was discussed, how it was discussed, and the consequences of what was discussed. This study found that participants of breastfeeding subreddits related to low milk supply constructed their experiences with five major categories of discursive strategies: Instructive, Pumping, Emotional Support, Recognition of Low Milk Supply, and Supplementation as Inferior. These findings represent a new awareness of the psychological impact of infant feeding journeys on infant feeding discourse, an awareness that highlights a need for additional support of maternal mental health and resources to personalize infant feeding support.

**Rachel Dykes**

**Graduate Program:** Molecular and Structural Biochemistry

**Advisor:** Arion Kennedy

**Poster Number:** 47

### **Fructose Promotes ER Stress-associated Mitochondrial Dysfunction in B Cells During MASLD**

Metabolic-dysfunction associated steatotic liver disease (MASLD) affects approximately 30% of the global population, yet the mechanisms driving disease progression remain incompletely understood. Among other hepatic immune cell populations, B cells have emerged as key contributors to inflammation through antibody and proinflammatory cytokine production. However, how specific dietary components, namely fructose, affect B cell metabolism, subsets, and function in MASLD remains unclear. We observe that mice administered a chow diet with fructose supplemented in their drinking water causes a significant reduction in hepatic B cells compared to control and glucose treated mice. In addition to elevations in hepatic inflammation and fibrosis. Using both in vitro and in vivo approaches, we demonstrate that fructose treatment significantly decreases B cell viability. Moreover, liquid chromatography-mass spectrometry (LC-MS) metabolic profiling demonstrates primary splenic B cells efficiently metabolize fructose through glycolysis and the pentose phosphate pathway, but exhibit decreased incorporation of fructose-derived carbons through the TCA cycle. Proteomics analysis further revealed dysregulated expression of proteins related to endoplasmic reticulum (ER) stress. Because ER stress is known to promote increased cytoplasmic calcium, which can have negative downstream effects on mitochondrial membrane polarization, we next investigated the role of fructose on mitochondrial membrane potential. Utilizing flow cytometry, we demonstrate that fructose induces significant mitochondrial membrane depolarization in primary splenic B cells, as well as in B cells within the bone marrow in vivo. Based on these findings, we propose that fructose induces ER stress in early B cell subsets in the bone marrow, leading to mitochondrial membrane depolarization, impaired mitochondrial metabolism, decreased cell viability, and decreased egress of B cells to peripheral tissues, such as the spleen and liver. This work lays the foundation to better understand the mechanisms by which fructose regulates B cell populations, as well as identify novel therapeutic targets to better treat MASLD.

**Greg Ferraro and Rod Rejesus**

**Graduate Program:** Agriculture and Resource Economics

**Advisors:** Rod Rejesus and Zack Brown

**Poster Number:** 53

### **Effect of Saltwater Intrusion and Sea Level Rise on US Atlantic Agriculture**

Saltwater intrusion and sea level rise (SWISLR) cause substantial damage to coastal agriculture by permeating up through the water table or hydrological connections. Sea level rise projections suggest effects will increasingly worsen. Using coastal monitoring data and real estate sale records, which reflect landowner welfare and individual valuations, I estimate SWISLR's effect (through coastal flooding and relative local mean sea level) on agricultural land sales from 1985 to 2023, from Texas to New Jersey. This study is the first and most spatially comprehensive sale price investigation of SWISLR effects on agriculture. I find SWISLR reduced per-acre land values within 20 miles of the coast by approximately \$1300 on average over the study period (with 95% of the damage distribution between \$410 to \$2100), or about 10% of the average sample per-acre land value. This amounts to about \$900 billion total damages (\$24 billion a year) across 709 million agricultural acres. Changes in marginal effects by historical exposure suggest landowners are adapting, though cumulative effects may be overwhelming. Effects include capitalization of worsening landowner pessimism and simultaneous SWISLR effects on residential sales values. Landowners do not use conservation programs as a means of mitigation, and exposure does not selectively change the rate at which agricultural land converts to residential use. SWISLR effects are independent of population and meteorological factors. Sea level rise is an apparent problem for agriculture, land use allocation, and damage minimization given cropland constitutes 11% of land use within 20 miles of the coast.

**Jade Fluharty**, Brenna Zimmer, Linlin Ma, Joshua Hartsell, Xiaojing Liu, Joseph Barycki, and Melanie Simpson

**Graduate Program:** Molecular and Structural Biochemistry

**Advisor:** Melanie Simpson

**Poster Number:** 54

### **Integrative Transcriptomic and Metabolomic Analysis Provides Insights into Metabolic Reprogramming by UDP-glucose 6-dehydrogenase**

A hallmark of tumorigenesis is increased glucose consumption, allowing for pools of intermediate metabolites to be utilized for UDP-sugar metabolism. UGDH is a dynamic sensor that integrates the cellular metabolic needs with UDP-Glucuronate (UDP-GlcA) priority into glucuronidation, hyaluronan synthesis, or proteoglycan production. Previous research in our lab has found UGDH elevated in prostate cancer (PC) tumor biopsies and integral for androgen homeostasis. To model the androgen-dependent (AD) to castration-resistant (CR) transition in PC recurrence, our lab utilized the isogenic LNCaP model. Elevated UGDH expression in the AD background caused an increase in tumorigenesis and prioritization of glycosaminoglycan biosynthesis. Conversely, UGDH knockdown in the CR background resulted in reduced tumor volume and UDP-GlcA flux into glucuronidation.

To further look at the impacts of UGDH activity in PC, we utilized metabolite tracing and RNA-sequencing techniques. UGDH overexpression resulted in enriched pathways corresponding with tumor aggressiveness and cellular survival. Additionally, we found increased expression of mesenchymal markers implicating UGDH in the pro-tumorigenic epithelial-to-mesenchymal transition, an indicator of disease progression. UGDH knockdown revealed downregulation of pro-tumorigenic pathways and changes in androgen biosynthesis genes. Lower levels of hyaluronan (HA) and hyaluronan synthase (HAS) expression in our prostate model provide a reductionist view of metabolic reprogramming, but the direct impacts of UGDH on HA metabolism are subtle. By integrating our current knowledge of these prioritization mechanisms within PC, we sought an additional model to examine coordination mechanisms between UGDH, HAS, and HA production. We analyzed HA levels present in the extracellular environment of breast, colorectal, and endometrial cell lines. Colorectal cancer cell models, SW480 and SW620, exhibit high protein levels of HAS and HA output compared to the other models. Using this model, we are examining UGDH and how it drives HA production. Altogether, contributing to a comprehensive understanding of UGDH as a potential therapeutic target.

**Ashlee George**<sup>1</sup>, Daniela Jones<sup>2</sup>, Rong Yin<sup>3</sup>, Alex Woodley<sup>1</sup>, and David Suchoff<sup>1</sup>

**Graduate Programs:** Crop and Soil Science<sup>1</sup>; Biological and Agricultural Engineering<sup>2</sup>; College of Textiles<sup>3</sup>

**Advisors:** David Suchoff and Alex Woodley

**Poster Number:** 59

### **Fiber Hemp Dew Retting in North Carolina**

Fiber hemp (*Cannabis sativa* L.) demand is increasing while retting, a major aspect of post-harvest processing remains ambiguous. Dew retting, or just 'retting', is the practice of leaving the cut hemp in the field for a period of time before baling. During this time, moisture and temperature from the environment drive the enzymatic degradation of pectin in the stems. This allows the bast fiber to easily separate from the inner hurd during decortication. Easy separation of the bast from the hurd reduces the amount of further mechanical and chemical processing needed. While the basics of dew retting are understood, we still do not have solid recommendations on retting times for producers. Current production guidelines emphasize physical feel and color, which can be subjective and vary widely depending on hemp cultivar and climatic conditions. The purpose of this study is to develop clear retting time recommendations for North Carolina. Environmental metrics, including humidity, precipitation, and temperature were continuously monitored over the five-week retting period. Each week, stems were randomly selected from the field for color analysis. Bundles of 50 stems were also picked up each week, dried, and decorticated. The decorticated bast fiber was then hand-cleaned to compare the ease of processing, or decorticability, of the fiber from each retting period. Preliminary results have indicated that time is the main factor driving decorticability, and color is not a good indicator of retting progress. However, these results do not yet include fiber quality metrics which may vary among the retting time periods.

**Kai J. Goble**<sup>1</sup>, Katherine M. Jennings<sup>1</sup>, Stephen J. Ippolito<sup>2</sup>, David W. Monks<sup>1</sup>, David L. Jordan<sup>3</sup>, Colton D. Blankenship<sup>2</sup>, and Adrienne M. Gorny<sup>4</sup>

**Graduate Programs and Institutions:** Horticultural Science<sup>1</sup>; LSU AgCenter, Louisiana State University<sup>2</sup>; Crop and Soil Sciences<sup>3</sup>; Entomology and Plant Pathology<sup>4</sup>

**Advisor:** Katherine M. Jennings

**Poster Number:** 62

### **Survey of Potential Weed Hosts for Root-knot Nematodes in North Carolina Sweetpotato (*Ipomoea batatas*)**

Sweetpotato (*Ipomoea batatas*) is a major crop in the southeastern US, with North Carolina accounting for over 50% of the nation's production. Effective pest management is crucial for maximizing yield and quality. Weeds cause direct yield loss by competing with the crop for resources such as light and nutrients. Additionally, weeds can act as hosts for nematodes, allowing them to persist even if a non-host crop is planted in rotation to sweetpotato. Guava root-knot nematode (GRKN) is an aggressive pest that can severely impact the yield and quality of sweetpotato. Two surveys (2023-2025) were conducted to identify the most common weeds in NC sweetpotato, and which weeds may act as hosts for root-knot nematodes (RKN). Fields across ten major sweetpotato-producing counties were surveyed for the prevalence of weed species, determined as the percentage of fields surveyed with the presence of a certain weed. Palmer amaranth (83%), carpetweed (70%), and sicklepod (36%) were the most common weeds. Additionally, weeds from 20 fields with suspected or previously confirmed to contain GRKN were examined for presence of RKN galling on the roots. Incidence rate was determined as the percentage of weeds sampled with galling. Common ragweed and alligatorweed had 100% incidence of RKN, followed by common lambsquarters (85%), and Carolina horsenettle (80%). Results from both surveys were combined to determine the predicted biogeographical importance (PBGI) of each weed species, calculated as prevalence of weeds x incidence of RKN / 100. PBGI represents weeds that are common and may more commonly act as RKN hosts. Weeds with the highest PBGI were carpetweed, Palmer amaranth, and annual morningglories. Results highlight the importance of controlling weeds regardless of their competitiveness to sweetpotato, especially those with high PBGI that allow RKN to persist during crop rotation.

**Kendall Godwin<sup>1</sup>** and Ryan W. Paerl<sup>1,2</sup>

**Graduate Programs:** Microbiology<sup>1</sup>; Marine Science<sup>2</sup>

**Advisor:** Ryan W. Paerl

**Poster Number:** 63

### **Using Metagenomics to Resolve the Primary and Secondary Metabolic Potential of Cyanobacteria in the Albemarle Sound, North Carolina**

The Albemarle-Pamlico Estuarine System (APES), covering approximately 7,800 km<sup>2</sup> of North Carolina's coast, is the country's largest coastal lagoon system. Cyanobacteria are important primary producers known to influence water quality across the APES, but in the northernmost portion – the Albemarle Sound (AS) - studies of cyanobacterial community composition are few. Initial efforts utilizing 16S gene sequence analyses in the AS and its tributaries suggest the system hosts a distinct and diverse cyanobacterial assemblage including genera that potentially produce cyanotoxins harmful to human and animal health. Indeed, one such tributary of the AS, the Chowan River, is notorious for recurring dense, sometimes spatially broad blooms of cyanobacteria.

While previous efforts using 16S amplicon sequencing or microscopy offer insight into the cyanobacterial community of the AS, its functional potential remains poorly resolved. To address this gap, we utilized “shotgun” metagenomic sequencing, assembly, and binning to construct over 100 cyanobacterial metagenome-assembled genomes (MAGs) from the summer and early fall of 2020 at three monitoring stations within the central core of the AS. While these genomes often correspond to lineages of greater relative abundance as measured by 16S rDNA (e.g., *Cyanobium*, *Synechocystis*, and *Nodosilinea*), others are less represented (e.g., *Sphaerospermopsis*) and one group of MAGs, corresponding to the genus CAIUCS01, are poorly described in general and not described in North Carolina waters. Here, we present our analysis of the taxonomy and metabolic capabilities of the obtained cyanobacterial MAGs as well as a survey of genes associated with cyanotoxin production identified within the AS metagenomes.

We offer a first direct look at the biochemical capabilities of AS cyanobacteria to gain a more complete understanding of the roles cyanobacteria play in estuary biogeochemistry and health, and to direct future research towards studying underrepresented cyanobacteria and cyanotoxins that may have been missed by prior efforts.

**Kashish Grover**, Kajal Gupta, Todd C. Wehner, and Roberto Fritsche-Neto  
**Graduate Program:** Horticultural Science  
**Advisor:** Roberto Fritsche-Neto  
**Poster Number:** 66

### **Optimizing Pickling Cucumbers Multi-environment Trials for Current and Future Challenging Growing Conditions**

Multi-environment trials (METs) are essential in a breeding program to identify high-performing and stable genotypes across different environments. However, trial sites are often chosen based on convenience rather than representativeness, leading to reduced relevance to actual grower environments and inefficient resource use. This project proposes a data-driven framework to optimize MET site selection for U.S. pickling cucumber breeding under both current and future climate scenarios. In this context, we integrated multi-location and multi-year historical yield data with 235 environmental covariates (ECs) derived from 15 years (2009–2024) of NASA POWER weather data. Then, using stepwise regression, we identified 14 key ECs that accounted for approximately 88% of the yield variation across environments. These ECs were then used to cluster the 39 major cucumber-producing counties (accounting for 95% of the USA production) into four distinct mega-environments. Next, the trial optimization reduced the number of sites by 43% (from 7 to 4) while maintaining 75% representativeness of production zones and increasing yield heritability from 0.88 to 0.98. Finally, to evaluate the resilience of these sites under future growing conditions (2050–2065), we compared present-day environmental clusters with projections for two future planting windows (March-June and April-July). The comparative analysis revealed that Michigan, Ohio, and Wisconsin counties are likely to remain environmentally similar in the future, while Sampson County (NC) may experience unique climatic shifts. Interestingly, North Carolina, Florida, and California counties were projected to converge environmentally. Despite these shifts, our analysis confirmed that the same optimized set of counties would remain representative across both present and future production scenarios. These results may improve the efficiency of the cucumber breeding program, reducing costs, increasing accuracy, and aligning field evaluations with current and future farmer needs.

**Ajah Haskell**  
**Graduate Program:** Agricultural Education and Human Sciences  
**Advisor:** Sudha Sankar  
**Poster Number:** 72

### **A Narrative Inquiry into the School Experiences of National Guard-Connected Adolescents During Parental Deployment**

National Guard-connected adolescents face unique challenges and are more vulnerable to academic, behavioral, and social-emotional challenges due to their geographic displacement from military-informed support systems. Rooted in Ungar's Social Ecological Resilience Theory, this study explores National Guard-connected adolescent's perceptions of being in civilian school environments while a parent is deployed and the support systems they are looking to receive from that environment. It is framed through a lens that prioritizes personal agency and environmental responsiveness allowing National Guard-connected adolescents to be their own advocates. This study examines the school experiences of adolescent (13-17 years) children of National Guard parents who have been deployed at least once in the last 5 years. Using thematic analysis, the study explores how National Guard-connected adolescents make sense of their experiences in civilian schools during a parental deployment, how they perceive the role of school as a support during parental deployments, and the supports they use to navigate their school environments during a parental deployment. Implications for the design of programs supporting National Guard-connected adolescents and for future research on National Guard-connected families is discussed.

**Sofia Jauregui<sup>1</sup>**, Jeanette Lyerly<sup>1</sup>, Adam Becker<sup>1</sup>, Democrito Rebong<sup>1</sup>, Gina Brown-Guedira<sup>1,2</sup>, and Nonoy Bandillo<sup>1</sup>  
**Graduate Program and Institutions:** Crop Science<sup>1</sup>; USDA ARS - Plant Science Research Unit<sup>2</sup>, USDA ARS — Plant Science Research Unit<sup>2</sup>

**Poster Number:** 81

### **Dissecting the Genetic Architecture of Grain Quality Traits in Soft Red Winter Wheat**

Wheat (*Triticum aestivum*) is one of the most important crops globally, contributing about 20% of the world's calories and protein. Grain quality, also known as end use quality, has direct impacts on the suitability of the grain for baking and milling purposes. High quality wheat receives a premium market price and is rich in bioavailable proteins, minerals, and vitamins, making it extremely important to both farmers and consumers. Thus, improving grain quality for human consumption is a critical breeding objective. Identifying and characterizing the genetic relationships amongst the various grain quality traits ensures that as yields improve, quality is maximized. In this study, we performed a comprehensive genetic analysis of multiple key quality traits using historical data from a collection of modern cultivars and elite breeding lines, including the Gulf Atlantic Wheat Nursery. We then performed a genome-wide association study to identify significant single nucleotide polymorphisms. Identifying significant SNPs will help to identify underlying genes and the network of genes that can be useful for applied breeding efforts of high-quality wheat. Future work will include dissecting variance components and gene networks underlying quality traits, along with characterizing and mapping the genes that shape these networks.

**Alena P. Jones**, Owen W. Duckworth, and Luke Gatiboni

**Graduate Program:** Soil Science

**Advisors:** Owen Duckworth and Luke Gatiboni

**Poster Number:** 83

### **Impact of Metal(loid) Accumulation from P-Fertilizer in Agricultural Soils**

Our world depends on phosphorus (P) to meet the demands of crop yield and ensure global food security. Phosphorus is an essential nutrient critical for biological functions in crops. However, low bioavailability of P can lead to several issues, including nutrient deficiencies, stunted growth, and impaired cellular functions. Due to limited P uptake, chemical P-fertilizers must be applied frequently. These fertilizers are mined from phosphate rock, which contain naturally occurring metal(loid)s including cadmium (Cd), uranium (U), chromium (Cr), vanadium (V), strontium (Sr), and lead (Pb). Long-term application of these fertilizers can result in the accumulation of metal(loid)s in soil, crops, and water sources, posing potential health risks and exposure to toxic elements. This project aims to evaluate metal(loid) accumulation in soil, plant tissue, and grain samples treated with five varying P-fertilizer rates from a 70-year long-term study. Samples were collected from the Tidewater Research Station in Plymouth, North Carolina. Acid digestions were performed, followed by total trace metal(loid) analysis using an inductively coupled plasma mass spectrometer. During 2021-2025, we observed significant differences in the accumulation of Cd, Sr, and U in the topsoil, correlated with increasing fertilizer application rates. This suggests that these metal(loid)s tend to accumulate in the topsoil. In contrast, some metal(loid)s showed similar concentrations across all fertilizer application levels, suggesting they were either not substantially introduced through the fertilizers or may have leached into the soil profile. Plant tissue samples are currently undergoing analysis. Once the soil, tissue, grain and water have been processed, we will assess where the metal(loid)s are accumulating. Understanding their distribution is essential, as it will allow us to identify the pathways these metal(loid)s follow. With this knowledge, we can begin considering potential preventative measures to mitigate their impact. It is crucial that the presence and behavior of these metal(loid)s is understood to minimize toxic contamination in agricultural ecosystems.

**Samantha C. Kisthardt**<sup>1</sup>, C. E. Perkins<sup>1</sup>, Noah S. Lyons<sup>1</sup>, Abigail S. Gancz<sup>1,3</sup>, Stephanie A. Thomas<sup>1</sup>, Elizabeth C. Rose<sup>1</sup>, Emily C. Vincent<sup>4</sup>, Guozhi Zhang<sup>4</sup>, John Tam<sup>5</sup>, Roman Melnyk<sup>5,6</sup>, Erin S. Baker<sup>4</sup>, and Casey M. Theriot<sup>1</sup>

**Graduate Programs and Institutions:** Population Health and Pathobiology<sup>1</sup>; Department of Plant and Microbial Biology<sup>2</sup>; Center for Gastrointestinal Biology & Disease, UNC School of Medicine<sup>3</sup>; Department of Chemistry, University of North Carolina at Chapel Hill<sup>4</sup>; Molecular Medicine Program, The Hospital for Sick Children Research Institute<sup>5</sup>; Department of Biochemistry, University of Toronto<sup>6</sup>

**Advisor:** Casey M. Theriot

**Poster Number:** 89

### ***Clostridium hiranonis* supplemented with cholate suppresses *C. difficile* toxin activity and sporulation in vitro and in vivo, ameliorating disease**

*C. difficile* is an anaerobic Gram-positive spore forming bacterium that is classified as an urgent public health threat by the CDC due to its impacts on health. Colonization resistance (CR) against *C. difficile* is associated with an increase in secondary bile acids (BAs) and restoration of commensal Clostridia, however the exact mechanisms are still unknown. Past studies have concluded that the mechanism of CR is BA-dependent, whereas recent studies suggest it is solely based on competition for amino acids. Here, we hypothesize that the balance between BA metabolism and competition for amino acids drives commensal Clostridia-mediated CR against *C. difficile*. To test this hypothesis, we selected two different commensal Clostridia species, *C. scindens* VPI12708 and *C. hiranonis* TO-931, which both use Stickland fermentation and produce secondary BAs, although their encoded BA altering enzymes differ with *C. hiranonis* encoding a bile salt hydrolase (BSH) and the bile acid inducible (*bai*) operon.

To determine how each Clostridial strain affects CR against *C. difficile*, we leveraged in vivo and in vitro models. We first monocolonized C57BL/6J germfree mice with either *C. scindens* or *C. hiranonis* for 7 days before challenging them with *C. difficile* spores and measured disease over a two-day window. *C. scindens* cocolonized mice had significant weight loss and were not protected from disease. In comparison, *C. hiranonis* cocolonized mice did not lose weight and had less toxin activity and intestinal histopathological changes. Complementary in vitro assays showed that *C. hiranonis* supernatants supplemented with CA significantly decreased *C. difficile* toxin activity and spore formation. Targeted BA metabolomics and RNAseq showed that DCA drove decreases in *C. difficile* toxin activity and spore load. The *C. hiranonis* BSH may be essential for this phenotype in vivo since it, in conjunction with the *bai* operon, liberates CA from host taurocholate (TCA) to make DCA.

**Jenna Kraemer<sup>1</sup>, Natalie Nelson<sup>2</sup>, Katherine Anarde<sup>3</sup>, and Angela Harris<sup>3</sup>**

**Graduate Programs:** Microbiology<sup>1</sup>; Biological and Agricultural Engineering<sup>2</sup>; Civil, Construction, and Environmental Engineering<sup>3</sup>

**Advisors:** Angela Harris and Natalie Nelson

**Poster Number:** 92

### **Investigating Fecal Bacteria and Contamination Source Signals in Tidal Floodwaters in Carolina Beach, North Carolina**

Rising sea levels are increasing the frequency and severity of tidal flooding in coastal communities, where seawater from high tides inundates stormwater networks and floods streets. Tidal floods may pose substantial public health risks due to the spread of fecal bacteria and antimicrobial resistance (AMR) genes, which is an increasing global health threat. This study investigated microbial contamination in tidal floodwaters in Carolina Beach, North Carolina. Sampling occurred across six tidal flood events at four flooded street intersections and two locations in the adjacent receiving waterway. Samples were processed for fecal indicator bacteria (FIB) using IDEXX, microbial source tracking targets for human, canine, and avian markers using droplet digital PCR and quantitative PCR, and pathogen and AMR genes using TaqMan Array Cards. Intersection composite samples processed for FIB had mean concentrations of 1,594 MPN/100 mL Enterococcus and 507 MPN/100 mL E. coli (n = 21). Enterococcus and E. coli exceeded U.S. EPA single-sample recreational water thresholds (104 and 235 MPN/100 mL, respectively) in 95.2% and 33.3% of samples. The results from the microbial source tracking and TaqMan Array Cards will provide insight into the potential sources of contamination and presence of pathogens in the tidal floodwaters. The detected fecal contamination in the floodwaters presents concern of health risks for the communities affected and the results could be used to advise targeted management and mitigation strategies.

**Teagan Kuzniar, Joshua Heitman and Wei Shi**

**Graduate Program:** Crop and Soil Sciences

**Advisors:** Joshua Heitman and Wei Shi

**Poster Number:** 96

### **Niche and Fitness Differentiations Drive Microbial Distribution Across Soil Pore-scale Heterogeneity**

Explicit inspections are lacking in terms of the linkage between pore-scale resource (e.g., water) heterogeneity and microbial distribution across pores. Trait-based knowledge is imperative because microbial metabolism in pores can scale up to shape the entire soil health. In the present study, trait-based microbial distribution at the soil pore scale was examined using the high-throughput sequencing approach for bacterial 16S and fungal ITS DNA. To set up different pore size distributions, soil cores composed of Herndon Silt Loam with a barley straw addition were packed to high and low bulk densities (1.15 g cm<sup>-3</sup> and 0.77 g cm<sup>-3</sup>). Then, the pressure plate desorption method was applied to selectively remove water from specific soil pore sizes by pressure application after saturation: pressures of 4, 10, and 100 kPa were expected to remove water from pore necks >75, >29, and >3 μm, respectively. These pore size and moisture manipulations created different pore size classes with varying moistures. We used the 'time-for-pore size' substitution to deduce microbial distribution across large and smaller pores: magnitudes in the change of ratios of microbial taxa or predicted functions between day 38 and day 10 of the incubation might signify microbial preferences of pore size classes. Both bacterial and fungal diversity and community composition were associated with pore size distributions (i.e. bulk density), pore water manipulation (i.e., pressure plate desorption), and sampling time. Copiotrophs/r-strategists (e.g., Bacteroidetes and Firmicutes) prevailed in large pores, while oligotrophs/K-strategists (e.g., Actinobacteria) dominated smaller pores. However, the pore environment may considerably modify this lifestyle-based pattern. Acidobacteria, which are commonly thought to be oligotrophs, resided in large pores, likely due to decomposition-induced pH changes. Our work helps advance knowledge of how microbial niche differentiations may be mapped with soil pore-scale heterogeneity.

Jane Londoño<sup>1</sup>, Lisa Dean<sup>2</sup>, Abdelrahman Fares<sup>3</sup>, and Jonathan Allen<sup>1</sup>

**Graduate Programs and Institutions:** Food Science<sup>1</sup>; United States Department of Agriculture<sup>2</sup>; Biological Sciences<sup>3</sup>

**Advisor:** Jonathan Allen

**Poster Number:** 99

### **Impacts of Boiled or Roasted Peanuts on Glycemic Response in Acute and Chronic Trials**

Peanuts are a high-protein food with a low glycemic index and glycemic load. Boiled peanuts are widely eaten in the American South, which has the highest regional prevalence of diabetes nationally. Reis et al. found that peanut butter consumption resulted in a lower glycemic response than raw peanuts. This study measured the impact of peanut preparation methods on glycemic response. Hypotheses explaining an effect of peanuts on glycemic load of a diet involve the fat and fiber content or differences in destruction or activation of bioactive compounds in boiled or roasted peanuts. 14-17 subjects completed five glucose tolerance tests (GTT) over the course of 11 weeks, divided into two phases: acute and chronic. Each test was conducted after  $\geq 8$  hours of fasting and consisted of 10 blood glucose samples taken at 10 to 30 min intervals over two hours. The first test used a commercial glucose tolerance beverage to establish a personal baseline. The two acute tests were conducted immediately after consumption of roasted or boiled peanuts in addition to the glucose beverage. The two chronic trials consisted of a two-week period of daily consumption of boiled peanuts or roasted peanuts, with a week-long washout between trials, followed by a GTT. Compared to the baseline GTT data, none of the four trials showed a significantly different glycemic response ( $p > 0.05$ ). However, the mean ( $\pm$ SEM) net incremental area under the curve (NetiAUC) of all five tests demonstrated high variation among the participants. There is a repeatable significant variation among individuals, with high coefficients of variation (CV) for each GTT. Boiling or roasting peanuts showed no significant effect on glycemic response when compared to each other or the no-peanut control with either immediate or daily intake. Although the peanuts did not decrease the glycemic response, they equally did not increase it despite the additional carbohydrate intake. The high CV among subjects could be due to diet, BMI, or physical activity. Further research with boiled peanuts as a high-protein staple or snack food is warranted.

**Thaciane Amaral**, Demilade Ibiwoye, Philip Yeboah, Tracy Omasanuwa, Muhammad Wajeeh, Alexandra Ulans, Allison Pullin, and Lisa Bielke

**Graduate Program:** Prestage Department of Poultry Science

**Advisor:** Lisa Bielke

**Poster Number:** 7

### **In Vivo Challenge Model for Evaluation of Systemic Translocation and Skeletal Disease in *Enterococcus cecorum*-infected Broilers**

*Enterococcus cecorum* (EC) is an emerging pathogen associated with septicemia in young broilers and degenerative skeletal lesions later in production, leading to lameness. Mortality rates of up to 15% due to starvation and dehydration have been reported, along with increased condemnation rates at processing plants. Despite growing recognition of EC-associated diseases, experimental in vivo models capturing infection progression across the broiler production cycle remain limited. This study aimed to establish an EC challenge model to evaluate early systemic translocation, skeletal lesion development, and late mobility impairment. Male Cobb 500 broilers were assigned to inoculated (PC) or non-inoculated (NC) groups, with 12 pens/treatment and 14 birds/pen. Inoculated birds received  $1 \times 10^4$  CFU of a lameness-associated field isolate on d1 and d14. On d14, 21, 28, 35, and 42, two birds/pen were evaluated for latency-to-lie, spleen recovery ( $\text{Log}_{10}$  CFU per mL), and femoral head (FH) and tibial head (TH) lesion scores, with free thoracic vertebrae collected on d42. Inoculated birds showed higher splenic recovery on d14, followed by accelerated skeletal lesion progression and earlier lameness onset at d17. Mobility differences emerged between weeks 4 and 6, with NC birds standing longer at the end of the study. Mortality followed a biphasic pattern, with early losses and a later peak associated with lameness. Vertebral colonization was detected in both groups by d42, indicating horizontal transmission. A shift from systemic to skeletal infection was observed, with high early splenic bacterial recovery preceding lesion development, followed by reduced bacteremia as skeletal lesions progressed and lameness increased. This pattern suggests that early systemic bacterial load may precede and help predict subsequent lameness. Further refinement is needed to mitigate bacterial transmission between groups and strengthen the model for evaluating preventive or therapeutic strategies targeting *E. cecorum*-associated performance losses.

**Lillian Lower**

**Graduate Program:** Biological and Agricultural Engineering

**Advisor:** William Joe Sagues

**Poster Number:** 101

### **Sustainable Bio-Derived Graphite Anodes for Greener Lithium-Ion Batteries**

The rapid growth of electrochemical energy storage is driven by declining renewable electricity costs, electrification-focused policies, and efforts to reduce CO<sub>2</sub> emissions. Lithium-ion (Li-ion) batteries dominate this landscape, relying almost exclusively on graphite anodes derived from either natural or synthetic sources. Graphite is a critical mineral with a highly concentrated global supply chain and is produced through energy-intensive, environmentally burdensome processes, creating significant vulnerabilities for large-scale battery deployment. These challenges motivate the development of alternative, renewable graphite sources that can enhance supply chain resilience. Our group explores biomass-derived graphite as a sustainable and domestically sourced alternative to conventional graphite. We demonstrate catalytic graphitization of diverse biomass feedstocks including sawdust, seaweed, bio-oil, paper towel waste, and biochar using a single high-temperature heat treatment (~1500 °C) in the presence of iron, followed by purification. This approach enables efficient conversion of disordered biocarbon into highly crystalline graphite across a wide range of renewable inputs. Graphitization extents exceeding 90% are achieved, with lithium-ion half-cell testing demonstrating specific capacities of approximately 340 mAh g<sup>-1</sup> and initial Coulombic efficiencies greater than 90%. By decoupling graphite production from geographically constrained mineral resources and fossil-derived precursors, this work highlights catalytic graphitization of biomass as a scalable pathway to strengthen graphite supply chains and support more resilient, sustainable Li-ion battery manufacturing.

**Ryan Lundquist**<sup>1</sup>, Jessica A. Hoffman, Ph.D., NCSP<sup>2</sup>, Dara Bloom, Ph.D.<sup>1</sup>, Madison Sullivan<sup>1</sup>, and Virginia C. Stage, Ph.D., RDN<sup>1</sup>

**Graduate Programs and Institutions:** Nutrition<sup>1</sup>; Northeastern University<sup>2</sup>

**Advisor:** Virginia C. Stage

**Poster Number:** 102

### **Farm to Early Care and Education Programs in Promoting Positive Eating Behaviors: A Systematic Review**

**Background:** Farm to Early Care and Education (ECE) is a multicomponent intervention strategy comprising gardening, local food procurement, and/or food, nutrition, and agriculture (FNA) education. Farm-to-ECE programs offer opportunities for repeated food exposure, which may promote healthy eating behaviors. Yet the evidence of the effectiveness of Farm to ECE interventions in promoting these outcomes remains unclear.

**Objective:** To evaluate the strength of evidence of Farm to ECE interventions on young children's direct (e.g., plate waste) and indirect (e.g., willingness to try) eating behaviors. Additionally, to evaluate which components have the most significant impact on these outcomes.

**Study Design, Settings, Participants:** Using PRISMA guidelines, we searched four databases (ProQuest, ERIC, PubMed, and Web of Science) for peer-reviewed experimental or quasi-experimental studies (2005-2025) on Farm to ECE interventions. We included studies, both within the US and internationally, conducted in ECE settings that measured children's eating behaviors aged 3-7 years.

**Measurable Outcome/Analysis:** Outcomes included eating behaviors, both direct dietary intake and indirect consumption behaviors. We assessed study quality using the Joanna Briggs Institute (JBI) Critical Appraisal Tools. We performed a narrative analysis.

**Results:** We included 17 studies: seven RCTs and 10 quasi-experimental designs. All studies included FNA education. No studies isolated the effect of local food procurement. Interventions that included all three components (n=4) demonstrated the most positive impact on direct dietary intake measures. Across all studies, we identified methodological concerns of high attrition rates, lack of long-term follow-up, and/or use of unvalidated outcome measurement tools.

**Conclusions:** While Farm to ECE interventions show potential to improve positive eating behaviors among young children, the current evidence is limited by methodology and bias. Future research should use validated measures and rigorous study designs to isolate the impact of intervention components on children's eating behaviors.

**Jade Lyons**, Chengsong Zhao, Jose Alonso, and Anna Stepanova

**Graduate Program:** Genetics and Genomics

**Advisors:** Jose Alonso and Anna Stepanova

**Poster Number:** 105

### **Disrupting Upstream ORF Translation for Enhanced Protein Production in Plants**

Understanding how gene expression is regulated is essential for developing new biotechnological approaches to address agricultural challenges. Translation is a key regulatory layer of gene expression that shapes protein production. Advances in ribosome profiling and other high-throughput approaches have revealed that upstream open reading frames (uORFs) are pervasive regulatory elements within 5' untranslated regions (UTRs) that modulate translation of downstream main open reading frames. While uORFs are known to regulate translation, further studies are needed to understand how these cis-elements influence translational outputs. In this work, I combine reporter-based assays and CRISPR-mediated genome editing to investigate translational regulation via uORFs. Using a dual-luciferase reporter system in *Nicotiana benthamiana*, I assess the effects of 5' UTR variants with and without uORFs on luciferase activity. In parallel, I apply genome editing to modify endogenous 5' UTRs, such as that of EIN2, a central regulator of ethylene signaling, to explore how uORF architecture may influence translation in native contexts in *Arabidopsis*. Together, this work is providing insights into how uORFs contribute to translational control, paving the way to targeted gene expression regulation for smart crop design.

**Holly A. McInnes**, César A.D. Xavier, David Rasmussen, Kirsten A. Lahre, Dorith Rotenberg, and Anna E. Whitfield  
**Graduate Program:** Entomology and Plant Pathology  
**Advisor:** Anna E. Whitfield  
**Poster Number:** 111

### **Investigating North Carolina Resistance-breaking Tomato Spotted Wilt Virus Emergence Through Whole Genome Phylogenetic Analysis**

Tomato spotted wilt virus (TSWV) is a plant-infecting arbovirus that poses a severe threat to the production of foodstuffs and ornamentals worldwide. TSWV has a host range of over 1,000 plant species including potato, tomato, peanut, pepper, and lettuce. TSWV threatens global food security and is ranked as one of the most devastating plant viral pathogens. In tomato production systems, TSWV is primarily managed through vector control and the use of resistant cultivars with the Sw-5b resistance gene. Resistance breaking TSWV (RB-TSWV) has emerged worldwide since Sw-5b deployment, with a single point mutation in the TSWV movement protein (NSm) being sufficient to break resistance. Prior to 2022, only two types of RB mutations were reported: NSmC118Y and NSmT120N. However in 2022, RB-TSWV with a novel RB mutation type (NSmD122G) along with the first instance of a NSmC118Y type RB variant were identified in one of North Carolina's (NC) top tomato-producing counties. To investigate NC RB-TSWV emergence, several NC nonRB- and RB-TSWV isolates were sequenced and prepared for whole genome assembly. A Bayesian phylogenetic tree was constructed for each of TSWV's three genome segments to compare NC TSWV isolate sequences to globally representative TSWV sequences from the NCBI database. Clustering on each segment tree suggests that NC RB-TSWV mutants arose independently of previously reported RB-TSWV isolates, including the one other reported instance of RB-TSWV with the NSmD122G mutation. Furthermore, recombination and reassortment analysis indicates that there are very low rates of recombination but high levels of reassortment observed among our globally representative isolates; however, our NC TSWV isolates share reassortment signatures and showed little evidence of reassortment with the other globally representative isolates. This indicates that RB-TSWV seems to be emerging independently in the Southeastern U.S. and raises further questions about RB-TSWV fitness and evolutionary dynamics.

**Mohammad Nooshzadi Motlagh** and François Birgand  
**Graduate Program:** Biological and Agricultural Engineering  
**Advisor:** François Birgand  
**Poster Number:** 121

### **Monitoring Velocity and Stage in Stormwater Outflows Using Images and Videos**

Stormwater in urban and suburban settings can have detrimental impacts in receiving streams. Stormwater Control Measures (SCM) constitute a very active area of environmental research. However, monitoring stormwater flow has remained an arduous task because none of the traditional methods and sensors work well in these very flashy, turbulent, and dirty systems.

To address these issues, our study utilizes images and videos captured at the culvert's outflow, where the camera is positioned at a distance. In the first step, we focused on measuring stage. For that, we developed a hybrid method that used machine learning and a geometrical approach. Two deep learning models, Mask R-CNN and Ultralytics YOLOv8, are used to detect the unoccupied area of the culvert. When there is no flow, the full outlet area (within its inner edges) is detected and the corresponding ellipse is calculated. When flow is present, the unoccupied area is detected. The difference between these two detected areas provides the flow area.

In a second step, we attempted to estimate water surface velocity using the Farneback optical flow method. It tracks pixels between frames, from which the surface velocity is calculated. Subsequently, the derived velocity vectors and the detected stage points are transformed into a real-world coordinate system through dense matching and triangulation. This process relies on a setup comprising two cameras capturing the scene simultaneously from different perspectives with the overlap including the culvert area.

**Christopher C. Oates**<sup>1,2</sup>, Hector Fajardo<sup>1,2</sup>, Khara Grieger<sup>2,3</sup>, Daniel Obenour<sup>4,5</sup>, Rebecca L. Muenich<sup>5</sup>, and Natalie G. Nelson<sup>1,2,6</sup>

**Graduate Programs and Institutions:** Biological and Agricultural Engineering<sup>1</sup>, North Carolina Plant Sciences Initiative<sup>2</sup>, Applied Ecology<sup>3</sup>, Civil, Construction, and Environmental Engineering<sup>4</sup>, Biological and Agricultural Engineering, University of Arkansas<sup>5</sup>, Center for Geospatial Analytics<sup>6</sup>

**Advisors:** Natalie G. Nelson and Khara Grieger

**Poster Number:** 126

### **Nutrient Monitoring in Surface Waters of Agriculturally-intensive Regions of the U.S.: Current Status and Needs for Expansion**

Agriculture is a dominant source of nutrient pollution in U.S. surface waters, contributing substantial nitrogen and phosphorus loads from fertilizers and livestock manure to waterways. Elevated nutrient inputs promote eutrophication (i.e., nutrient enrichment driven by excess nitrogen and phosphorus), leading to increased algal growth, reduced dissolved oxygen, and widespread water quality impairment. The U.S. Environmental Protection Agency notes that nutrients are the most common cause of water quality impairment in U.S. streams, lakes, rivers, and coastal waters. While the Clean Water Act has been effective at reducing pollution from point sources, it provides limited regulatory oversight of nonpoint source pollution, particularly agricultural nutrient runoff. To evaluate whether agriculturally intensive watersheds are adequately monitored for nutrients, we assessed long-term nutrient monitoring data (i.e., at least 40 measurements of nitrogen or phosphorus species within a 10-year period) from the U.S. Water Quality Portal and combined these records with watershed-scale (HUC-8) nitrogen and phosphorus input data from fertilizer and livestock manure application. The resulting dataset provides a spatiotemporally explicit view of agricultural nutrient inputs in relation to monitoring coverage across U.S. watersheds. Our analysis reveals substantial imbalances in nutrient monitoring coverage across agriculturally intensive regions of the U.S. Many watersheds with high nitrogen and phosphorus inputs are poorly monitored or lack long-term nutrient records entirely. These gaps are most pronounced in the Midwest, California's Central Valley, and portions of the Atlantic and Gulf Coastal Plains, where agricultural nutrient inputs are high but monitoring coverage is sparse. In contrast, watersheds with more extensive monitoring are often associated with major downstream waterbodies with established Total Maximum Daily Loads, such as the Chesapeake Bay. Uneven monitoring coverage limits the ability to quantify nutrient fluxes, evaluate management effectiveness, and support reliable nutrient mitigation strategies.

**Rekha Pandey**<sup>1</sup>, Arjun Kafle<sup>2</sup>, Heike Bücking<sup>3</sup>, and Kevin Garcia<sup>1</sup>

**Graduate Programs and Institutions:** Crop and Soil Science<sup>1</sup>; USDA Agricultural Research Service<sup>2</sup>; Division of Plant Science & Technology, University of Missouri<sup>3</sup>

**Advisor:** Kevin Garcia

**Poster Number:** 130

### **Phosphorus and Nitrogen Availability Regulate the Arbuscular Mycorrhizal Symbiosis-Mediated Potassium Transport in *Medicago truncatula***

Arbuscular mycorrhizal (AM) fungi are well known to improve phosphorus (P) acquisition in plants. However, their role in transporting other essential macronutrients, particularly potassium (K), a key regulator of osmotic balance and stress tolerance, remains understudied despite widespread limitations of this element in agricultural soils. Moreover, how P and nitrogen (N) interact with K transport in AM symbiosis is least understood. Here, we investigated how P and N availability regulate AM-mediated K transport in *Medicago truncatula* colonized by the AM fungus *Rhizophagus irregularis*. For K and P interaction, plants were colonized or not, grown in two-compartment systems, and watered with high and low K and P levels. Rubidium (Rb) was used in the fungal compartment as a K analog to trace the fungal-mediated K transport. Root colonization and the abundance of arbuscules and vesicles varied across nutrient regimes, with reduced colonization under low K and P. Arbuscules dominated under high K and low P, indicating functional symbiosis, while higher vesicles in high K and high P indicated a less cooperative symbiosis. AM plants showed higher K content overall and under high K conditions compared to low K levels, supported by an increased Rb content and strong K-Rb correlation. Carbon and nitrogen content varied across nutrient regimes, showing higher levels under AM HK and HP. AM-mediated K transport is tightly regulated by P availability. Similar ongoing analysis of K and N interactions will further clarify the role of AM fungi in multiple nutrient regimes, relevant to crop resilience under K-limited conditions.

**Alden Sears**

**Graduate Program:** Plant Biology

**Advisor:** Will K. Petry

**Poster Number:** 149

### **Untangling Associational Effects via Resources and Insects on Plant Community Assembly**

The maintenance of species diversity depends on how individual fitness is impacted by neighbors with shared resources, mutualists, and enemies. Importantly, the fitness impact of neighbors cannot be predicted from the strength or the sign of a focal individual's interaction with the intermediary. For instance, neighbors may attract more mutualist pollinators that increase focal fitness, or, alternatively, may decrease the focal's fitness by competing for limited pollination service. Likewise, neighbors may recruit more herbivores that reduce focal fitness, or, alternatively, dilute the risk of herbivore attack. Here we experimentally manipulated the density and species identity of flowering neighbors around focal individuals for all pairwise combinations of four wildflower species, then measured the sign and magnitude of plant-plant interaction coefficients separately via pollinator and seed predator intermediaries. We moreover measured plant-plant interactions via resources using naturally-occurring variation in plant density within experimental plots and on demographic transects. The natural history of interactions for our four species—first through resources to produce ovules, then through pollinators to turn ovules into seeds, and finally through seed predators that consume seeds—allowed us to decompose their relative impacts on overall plant-plant interactions by measuring per-capita effects on total ovule production, ovule-to-seed conversion rates, and predation escape rates.

Our work uncovered clear evidence of simultaneous competition and facilitation via resources, pollinators, and seed predators amongst our plant species. Effects on total ovule production with increasing neighbor density were largely weak or absent. Meanwhile, effects on ovule-to-seed conversion and predation escape rates were strongly competitive and facilitative both within and among species. These results show that insect mediators of plant interactions produce comparably strong impacts on realized seed production between neighboring plants—indicating that perturbations to either guild (seed predators or pollinators) could have profound impacts on the ability of species to coexist.

**Skye Sgouridis<sup>1</sup>, Sudikshya Paudel<sup>1</sup>, Xiaoqiu Wang<sup>1,2</sup>, and Ethan Lee<sup>1</sup>**

**Graduate Programs and Institutions:** Animal Science<sup>1</sup>; The Comparative Medicine Institute<sup>2</sup>

**Advisor:** Xiaoqiu Wang

**Poster Number:** 150

### **Epigenetic Control of Uterine Development by SIN3A Coordinates Morphogenesis and Adenogenesis**

Postnatal uterine morphogenesis and gland development are critical processes in most mammals and involve coordinated organization of complex biological processes. Here, we identify Switch-Independent 3A (SIN3A) as a previously unrecognized epigenetic regulator of uterine morphogenesis and adenogenesis. SIN3A is a highly conserved scaffold protein and transcriptional coregulator that modulates chromatin structure and gene expression through context-dependent recruitment of chromatin-modifying complexes. SIN3A can mediate both transcriptional repression or activation by altering chromatin accessibility. Analysis of human and mouse uterine tissues revealed that SIN3A is expressed in both epithelial and stromal compartments of the uterus. Given that SIN3A mutations are involved in uterine corpus endometrial carcinoma, we generated a progesterone receptor-driven conditional knockout mouse model, *PgrCre/+Sin3af/f* (*Sin3ad/d*). Unexpectedly, adult *Sin3ad/d* females exhibited markedly reduced uterine size and complete infertility. Histological and molecular analyses demonstrated that *Sin3ad/d* uteri display reduced uterine diameter, reduced stromal compartment, and a severe loss of endometrial glands compared with controls. Because *Pgr-Cre* mediated recombination occurs in both epithelial and stromal compartments beginning in early postnatal life, we examined neonatal uterine development. *Sin3a* mRNA was robustly expressed in luminal epithelium and stroma as early as postnatal day (PND) 5. Compared with controls, *Sin3ad/d* neonates exhibited significantly smaller uteri by PND 15 and 21, accompanied by shortened and poorly branched glands, while ovarian development remained unaffected. These findings indicate that loss of SIN3A disrupts epithelial-stromal crosstalk required for proper uterine morphogenesis and gland development during neonatal uterine maturation. Collectively, our results establish SIN3A as a critical epigenetic regulator of postnatal uterine development and reveal a previously unappreciated role for chromatin remodeling in coordinating uterine morphogenesis and adenogenesis. This work provides a conceptual framework for dissecting epigenetic mechanisms underlying uterine development and fertility.

**Kaira Sidhwa**

**Graduate Program:** Food Science

**Advisors:** Fernanda Santos and Deepti Salvi

**Poster Number:** 155

### **Closing the Loop: Evaluating Sweetpotato and Peanut Byproducts as Alternative Feeds for Tenebriomolitor Protein Production**

The world population is growing rapidly, increasing pressure on global food security, especially protein. In consequence, insect rearing is slowly gaining recognition as a viable source of protein, with numerous studies being conducted in this field.

This study investigates *Tenebriomolitor*, commonly known as the mealworm, as an alternative source of protein. It aims to study rearing practices and identify an optimal diet that boosts the protein yield using upcycled food waste, such as sweetpotato peels and peanut skins, thereby reducing dependence on traditional wheat bran, an expensive feed source.

Sweetpotato peels were dehydrated prior to grinding. The particle size of sweetpotato peels, peanut skins, and wheat bran was standardized. Mealworm larvae (3 g) were reared in identical containers with 25 g of feed and 10 g of raw carrot to maintain moisture. Individual boxes were placed in incubators for observation. Each week, the worms and feed were separated using a graduated sieve, weighed, and then the feed was replaced. Following three weeks of growth, the worms were separated and freeze-dried for proximate analysis.

Larval growth rates over time showed a steady increase in mealworm body weight, indicating uptake of the different feed sources, as indicated by frass, feed, and larval weight comparisons. Comparable values were found for the approximate digestibility of the feed sources. The results of the proximate analysis revealed minor differences in the moisture, protein, crude fiber, ash, and crude fat compositions of mealworms fed different diets, particularly in protein content ( $52.17 \pm 6.20\%$ ). Thus, the sweetpotato and peanut skin feeds show potential as alternative feed sources when compared to the more expensive wheat bran.

By integrating circular-economy principles, this project provides a tangible pathway to scale sustainable protein technologies with measurable social, environmental, and commercial impacts.

**Madison Lawson Sullivan**<sup>1</sup>, Pauline Grist<sup>1</sup>, Brenna Kirk<sup>1</sup>, Jocelyn Dixon<sup>1</sup>, Dara Bloom<sup>1</sup>, Tamara Young<sup>2</sup>, Basheerah Enahora<sup>1</sup>, and Virginia C. Stage<sup>1</sup>

**Graduate Programs:** Agricultural Education and Human Sciences<sup>1</sup>; Educational Leadership, Policy, and Human Development<sup>2</sup>

**Advisor:** Virginia C. Stage

**Poster Number:** 158

### **Understanding Go NAPSACC Implementation: Perspectives from North Carolina Technical Assistance Consultants**

The early childhood years are pivotal for developing lifelong healthy habits. For this reason, our study focused on the Go Nutrition and Physical Activity Self Assessment for Child Care (NAPSACC), a tool designed to help childcare providers improve young children's health through physical activity and nutrition-related practices, policies, and environments. We examined the lived experiences of the tool's Technical Assistance (TA) Consultants who help childcare providers improve practices in North Carolina (NC) (n = 10). We studied how TA Consultants experience success, their implementation barriers, and the support they need for effective implementation. We used a phenomenological qualitative design, with additional quantitative data collected through a pre-interview survey. Ten NC Go NAPSACC TA Consultants were interviewed using semi-structured in-depth telephone interviews. To participate in the study, individuals had to be trained as a Go NAPSACC TA Consultant, be at least 18 years old, have implemented the Go NAPSACC tool with at least one childcare program, and agree to participate willingly. Results showed that TA Consultants operated in various ways; some chose a hands-on consulting model, while others provided only resources. Consultants reported challenges navigating a childcare climate marked by high staff turnover, limited financial resources, and time constraints, as well as difficulties integrating Go NAPSACC into their full-time jobs. Support in these areas was desired. Each consultant experienced success differently, with the common thread that they felt successful when they perceived themselves as having achieved a personal goal. Ultimately, the Go NAPSACC tool, as perceived by Go NAPSACC TA Consultants, exhibits sufficient variability in implementation, which may affect its effectiveness. Providing more precise definitions of a TA Consultant's role may improve the overall experience for consultants and increase the likelihood of achieving the tool's goal of improving health-related policies and practices in childcare centers in NC.

**Kairi Tanaka**<sup>1,2</sup>, Carla Sanchez<sup>1</sup>, Bai Li<sup>3</sup>, and Zhe Lyu<sup>1</sup>

**Graduate Programs and Institutions:** Microbiology<sup>1</sup>; Animal Science<sup>2</sup>; Clinical Laboratory Science, University of North Carolina at Chapel Hill<sup>3</sup>

**Advisors:** Zhe Lyu and Vivek Fellner

**Poster Number:** 162

### **Manhole Wastewater Methanogens – A Potential Source of Explosive Greenhouse Gas**

Methanogenic archaea (methanogens) are a major source of methane production in the urban sewer systems, contributing significantly to anthropogenic methane emissions. In a modern sewer system, urban wastewaters converge at manholes and flow through city sewer lines to wastewater treatment plants (WWTPs). While it is well established that methane emissions from WWTPs account for 6% of global methane emissions, the contribution from the upstream components of the sewer system is poorly understood. Besides its greenhouse impact, accumulation of methane in the sewer system is a safety hazard, leading to 3,000-5,000 manhole events (explosions and fires) annually in the US alone. This underscores an urgent need to understand wastewater methanogens beyond those in the WWTPs. Here, we employed cultivation-independent and -dependent approaches to investigate the presence of methanogens in manhole wastewater samples (n=39) collected across Houston, TX. Shotgun metagenomics showed 92% of the samples (n=36) contained archaea, and their mean relative abundance was 0.40% (0.003-1.89%) in the overall microbiome. Hydrogenotrophic methanogens dominated the archaeal populations (0.32%±0.27%), which could be clustered into two groups: Mb and Ms. Mb consisted largely of *Methanobrevibacter* spp. (0.33%±0.23%) and occasionally *Methanobacterium* spp. across 32 samples, while the dominant methanogen was *Methanospirillum lacunae* (0.02%±0.02) in the remaining four. At least four *Methanobrevibacter* species were identified in Mb, including *M. smithii* (0.24%±0.19%), *M. intestini* (0.08%±0.11%), unclassified *M. sp. UBA412* (0.07%±0.14%), and *M. arboriphilus* (0.004%±0.005%). Methanogens capable of acetoclastic and/or methylotrophic pathways were rare (0.13%±0.15%), including *Methanotherix*, *Methanosphaera*, *Methanomethylovorans*, and *Methanosarcina*. To test the viability of manhole methanogens, one sample was cultivated in a methanogen enrichment medium supplemented with H<sub>2</sub> and formate, and later antibiotics. The enrichment cultures were methane positive and highly enriched with autofluorescent cells (λ<sub>Ex</sub>/Em=420/480nm), indicative of methanogens. Plating on an anaerobic agar medium ultimately yielded nine isolates, which belong to *M. intestini* as determined by *mcrA* and genome sequencing. In conclusion, manhole methanogens are dominated by viable hydrogenotrophic methanogens, whose composition closely resembles that in the human gut. In contrast, WWTPs typically favor acetoclastic methanogens where hydrogenotrophs are secondary. Taken together, these results indicate that contribution of hydrogenotrophs to wastewater methane emissions is likely underestimated. Future studies are needed to further quantify their activities across the sewer system.

**Noah Totslie**, David F. Ritchie, Prasanna Joglekar, and Alejandra I. Huerta  
**Graduate Program:** Entomology and Plant Pathology  
**Advisor:** Alejandra I. Huerta  
**Poster Number:** 165

### **Spatiotemporal Population Genomics of Pepper Bacterial Spot Xanthomonads in the Southeastern United States**

Bacterial Spot (BS) of pepper is an economically destructive, yield-limiting plant disease worldwide, caused by four *Xanthomonas* taxa: *X. euvesicatoria* pv. *euvesicatoria* (Xee), *X. euvesicatoria* pv. *perforans* (Xep), *X. vesicatoria* (Xv), and *X. hortorum* pv. *gardneri* (Xhg). This pathogen complex has undergone population shifts in pepper production systems worldwide. To test if a population shift occurred in North Carolina, I developed a multiplex PCR framework that targeted clade-specific loci to distinguish the four pathogens. I then used this framework to characterize 1,037 bacterial strains isolated from pepper and tomato plants collected across the continental US and the last five decades, with emphasis on North Carolina. My data support a population shift in North Carolina towards Xep on pepper. I hypothesize this shift is driven by genomic factors governing pathogen fitness and niche adaptation. To test this hypothesis, I selected ~200 isolates representing my collection's taxonomic, temporal, host, and geographic diversity for long-read whole-genome sequencing, assembly, and annotation. I will next perform comparative genomics including SNP-based population structural analysis, phylogeography, codon-based positive selection, and molecular-clock analysis, using an array of genomic tools. My research will provide mechanistic insights into pathogen population shifts and will inform a computational framework for monitoring emerging lineages of plant pathogens.

**Asher Utz**, Linlin Ma, Brenna Zimmer, Emily Allego, Jade Fluharty, Pooja Narasimhan, Dalton Hilovsky, Xiaojing Liu, Joseph Barycki, and Melanie Simpson  
**Graduate Program:** Molecular and Structural Biochemistry  
**Advisor:** Melanie Simpson  
**Poster Number:** 167

### **UDP-glucose dehydrogenase is a novel AGC kinase target that promotes prostate tumoroid formation and glycome aberrations**

Aberrant proteoglycan expression is a significant and driving feature of cancer progression. The synthesis of proteoglycans requires UDP-glucuronate, a sugar precursor produced by a sole enzyme, UDP-glucose dehydrogenase (UGDH). UGDH is implicated in the progression and severity of several epithelial cancers, and its regulation of glucuronate presents an attractive target for the control of biosynthetic processes that drive invasion and metastasis. Computational and in vitro studies of UGDH revealed a highly conserved phosphorylation site (Ser 316) near the dimeric interface of the homohexameric UGDH assembly. Kinases RSK2, S6K1, and SGK1 were found to phosphorylate UGDH Ser316 in vitro. To test functional consequences of S316 phosphorylation, we performed site-directed mutagenesis to generate UGDH phosphodeficient (UGDH S316A) and phosphomimetic (UGDH S316D) point mutants. The UGDH mutants behaved similarly to WT UGDH in assays that measured the stability and kinetic activity of purified protein but had significant functional impacts when expressed in prostate cancer cells. Cells bearing the phosphomimetic UGDH S316D mutation exhibited increased tumoroid growth and elevated global glycan expression, compared to those with wild-type UGDH. In contrast, cells expressing the phosphodeficient UGDH S316A mutation had markedly less tumoroid growth and reduced glycan expression. These results support a functional role for UGDH phosphorylation status at S316 in directing UDP-glucuronate into biosynthetic pathways, thereby promoting anchorage-independent growth, a hallmark of tumorigenesis. Further studies aim to determine the precise mechanism linking UGDH activity and phosphorylation status to changes in glycan composition.

**Katie Vollen**, Chengsong Zhao, and Anna Stepanova

**Graduate Program:** Plant Biology

**Advisors:** Anna Stepanova and Jose Alonso

**Poster Number:** 172

### **Expanding the Precision Editing Toolbox: DarT Append Editing in Plants**

Base editing tools are transforming plant biotechnology, enabling precise single-nucleotide changes for trait improvement and sophisticated functional genomics. However, it remains challenging to introduce these desirable sequence modifications at a specific location within the genome due to efficiency constraints and target sequence limitations. Thus, further development and optimization of precision editing tools are required to increase the flexibility and efficiency of these tools. Append editing is a new base editing technology with the potential to diversify the base-editing toolbox. This system fuses the bacterial ADP-ribosyltransferase DarT to a Cas9 nickase (nCas9), enabling targeted modification of thymine (T) bases to adenine (A), cytosine (C), or guanine (G) without introducing double-strand breaks. nCas9 directs DarT to the target site and creates a nick on the non-target strand, while DarT attaches a bulky ADP-ribose adduct onto the target T. During DNA replication, this bulky adduct is reconciled through a combination of translesion synthesis and nucleotide excision repair pathways, resulting in a base change. We are currently optimizing and testing append editing in *Nicotiana benthamiana*, establishing its activity and characterizing different editing outcomes in plants.

**Muhammad Wajeeh UI Hassan**<sup>1</sup>, Nivedita Pareek<sup>2</sup>, and Lisa R. Bielke<sup>1</sup>

**Graduate Programs and Institutions:** Prestage Department of Poultry Science<sup>1</sup>; School of Medicine, University of North Carolina at Chapel Hill<sup>2</sup>

**Advisor:** Lisa R. Bielke

**Poster Number:** 173

### **Assessing Potential Maternal Transmission of Bacteria from Broiler Breeder Hens to Chicks Using Whole-Genome Sequencing**

The poultry gut microbiome is critical for digestion, immunity, and disease resistance, but artificial incubation limits maternal transfer, causing chicks to develop microbiomes largely shaped by their environment. This study characterized the microbiome of broiler breeder hens and day-of-hatch chicks and assesses the potential for bacterial transmission between them. Samples from five 69-week-old hens including ceca, crop, small intestine, cloaca, and eggs, day-of-hatch chicks, and hatchery fluff were processed for whole-genome shotgun sequencing. DNA was processed for whole genome sequencing. Reads were quality-filtered, trimmed, and taxonomically classified with Kraken2/Bracken. Results showed that alpha diversity, measured by Pielou's evenness, ranged from 0.72 to 0.89, indicating generally balanced microbial communities across sample types. The ceca and small intestine were the most stable, while the crop and day-of-hatch GIT showed greater variability. Although some site pairs showed minor differences ( $p < 0.05$ ), none remained significant after correction ( $q > 0.05$ ). Bray-Curtis PERMANOVA showed that the cloaca and small intestine were the hen sites most similar to the day-of-hatch GIT, with only non-significant differences ( $q = 0.16-0.17$ ), suggesting potential maternal contribution and some continuity along the intestinal axis. Eggshells and hatchery fluff showed similar microbial profiles ( $q = 0.21$ ) and were not significantly different from the small intestine or day-of-hatch GIT ( $q = 0.05-0.21$ ). In contrast, the ceca and crop formed distinct communities ( $q \leq 0.03$ ) and are unlikely contributors to initial chick microbiota. Our findings indicate that the cloaca and small intestine are the most likely maternal contributors to early chick microbiota, while the hatchery environment also plays a significant role. Small intestinal and cloacal communities most closely resembled day-of-hatch GIT profiles, whereas ceca, crop and fluff showed minimal sharing, suggesting early colonization reflects combined hatchery exposure and maternal input. Strain-level resolution is required to assess individual maternal bacterial transfer.

**M.C. Williams<sup>1</sup>, S.A. Bowdridge<sup>2</sup>, and A.R. Weaver<sup>1</sup>**

**Graduate Programs and Institutions:** Animal Science<sup>1</sup>; Animal & Nutritional Sciences, West Virginia University<sup>2</sup>

**Advisors:** Andrew Weaver and Daniel Poole

**Poster Number:** 181

### **Relationship Between Immune Fitness and Maternal Productivity Traits in Katahdin Sheep**

Antibody response to vaccination may be used to quantify immune fitness. Understanding relationships between immune fitness and maternal productivity traits is necessary to optimize breeding objectives. The objective here was to evaluate antibody concentration post-Clostridium perfringens Type C&D and *C. tetani* (CDT) vaccination relative to maternal traits in Katahdin sheep. Purebred Katahdin sheep from the Upper Piedmont Research Station (UPRS; Reidsville, NC; n = 46) and North Carolina State University Small Ruminant Education Unit (SREU; Raleigh, NC; n = 39) were born mid-February to early March 2024. Lambs were given an initial CDT vaccination on April 4 (UPRS) and April 24 (SREU) followed by booster on April 24 (UPRS) and May 13 (SREU). Serum was collected seven days post-booster vaccination for IgG antibody concentration analysis via the Valita Titer assay. All lambs were enrolled in National Sheep Improvement Program (NSIP) with phenotypes submitted for growth, maternal, and fecal egg count traits. Maternal estimated breeding values (EBVs) including weaning weight (WWT), maternal weaning weight (MWWT), number of lambs born (NLB), number of lambs weaned (NLW), and Maternal Hair Index were summarized from September 2025 data run. A subset (n = 26) of 2024 spring-born ewe lambs were exposed for breeding in April 2025. Pregnancy status in these yearling ewes was assessed by ultrasound 38 days after ram removal (June 23). Effects of location (UPRS vs. SREU), birth and rear type, and sex on IgG status were analyzed with SAS (9.4) along with relationships between IgG response to vaccination and maternal EBVs. A post-hoc analysis of IgG concentration based on pregnancy status was performed to evaluate effects of response to vaccination as lambs on fertility as yearling ewes. There were no effects of litter size, sex, nor birth location ( $P > 0.05$ ). No correlations existed between IgG concentration and WWT, MWWT, NLB, NLW nor Maternal Hair Index EBVs ( $R^2 = 0.003, 0.008, 0.001, 0.004$  and  $0.002$ ; respectively). Yearling ewes confirmed pregnant had lower IgG concentrations compared to open ewes ( $P < 0.05$ ). These data indicate response to vaccination measured by IgG concentration one week post-booster injection is likely independent from genetic potential for many ewe productivity traits. However, no EBV is available for fertility. The ability to mount a greater immune response to vaccination is potentially an indicator of decreased ability to establish a pregnancy. Thus, additional investigation is needed to explore the relationship between response to vaccination and pregnancy outcomes.

**Seung Hyun Yoo**, Millena Cruz, Ajinkya Atkare, Jonathan Allen, and Minliang Yang

**Graduate Program:** Food, Bioprocessing and Nutrition Sciences

**Advisor:** Minliang Yang

**Poster Number:** 187

## **Evaluating Environmental and Nutritional Impacts of Dietary Patterns via Nutritional Life Cycle Assessment (nLCA)**

### **Methods**

Switching the current US diet to recommended diets has been proposed for decades to have positive impacts on both environmental sustainability and human health through their nutritional quality. While many studies assess environmental or nutritional impacts separately, few integrated both metrics and assessed potential trade-offs or co-benefits between them. This study aims to fill this gap by evaluating five US dietary patterns via a farm-to-ready for market nutritional life-cycle assessment (nLCA) method. Each diet was assessed at a 2,000-kcal daily intake for adults. Environmental impacts were measured using life cycle assessment, diet quality was assessed using the Healthy Eating Index (HEI), and integrated impacts were evaluated using the Environmental-Healthy Eating Index (EHEI). Results showed that the Mediterranean (MED) and Eat Healthy Your Way (EHYW) diets had the lowest environmental burdens across multiple impact categories, and the vegetarian diet showed the highest nutritional quality. Combining both metrics into EHEI, EHYW diet was found to be the most sustainable diet. It's also found that MED diet showed the most consistent performance across individual environmental impact scenarios. Overall, nLCA measures both environmental and nutritional sustainability and able to identify the potential trade-offs among the dietary patterns. Additionally, this method could provide evidence to inform dietary guidelines, policy development, and consumer decision-making towards more sustainable diets.

# College of Design

**Raja Manikam Bandari**  
**Graduate Program:** Design  
**Advisor:** Robin Abrams  
**Poster Number:** 16

## **Urban Cities Have Evolved Dramatically Over Time, Transitioning From Small Settlements to Expansive Metropolises with Sprawling Boundaries**

This process of urban growth, often associated with urban sprawl, has become a defining feature of American cities, particularly in the post-2000 era (Glaeser & Kahn, 2004). Central to this transformation is the influence of the automobile, which has fundamentally reshaped urban design and transportation patterns. Car-centric urban planning, a response to widespread automobile use, often leads to urban sprawl, causing population densities to decrease in the outskirts of cities. As cars became the primary mode of transportation, they introduced a new layer of independence in commuting and spatial organization.

However, the study of urban growth, particularly in cities like Raleigh, requires a multifaceted approach. Raleigh's historical design, rooted in a gridiron pattern, provides a sharp contrast to its contemporary fractal-like urban growth, a phenomenon that challenges traditional urban planning models. This study primarily aims to explore the various methodologies used to understand urban growth and briefly look into the dynamic factors that have shaped Raleigh's morphological evolution. Specifically, it seeks to evaluate how historical data, such as maps and census records, can be integrated with modern geospatial tools like GIS and remote sensing to analyze urban expansion.

By examining Raleigh as a case study, this research will investigate the strengths and limitations of using historical and modern data sets in understanding the city's growth patterns. The study will also explore the factors contributing to urban sprawl in the Triangle area and the ways in which cities in this region expand towards one another over time. Ultimately, this research aims to contribute to the broader field of urban studies by developing an integrated framework for studying urban growth that bridges the gap between historical and contemporary methodologies.

The findings of this research will provide valuable insights for urban planners, policymakers, and scholars, offering a deeper understanding of how car-centric design has influenced Raleigh's expansion. Additionally, it will suggest alternative growth strategies to enhance urban sustainability and efficiency, informing future urban planning practices and policies.

**Kimaya Chougule**

**Graduate Program:** Graphic and Experience Design

**Advisors:** Deborah K. Littlejohn and Valeria López Torres

**Poster Number:** 34

### **Designing a Decision Support Interface to Reduce Cognitive Oversimplification in Medicinal Chemistry Compound Prioritization**

**Abstract:** Drug discovery is a lengthy and resource-intensive process, often spanning over a decade with very low success rates. It involves repeated cycles of designing, synthesizing, testing, and analyzing molecular compounds, within which medicinal chemists play a key role by designing new compound variations and deciding which ones to prioritize for synthesis. These prioritization decisions directly impact project timelines and resource allocation, and require evaluating compounds across numerous molecular properties simultaneously. Yet prior research shows that, in practice, chemists often unconsciously narrow this complex, multi-parameter evaluation process. This cognitive oversimplification often goes unrecognized by the chemists themselves, potentially leading to less effective compound selections. Additionally, fragmented workflows that distribute compound data across disconnected tools make it harder to evaluate the full picture, highlighting the need for interfaces that better support how chemists evaluate and compare compounds. This thesis explores the design of a decision support interface that helps chemists approach compound prioritization more systematically, without replacing their expert judgment. Through the design and evaluation of visual prototypes informed by existing literature and expert interviews, this study focuses on multi-parameter comparison, parameter awareness, and decision capture, with the goal of deriving design principles to reduce cognitive oversimplification in expert decision-making workflows.

**Heather Hennessey**

**Graduate Program:** Graphic and Experience Design

**Advisors:** David Oh and Deborah Littlejohn

**Poster Number:** 75

### **Communicating Marine Research for Conservation Action**

Human societies depend on healthy oceans for benefits including food provision, carbon storage, and natural resources, though ocean health is not widely viewed as a critical issue among the general public. Effective conservation requires participation from both scientific and non-scientific parties. However, there is a significant knowledge gap separating those groups. Addressing this gap requires communicating in ways that resonate with diverse groups and audiences (Vonk et al., 2024). Designing a tool that helps marine conservationists translate ecosystem and species data into compelling narratives would strengthen public awareness, engagement, and sustainable action (Reamer, 2022). This project investigates the disconnect between marine conservationists and non-scientific communities with the aim of fostering empathy and conservation-oriented practices among the general public. It explores how user experience and interface design can create a digital communication tool that improves the delivery of marine science information through data translation, audience research, and narrative construction. This research incorporates user interviews, archetype development, user journey mapping, and iterative design methods to understand how marine conservationists can effectively communicate with target audiences. This work ultimately proposes strategies for enhancing engagement between marine conservationists and the general public in ways that encourage empathy and action.

**Seungmin Lee**  
**Graduate Program:** Design  
**Advisor:** Soolyeon Cho  
**Poster Number:** 97

### **Forecasting High-Impact, Low-Probability Power Outages with Temporal Fusion Transformers: A Case Study of Wake County**

Climate-driven extreme weather and aging grid infrastructure have heightened the risk of high-impact, low-probability power outages, posing significant challenges for reliable forecasting. This study evaluates the Temporal Fusion Transformer (TFT) for short-term outage prediction in Wake County, North Carolina, by integrating 15-minute interval outage data from the United States Department of Energy's EAGLE-I platform (2018–2023) with synchronized meteorological observations from the Automated Surface Observing System. Weather-related events were identified using datasets from the National Oceanic and Atmospheric Administration and the Pacific Northwest National Laboratory, and a logarithmic transformation was applied to address skewed outage magnitudes. The TFT architecture combines recurrent encoding, multi-head attention, and quantile-based forecasting, and its performance was benchmarked against a Long Short-Term Memory (LSTM) network using mean absolute error (MAE), the coefficient of determination ( $R^2$ ), and quantile root mean squared error (Quantile RMSE). The TFT achieved an  $R^2$  of 0.777 and reduced MAE by nearly 50 percent relative to the LSTM, with consistently lower Quantile RMSE across the 10th, 50th, and 90th percentiles. Probabilistic outputs produced narrower and more reliable prediction intervals, while variable importance and attention analyses highlighted atmospheric pressure and recent temporal context as dominant predictors. Despite the rarity of extreme outages and the exclusion of grid infrastructure data, the study demonstrates the potential of transformer-based architectures with quantile forecasting to improve outage prediction accuracy, interpretability, and operational value for resilience planning.

**Rosa McDonald**  
**Graduate Program:** Design  
**Advisor:** Wayne Place  
**Poster Number:** 110

### **Architectural Solar Control Assessment: The Impact of Four Strategies on Building and Occupant Factors on the East and West Facades of Offices**

There is currently limited knowledge on the effectiveness of solar control techniques on east- and west-facing facades, and there is limited agreement on when and how they should be used. Authoritative sources recommend using the less effective techniques on these sides or to decrease the amount of glazing, but evidence suggests that people prefer having windows for access to daylight and nature, so decreasing glazing amount is also not an ideal solution. Designers need a better understanding of the performance of solar control techniques on the east and west of buildings. The purpose of this research study is to assess the effectiveness of shading techniques on those facades of buildings, taking into account both benefits to the building functionality and benefits to the occupants. Using Ecological Psychology's Theory of Affordances, building-focused and occupant-focused affordances are explored through a mixed methods explanatory sequential methodology consisting of an experiment, survey, and in-depth interviews. This study can provide a baseline for future research in this area, contribute methodologically, and offer a more holistic understanding of the benefits and drawbacks of solar control techniques on the east- and west-facing facades of buildings by including both instrument measurements and direct perceptions, preferences, and opinions of occupants.

**Grace McNabb****Graduate Program:** Media, Art, and Design Technology**Advisors:** Tania Allen, Justin Johnson, and Patrick Fitzgerald**Poster Number:** 113**Time To Sleep**

Mobile games can be used to create a natural stopping cue to power down devices at the end of the day, like Animal Crossing or A Short Hike. This paper will specifically address mobile games designed for children. Children's overall screen time use is at an all time high, and it is an increasing struggle for parents to get their children off devices at the end of the day. Features such as time limits have been implemented to combat this issue, but fail to address the emotional component of interrupting games. My app, Time To Sleep, will function to wean children from the devices by creating a low-arousal game play experience. It will guide them through a bedtime routine gradually, and subliminally send messages that it is time to turn off the device. Additionally, this game is meant to be played with parent and child to support feelings of connection which is vital to healthy development.

**Colin McNeill****Graduate Program:** Industrial Design**Advisor:** Kelly Umstead**Poster Number:** 114**Avalanche Survivability**

This project aims to identify possible ways to reduce the number of avalanche related fatalities incurred by backcountry skiers & snowboarders. By identifying gaps in backcountry trip planning, backcountry safety procedures, or avalanche recovery & survivability, the project has the potential to create a safer way to enjoy backcountry travel.

The backcountry safety market focuses on solutions for preventing avalanche burial and recovering victims. Currently, avalanche risk decision-making relies on broad-range forecasts of danger areas and individual subjective risk assessment. Skiers need interventions for more precise decision-making in avalanche terrain, and solutions to extend the window of survivability in the event of an avalanche burial.

**Christopher E. Mismash**  
**Graduate Program:** Design  
**Advisor:** Elen Deming  
**Poster Number:** 116

### **The Social Media Governance Crisis: Why Centralized Governance is Failing and What Commons Governance Can Teach Us**

Social media platforms face recurring governance and legitimacy crises, particularly during periods of unrest when contextual knowledge is most critical. Centralized governance models often struggle to incorporate dispersed, local knowledge into decision-making—a challenge this research conceptualizes as the Peripheral Knowledge Problem (PKP), drawing on Hayek's account of distributed knowledge and Scott's critique of high-modernist planning.

Commons governance scholarship suggests that polycentric arrangements may better integrate peripheral knowledge under stress. This research asks: Which governance mechanisms that successfully integrate peripheral knowledge in physical commons contexts can inform platform governance during crisis?

Using comparative case study method, the study introduces and applies an original Rules–Culture–Design (RCT) framework developed in this research to examine three bounded crisis episodes: the Fargo–Moorhead Flood Diversion Project governance conflict; the Maple Street Community Garden dispute in New York City; and a platform governance crisis during civil unrest (case selection in progress). The unit of analysis is the governance mechanism (Ostrom) under stress (e.g., intake, escalation, sanctioning). Each case is evaluated through a seven-layer artifact corpus designed to distinguish formal rules, cultural practices, and design affordances. Mechanisms are assessed using shared operational indicators across four dimensions—legitimacy, knowledge flow, enforcement, and adaptability—scored on a 0–3 institutionalization scale.

The project will produce a cross-case mechanism matrix and pattern library identifying which commons governance routines translate across physical and digital contexts, with implications for platform governance design under crisis conditions.

**Ijeoma Njaka**  
**Graduate Program:** Design  
**Advisor:** Tania Allen  
**Poster Number:** 124

### **Learning Among Commemoration: The Educational Impact of On-Campus Memorials to the Enslaved**

The founding of universities in the colonial United States has clear connections to the transatlantic slave trade and promoting white supremacy. In the last two decades, many institutions have started acknowledging and investigating their historical ties to enslavement. These research efforts often yield formal recommendations by way of reconciliation and repair, and physical memorials or commemorations to the enslaved are frequently pursued. Memorials and monuments serve a pedagogical function. Additionally, they are not neutral; monuments and memorials are instead contextual and partisan while aiming to be effective. On a university campus, memorials to the enslaved physically transform the campus landscape with the potential to transform the education of its students. This study asks: how does engagement with memorials to the enslaved on college campuses foster transformative learning for undergraduate students? This poster outlines a mixed methods research design informed by transformative learning theory and critical university studies to examine if on-campus memorials to the enslaved reach their pedagogical intentions.

**Cornelius Ojo**

**Graduate Program:** Design

**Advisor:** Traci Rose Rider

**Poster Number:** 128

### **A Coherence-based Study of the Post-Disaster Environments in Wilmington and Kinston, North Carolina**

Climate-driven disasters are intensifying. In 2024 alone, 27 catastrophic events in the United States (U.S.) caused 568 deaths and over \$180 billion in losses, with North Carolina experiencing nine of these events (NCEI, 2025). Increasingly frequent 100-year floods and human settlement patterns that amplify hazard exposure raise an important question: are our communities places where people can maintain well-being amid recurring hazards even as they try to survive? This study examines how residents of two hurricane-prone communities in North Carolina (Wilmington and Kinston) navigate daily life in the face of recurrent environmental challenges. Drawing on the Sense of Coherence framework, the project employs a validated sense of coherence survey and semi-structured narrative interviews to assess residents' confidence in their environments' ability to support their well-being and the reasons behind their perceptions. Findings from this study aim to help planners, designers, and policymakers create community environments that strengthen coherence, reduce avoidable stressors, and enhance long-term resilience in hurricane-prone regions.

**Laura Próspero**

**Graduate Program:** Media Arts, Design and Technology

**Advisor:** Jedidiah Gant

**Poster Number:** 137

### **Her Touch: How Interactive Immersive Installations Can Become a Storytelling Space for Lesbian Visibility**

Lesbian stories have often existed in silence, expressed through gestures, memories, and intimacy rather than public representation. Her Touch explores how interactive immersive installations can function as a storytelling space to make lesbian experiences emotionally visible through affect, presence, and interaction. Inspired by *La insumisa* by Cristina Peri Rossi and the paintings of Petrona Viera, this thesis project translates fragments of memory, affection, and restraint into light, movement, and sound.

The project takes the form of an immersive, interactive installation developed using TouchDesigner, animated visuals, sound design, motion sensors, a microphone, and a touch sensor connected to an Arduino Uno. The installation responds to the presence, movement, sound, and touch of visitors, allowing their bodies to become part of the narrative and shaping the visual environment through subtle interaction.

Grounded in Queer Theory, Affect Theory, and Media Ecology, the project reflects on how interactivity can shift lesbian invisibility toward perceptibility by transforming small gestures into visible traces of light and color. Audience interaction activates visual responses that accumulate over time, some leaving visible traces while others remain ephemeral, shaping a shared emotional space through bodily presence and interaction.

This research asks how interactive immersive installations can operate as storytelling environments that amplify lesbian visibility. By prioritizing emotion, intimacy, and embodied participation, Her Touch proposes immersive technology as a medium for empathy and belonging, positioning interaction not as control or entertainment, but as a poetic and political act of visibility.

**Aisha Raja**

**Graduate Program:** Graphic and Experience Design

**Advisors:** Matthew Peterson and Deborah Littlejohn

**Poster Number:** 139

### **Supporting College Access at Scale: Designing a Management System for Near-Peer Mentoring Programs**

High school counselors play a critical role in supporting students through the college application process, yet increasing caseloads and limited time often constrain their ability to provide individualized guidance (Corwin et al., 2004). Near-peer mentoring programs, in which recent graduates offer relatable, experience-based support, have shown promise in extending college access, particularly for students navigating informational and cultural barriers (McCallen et al., 2025). However, counselors often lack effective tools to organize, monitor, and sustain these programs within existing school workflows (Majjate et al., 2024). This thesis explores how the design of a digital management system can support high school counselors in coordinating near-peer mentoring programs. The project investigates three design opportunities: interest- and needs-based mentor matching, progress visualization of mentor–mentee engagement, and flag-based communication for timely escalation of sensitive issues. Using a research-through-design approach informed by precedent analysis, interviews, and iterative prototyping, this work examines how design can improve information flow, oversight, and continuity of guidance. The resulting design framework demonstrates how thoughtfully designed digital tools can extend counselor capacity, strengthen near-peer relationships, and help sustain equitable college guidance for a broader range of students.

**Tess Stogner**

**Graduate Program:** Landscape Architecture

**Advisor:** Andrew Fox

**Poster Number:** 157

### **Expanding Access to Public Lands in Tyrrell County, North Carolina**

In 2023, visitors spent about \$6.94 million in Tyrrell County. That accounts for less than 1% of the \$35.6 billion spent on tourism across North Carolina in 2023. Even so, tourism still made a real difference in Tyrrell—saving each resident about \$173 in taxes, and helping pay for local public services like parks, roads, and safety. This shows that even a little tourism can go a long way in helping the community. In short, ecotourism is a smart way for Tyrrell County to grow its economy while also protecting the land, water, and culture that make it unique. (NCDOC)

Tyrrell County has abundant natural and cultural assets—including Pocosin Lakes National Wildlife Refuge and the Scuppernong and Alligator Rivers—that form the foundation of a rich ecotourism and outdoor recreation landscape attractive to both locals and visitors. These resources support wildlife habitat, water-based recreation, and heritage tourism that contribute to quality of life and community identity. Residents support increased access to these places, yet common barriers such as limited maintenance capacity, insufficient visitor infrastructure, and constrained funding hinder broader use and enjoyment of these assets. These gaps not only reduce local engagement with natural and cultural resources but also limit the county’s ability to fully capture tourism-related economic opportunities.

The goal of this project is to investigate the potential for expanding public access to public lands and waters in Tyrrell County, North Carolina, in order to strengthen environmental and economic resilience.

By addressing barriers to access and increasing targeted investments in maintenance, infrastructure, and protective land management, Tyrrell County can strengthen both its economic vitality and environmental resilience—leveraging its ecological and cultural richness into sustained benefits for residents, landowners, and visitors alike.

**Qionglan Wang**

**Graduate Program:** Industrial Design

**Advisor:** Yuanqing Tian

**Poster Number:** 176

### **Reclaiming Comfort in Cafés: Addressing Ergonomic Challenges for Digital Workers**

As remote and hybrid work becomes increasingly common, cafés have emerged as important informal workplaces for digital workers. However, these environments lack ergonomic support, forcing users to adapt to static furniture and spatial constraints. This often results in physical discomfort, reduced productivity, and unsustainable working postures over extended periods.

This research investigates ergonomic challenges in café work environments through a human-centered design approach, including ergonomic analysis, market review, user surveys, interviews, and observational studies. Key pain points include limited table space that restricts natural working posture and device placement, mismatched table and chair heights leading to neck and back strain, lack of proper back support, and wrist discomfort caused by rigid table edges. Environmental factors such as inadequate privacy and inconsistent lighting further impact comfort and focus.

In response, this project explores adaptive ergonomic design solutions that support healthy posture in dynamic public environments. The proposed design emphasizes portability, adaptability, and unobtrusive integration into café settings, enabling users to maintain comfort without disrupting the social and spatial qualities of cafés. By reclaiming ergonomic support in third-space work environments, this research demonstrates how industrial design can enhance well-being and support the evolving culture of mobile digital work.

**Caleb Zander**

**Graduate Program:** Industrial Design

**Advisor:** Kelly Umstead

**Poster Number:** 190

### **Workplace Ergonomic Support in the Coffee Roasting Industry: Supporting Worker Health in Manual Material Handling**

In the coffee processing and roasting field, the prevalence of WMSDs is high due to frequent manual material handling tasks and limited ergonomic support structures. Workers in this field report issues with the physical demands of the job causing pain and wear on their bodies. Common areas of reported pain are the shoulders, neck, and lower back. This research investigates the biomechanical and physiological risks associated with manual material handling (MMH) tasks, such as lifting 50–60 kg grain bags, repetitive scooping, and bending at the waist to reach material.

A multi-method investigation approach was employed with secondary research, direct observation, user interviews, observational tools REBA and RULA, and a co-design workshop with workers in the industry. Initial findings showed that worker posture while scooping unroasted coffee beans placed the workers at high risk for WMSD and warranted further investigation into ergonomic interventions such as task redesign, structural support, or automation.

**Chengchen Zhang**

**Graduate Program:** Graphic and Experience Design

**Advisors:** Valeria Lopez Torres and Deborah Littlejohn

**Poster Number:** 191

### **Making Performance Difficulties Interpretable: Designing an Explainable Training Interface for College Women Athletes Under Physiological Variability**

College women athletes often train under rigid schedules and performance expectations that leave little room for physiological variability. Menstrual cycle–related physiological fluctuations in energy, fatigue, and bodily readiness can drive cyclical changes in performance, creating moments of difficulty that athletes struggle to interpret or explain. In the absence of personalized, integrative explanations that frame these data within each athlete’s highly individual physiological patterns and longer-term context, training metrics may feel disconnected from lived bodily experience, leading to confusion, self-doubt, or misplaced self-blame. This project explores how an explainable training interface can help college women athletes make sense of performance difficulties. Rather than focusing on automated optimization or prescriptive recommendations, the design prioritizes interpretability and athlete agency. Through a research-through-design approach, the project investigates three complementary interface strategies: (1) visually integrating objective biometric data with lightweight self-reported input to externalize physiological state in an interpretable manner; (2) using layered explanations that respond to user-initiated inquiries to reveal contributing factors behind performance difficulties; and (3) employing temporal interface design to surface patterns and relationships across training history and cyclical physiological change. The design is informed by informal interviews with current and former women athletes and a review of the literature on women athletes’ performance. The resulting interface concept demonstrates how an explainable interface supports athletes in integrating their personal data and metrics to reduce self-doubt and misplaced self-blame, and to develop a clearer understanding of their performance over time.

## **College of Education**

**John Hensley**

**Graduate Program:** Teacher Education and Learning Sciences

**Advisor:** Meghan Manfra

**Poster Number:** 76

### **“I Always Had a Voice”: How Community-based Civics Can Empower Students to Embrace Engagement.**

Traditional models of civic education have proven inadequate to address our ongoing slide towards political polarization and have proved inadequate to close civic empowerment gaps. Using action civics, action research and a mixed methods explanatory sequential design, this work seeks to retool civic education by deploying a critical civics curriculum that fulfills the call of the C3 Inquiry model to “take informed action” while improving civic education outcomes. Civic engagement survey instruments measuring political efficacy, political interest and the likelihood of future political action are administered to a treatment group receiving the action civics approach and outcomes are compared to those of a standard North Carolina high school Civic Literacy class. The results show a powerful and significant effect: action civics combined with an open classroom environment and using inquiry-based methods improves student efficacy, strengthens student interest in the political process and results in a higher probability that the students will remain engaged after graduation.

**Dhruva Mathur**

**Graduate Program:** Educational Leadership, Policy and Human Development

**Advisor:** Stephen Porter

**Poster Number:** 109

### **Power, Prestige, and Coalitions: How NC State Navigated the Politics of Budget Cuts during the Great Depression**

Federal budget cuts and the approaching enrollment cliff place higher education institutions in a precarious position. The existing literature tends to examine only the outcomes of budget cuts, treating them as rational and technical exercises, ignoring the political processes that shape the outcomes. This study uses NC State's history of navigating budget cuts during the Great Depression as a case study to develop a theory on the budget-cutting process. It develops a theoretical framework around three lenses: centralization of power, sub-unit prestige, and coalition building to study the process. By integrating elements from the Resource Dependence Theory, this study analyzes the management practices that occurred across multiple levels at NC State and within the wider higher education system in North Carolina during the Great Depression. To do this, it draws on archival data (1929 to 1939) from the Special Collection Research Center at NC State and University Archives at Wilson Library, UNC Chapel Hill. By triangulating documents (minutes of meetings, correspondence, alumni newsletters, and administrative records) across the two archives, the interpretations of conversations and proceedings are validated. The study finds that leaders across the higher education system sought to centralize authority by developing uniform processes, creating new positions, and reallocating functions. NC State relied extensively on faculty-led research on its enrollment data, federal funding, and reiteration of its vision and mission to safeguard key functions such as the engineering school. The study also highlights how NC State administrators successfully mobilized alumni and built coalitions with business associations to strengthen their negotiating position. By undertaking this analysis, this study seeks to shift the conversation from the outcomes of budget cuts to the process of budget cuts. It offers higher education administrators key insights into how different actors organize their interests and actions to protect their turf during impending budget cuts.

**Rachel Waltz**

**Graduate Program:** Teacher Education and Learning Sciences

**Advisor:** Paula McAvoy

**Poster Number:** 175

### **Learning Together about Classroom Discussion: How Beginning Middle Grades Social Studies Teachers Co-Construct Meaning in an Online Community of Practice**

Research has long demonstrated the civic benefits of student-centered classroom discussions. Yet, such discussions remain largely absent from middle school social studies classrooms due to standardization pressures, concerns about students' abilities, fears that discussions will become unmanageable or prompt pushback, and limited pedagogical training. For beginning teachers (BTs), these challenges are compounded by the reality that the first years of one's career are extremely demanding and often isolating. Grounded in Wenger's social theory of learning and conceptualized as a community of practice (CoP), this qualitative instrumental case study considers teacher learning as situated, relational, and socially negotiated, positioning BTs as knowledgeable inquirers rather than novices in need of "expert" help. Specifically, this study investigates how seven beginning middle grades social studies teachers in North Carolina co-construct knowledge of classroom discussion practices within an online CoP meeting twice monthly for six months. Data collection includes pre- and post-interviews, CoP observations, and teacher-generated documents. Preliminary findings indicate that novice teachers perceive learning alongside BT peers as valuable, as it challenges their thinking, provides outlets for sharing experiences, and encourages pedagogical risk-taking. By foregrounding BTs' voices and experiences, this study challenges deficit-oriented narratives of novice educators, contributes to underexplored scholarship on middle school social studies discussions, and offers timely insights into preparing teachers to foster civic discourse in an increasingly divided sociopolitical context.

# College of Engineering

**Paul Acuña** and Rudolf Seracino

**Graduate Program:** Civil Engineering

**Advisor:** Rudolf Seracino

**Poster Number:** 1

## **Corrosion-Resistant Bridges: Harkers Island Case Study**

Corrosion of steel reinforcement drives repeated maintenance and premature replacement in coastal bridges. Fiber-reinforced polymer (FRP) reinforcement offers a corrosion-resistant alternative that can extend service life and reduce life-cycle costs; however, despite recent advances in design guidance (e.g., ACI 440 and AASHTO specifications), wider adoption remains limited by gaps in material qualification requirements and in project-level quality control (QC).

This poster presents a full-scale case study of the Harkers Island Bridge replacement in Carteret County, North Carolina, a 3,200-ft-long, 28-span, all-FRP-reinforced and prestressed concrete bridge, and the first of its kind in the state. Construction-sequence monitoring and field lessons learned are paired with a statistical evaluation of the project's QC test database. After verifying distributional assumptions (e.g., normality), the data are used to estimate the minimum sample sizes required to achieve target confidence levels for routine acceptance testing.

Design confidence is further strengthened by destructive, full-scale shear testing of FRP-reinforced bridge girders. Together, field observations, the QC framework, and large-scale test results inform practical pathways for specifying, qualifying, and validating FRP reinforcement in aggressive marine environments, thereby supporting broader, cost-effective adoption where corrosion risk and life-cycle demands make FRP advantageous.

**Muhammed Ziauddin Ahmad Ebrahim**, Darshana Malusare, Tahira Pirzada, and Saad A. Khan  
**Graduate Program:** Chemical Engineering  
**Advisor:** Saad A. Khan  
**Poster Number:** 3

### **Bioinspired Janus Nanofibrous Aerogel with Switchable Wettability for Efficient Oil-Water Emulsion Separation**

Oil-water separation remains a critical global challenge due to increasing industrial wastewater and marine pollution, especially when dealing with surfactant-stabilized emulsions (SSEs) characterized by highly stable micro-sized droplets (<20  $\mu\text{m}$ ). Traditional separation technologies suffer from limitations such as low flux, high energy consumption, and fouling, highlighting the need for efficient and sustainable alternatives. Janus materials with asymmetric wettability have emerged as promising solutions. However, their application has primarily been restricted to two-dimensional membranes, where trade-offs between selectivity and permeability persist, and where simultaneous separation of oil-in-water (O/W) and water-in-oil (W/O) emulsions remains difficult. To overcome these limitations, we developed a bioinspired bilayered nanofibrous aerogel (NFA) using a directional layer-by-layer freezing technique, eliminating complicated solvent exchange processes and harsh chemical treatments. This method integrates hybrid nanofibers into a robust hierarchical 3D architecture with distinct wettability on each side. Inspired by the dual wettability of natural systems such as the lotus leaf, the aerogel exhibits switchable wettability and efficiently separates both O/W and W/O emulsions through gravity-driven processes, achieving removal efficiencies exceeding 95% over multiple cycles. The addition of magnetic nanoparticles facilitates rapid recovery and reuse, enhancing practicality and sustainability. We further elucidate the aerogel's selective sorption capabilities using theoretical frameworks based on Zisman's theory and Fowkes' model, quantifying surface energies to systematically predict solvent interactions with the matrix. This robust and versatile bilayered NFA architecture provides a transformative platform for environmental remediation. The layered architecture can also be extended to advanced multilayered designs, including catalysis, pollutant adsorption, and gas separation through further functionalization.

**Ali Akbari**

**Graduate Program:** Mechanical Engineering

**Advisor:** Yong Zhu

**Poster Number:** 4

### **Sustainable and Biodegradable Soft Electronics Enabled by Localized Intense Pulsed Light Sintering of Silver Nanowire (AgNW) Networks**

The rapid growth of soft electronic devices has raised significant concerns regarding electronic waste and environmental sustainability. Biodegradable materials offer a promising way to reduce long-term environmental impact. However, integration of these materials as the substrate for flexible electronics with highly conductive nanomaterials is still a challenging task due to thermal processing limits. Stretchable silver nanowire (AgNW) networks with large conductivity are attractive for sustainable flexible electronics, but conventional thermal sintering processes that need high temperatures for long durations are incompatible with most biodegradable substrates. In this research, intense pulsed light (IPL) sintering is demonstrated as a rapid and highly localized method to sinter screen-printed AgNW networks on biodegradable agarose/chitosan/glycerol films. Millisecond-scale pulses of high-energy light selectively heat the AgNW percolation network while maintaining the substrate at safe temperature. The results show that after IPL sintering, the electrical resistance of the AgNW pattern dramatically decreases, while there is no physical damage to the substrate. To confirm selective sintering, infrared (IR) camera and scanning electron microscope (SEM) imaging techniques are employed. IR images show that when a pulse of light is illuminated on the AgNW network, it can be heated to a temperature of 160°C while the substrate temperature only rises to 32°C. The SEM images demonstrate the welding of IPL-sintered AgNWs at their junctions. Fourier transform IR spectroscopy represents that the chemical structure of the biodegradable film does not change after IPL sintering illustrating the compatibility of this method with heat-sensitive substrates. Reliable performance of the IPL-sintered samples as wearable devices is depicted by cyclic mechanical tests. The application of the sintered samples as high-sensitivity skin temperature sensor and flexible light-emitting diode circuit is demonstrated. By enabling biodegradable soft electronic systems, this work proves the potential of IPL sintering to pave the way to a more sustainable future.

**Omar Alsaeed**<sup>1</sup>, Brett S. Scheiner<sup>2</sup>, Benjamin T. Yee<sup>2</sup>, Shaun Smith<sup>2</sup>, Chenhui Qu<sup>2</sup>, Brian Z. Bentz<sup>3</sup>, Cameron Wagoner<sup>1</sup>, and Amanda M. Lietz<sup>1</sup>

**Graduate Programs and Institutions:** Nuclear Engineering<sup>1</sup>; Lam Research Corporation<sup>2</sup>; Sandia National Laboratories<sup>3</sup>

**Advisor:** Amanda M. Lietz

**Poster Number:** 6

### **Self-Organization in Low-Temperature Plasmas: The Dufour Instability**

Low-temperature plasmas underpin modern semiconductor manufacturing and, by extension, the information age. Yet plasma self-organization (e.g., striations, spokes) remains a persistent obstacle to achieving wafer-scale uniformity. In this work, we develop a reduced-order modeling framework for a plasma instability, notable for its presumed role in pattern formation in semiconductor processing radiofrequency plasmas at low pressures.

Theoretical predictions are obtained using a fluid electron model grounded in the drift-diffusion approximation and analyzed via linear stability theory. We show that self-organized plasma patterns in electropositive gases at low to moderate pressures (0.1-10 Torr) are driven by an electron energy transport mechanism known as the Dufour effect. The instability's wavelength (0.1-10 cm) and growth rate (10-100 kHz) are derived, and their dependence on pressure, system size, power, and gas composition is quantified. The analysis predicts well-defined, experimentally accessible instability windows in noble gases, with argon exhibiting the highest susceptibility and helium the greatest stability. In contrast, molecular gases such as H<sub>2</sub> and N<sub>2</sub> are stabilized by vibrational and rotational energy channels when multistep processes are weak. Gas-mixture studies further demonstrate that even small molecular admixtures (e.g., Ar/ N<sub>2</sub>:90/10) strongly suppress instability. Inclusion of the previously neglected Soret effect reveals an additional destabilizing contribution. Experimental measurements using electrical and optical diagnostics confirm the theoretically predicted instability trends, showing qualitative and quantitative agreement across the board, while also exposing model limitations at elevated pressures (>1 Torr) and powers (>200 W).

The reliability of the results is bolstered by its corroboration by theory, computation, and experimental validation. The emphasis on physically interpretable analytical stability criteria as functions of design and operational parameters provides actionable guidance for instability control and mitigation in semiconductor processing and other plasma-based technologies.

**Hari Kiran Balachandran**

**Graduate Program:** Engineering

**Advisor:** Ashok Gopalarathnam

**Poster Number:** 15

### **Effectiveness of Simplified 2D CFD in Predicting Onset of Vortex Formation on the Blades of a Helicopter**

Dynamic stall is an undesirable flow phenomenon that could occur on rotor blades of helicopters in forward flight due to azimuthal changes in local angle of attack resulting from blade motion, blade deformation and blade-vortex interactions. It is characterized by leading-edge vortex (LEV), or dynamic-stall vortex (DSV) shedding and significantly affects rotor performance and longevity. Therefore, the capability to predict dynamic stall, especially using rapid low-order approaches could potentially improve helicopter speeds and flight safety. Recent work has resulted in the development of a theoretical parameter called leading-edge section parameter (LESP), which provides a measure of the suction force acting on the leading edge. It has been shown that the occurrence of dynamic stall on airfoils and finite wings corresponds to the time in an unsteady motion when the instantaneous LESP crosses a predetermined critical value. The current work shows that the critical LESP value, determined from relatively inexpensive 2D computational fluid dynamics (CFD) on an airfoil undergoing pitch and surge motions, can be used to predict the onset of dynamic stall on the section of a rotor blade in forward flight or other rotary devices such as wind turbines.

**Vasishta Burugula**

**Graduate Program:** Electrical Engineering

**Advisor:** Subhashish Bhattacharya

**Poster Number:** 23

### **Improved DC Link Voltage Balancing in an MV-Compliant Solid-State Transformer**

The modular solid-state transformer comprising a series-connected front end cascaded to a parallel-connected isolated back end is a popular choice for grid-connected electric vehicle charging stations. The modularity allows for straightforward voltage and power scaling and a simple design. The balance of the DC voltages in the cascaded front end and power flow through the back end is critical for the smooth and safe operation of the converter. Any imbalances in voltage and power in the converter must therefore be regulated by a dedicated control methodology that can operate under all input and loading conditions. The state-of-the-art voltage-balancing algorithms are usually designed to operate under rated operating load, but are ineffective under light load conditions. This work proposes a voltage-balancing algorithm that is effective across all possible loads while maintaining steady-state power balance.

**Michael Carter**<sup>1</sup>, Md Fahel Bin Noor<sup>1</sup>, Masahiro Kamiyama<sup>1</sup>, Ronny Kirste<sup>2</sup>, Seiji Mita<sup>2</sup>, Monica Allen<sup>3</sup>, Jeffery Allen<sup>3</sup>, Ramón Collazo<sup>1</sup>, and Zlatko Sitar<sup>1,2</sup>

**Graduate Programs and Institutions:** Materials Science and Engineering<sup>1</sup>; Adroit Materials<sup>2</sup>; Air Force Research Laboratory<sup>3</sup>

**Advisors:** Ramón Collazo and Zlatko Sitar

**Poster Number:** 26

### **MOCVD Growth of GaN/InN/GaN Quantum Wells**

InN has a direct bandgap of 0.7 eV and a reported theoretical electron mobility of >10,000 cm<sup>2</sup>/Vs at room temperature, making it a potential candidate for applications in infrared optoelectronics and high electron mobility devices. However, it remains challenging to achieve high quality InN growth via MOCVD. We have achieved this capability through application of a growth supersaturation model to the InN growth reaction, resulting in nearly atomically flat, high quality InN layers. This represents a significant improvement in MOCVD growth of InN for device applications.

In this study, we extend our investigation of MOCVD InN growth to InN integration in III-Nitride heterostructures. As a model structure, we consider a GaN/InN/GaN quantum well (QW), which may be used for infrared emitters/detectors. The growth of GaN on InN is investigated at temperatures up to 600°C to avoid InN decomposition. Using optimized GaN on InN growth conditions, transmission electron microscopy (TEM) measurements show a well-defined InN QW within GaN. InGaN alloying is observed, corroborated by x-ray diffraction results. The InN layer is also shown to increase in roughness from ~0.5 nm to nearly 5 nm. Threading dislocations are determined to be the cause of the alloying behavior and the increase in roughness. Using the InN supersaturation model, threading dislocation density (TDD) is reduced in the InN layer. This results in a state-of-the-art InN QW with flat interfaces at both the top and bottom and a nearly 100% pure InN layer.

**John Cheadle**<sup>1</sup>, Manuel Kleiner<sup>2</sup>, Omri Finkel<sup>3</sup>, Maggie Wagner<sup>4</sup>, and Nathan Crook<sup>1</sup>

**Graduate Programs and Institutions:** Chemical and Biomolecular Engineering<sup>1</sup>; Plant and Microbial Biology<sup>2</sup>; Plant and Environmental Sciences, The Hebrew University of Jerusalem<sup>3</sup>; Ecology and Evolutionary Biology, Kansas University<sup>4</sup>

**Advisors:** Nathan Crook and Saad Khan

**Poster Number:** 31

### **Uncovering Mechanisms of Microbial Persistence in the Maize Root Microbiome with Functional Metagenomic Screening**

Rhizosphere microbiomes impact plant productivity through nitrogen fixation, nutrient solubilization, protection from pathogens, and stress resilience. For plant-beneficial bacteria, colonization of and proliferation on or in the plant roots is critical to conferring these benefits. Many studies investigating the persistence of a microbe in a plant microbiome observe a single host species and/or microorganism at a time. Here, we leverage functional metagenomic screening to identify microbial genes that are important for maize root persistence without a priori knowledge of the microorganisms involved, allowing for discovery of new-to-science genes and microbial functions in the maize root niche. We expand upon previous work establishing a genetic toolkit for engineering maize root microbes to efficiently transform (10<sup>6</sup> – 10<sup>7</sup> CFUs) *Escherichia coli*, *Pseudomonas putida*, and *Bacillus subtilis*, allowing for expression of large metagenomic libraries in a diverse set of hosts. In further studies, we will apply this combination of tools to other plant systems under different selective pressures (host genotype, drought stress, presence of microbial neighbors) to identify fitness-enhancing genes that function within or across specific contexts. Improving our understanding of colonization- and persistence-related genes may improve the design of microbial inoculants for sustainable agriculture, which rely on persistence in a plant microbiome to be effective.

**Peng Chen**<sup>1</sup>, Shaphan Jernigan<sup>1</sup>, Keren Zhao<sup>1</sup>, George Varghese P J<sup>1</sup>, Mitesha Saha<sup>1</sup>, Charles Kim<sup>2</sup>, Amirhossein Arzani<sup>3 4</sup>, Gregory Buckner<sup>1</sup>, and Jingjie Hu<sup>1</sup>

**Graduate Programs and Institutions:** Mechanical and Aerospace Engineering<sup>1</sup>; Division of Vascular and Interventional Radiology, Department of Radiology, Duke University Medical Center<sup>2</sup>; Department of Mechanical Engineering, University of Utah<sup>3</sup>; Scientific Computing and Imaging Institute<sup>4</sup>

**Advisor:** Jingjie Hu

**Poster Number:** 32

### **Image-Guided Embolization Using Ta@Ca-Alg Microspheres with Optimized Mechanical Performance**

Transcatheter arterial embolization (TAE) is a minimally invasive technique used to treat hypervascular tumors, hemorrhage, and vascular abnormalities. Though Microspheres (MSs) have achieved widespread clinical use as embolic agents, they often lack imaging opacity, optimal morphology and mechanical properties which can lead to unpredictable trajectories, non-target delivery, and suboptimal embolization. This study developed tantalum-loaded calcium alginate (Ta@Ca-Alg) MSs with intrinsic radiopacity and tunable density and mechanical properties. Ta@Ca-Alg MSs were synthesized using a gas-shearing method and analyzed for size, morphology, swelling behavior, density, radiopacity, and optimized mechanical properties. The results demonstrated that Ta@Ca-Alg MSs maintained a narrow size distribution, with increasing Ta concentration enhancing radiopacity to levels comparable with the clinical contrast agent OMNIPAQUE 350. Density and Young's modulus corresponding to different Ta concentrations were also investigated. Phantom model testing validated effective vessel occlusion and controlled penetration. In vitro hemocompatibility, sterility, and cytotoxicity studies confirmed excellent biocompatibility. These findings suggest that Ta@Ca-Alg MSs are a promising radiopaque embolic agent with optimized, radiopacity, density, and mechanical properties, offering excellent potential for TAE procedures.

**Nisan Chhetri**

**Graduate Program:** Computer Science

**Advisor:** Christopher Healey

**Poster Number:** 33

## **Estimating Image Creativity Using Psychological Creativity Dimensions**

What makes an image creative? However, research in psychology and computer vision has proposed that across the groups of individuals, creativity in general and image creativity in particular may be based on a fundamental set of creativity dimensions like novelty, arousal, surprise, and value. A deeper understanding of image creativity holds significant promise for both research and practical applications. In particular, understanding how viewers perceive creativity can directly benefit domains where creativity and engagement are essential --- such as graphic design, web design, and advertising. Identifying preferences over the creativity dimensions suggests the possibility of estimating image creativity. What dimensions of creativity are relevant to image creativity? Is there a correspondence between users' evaluations of a creativity dimension and their overall perception of image creativity? Can computer models be constructed to estimate an image's creativity dimension strengths and convert them into an estimate of the image's overall creativity?

In this work, we present a novel framework to automatically estimate the perceived creativity of an image by first predicting the strengths of its underlying creativity dimensions --- novelty, surprise, and arousal. We modified their psychological definitions for an image-based context and curated 45 images per dimension spanning a range of dimension strengths. We then conducted pilot and full human-subject experiments on Amazon Mechanical Turk to refine and finalize three separate datasets, each rated by 20 participants. Using key terms drawn from participant feedback, we constructed LLM-based predictors that achieve approximately 75% alignment with human judgments. Results show that single dimensions perform comparably to multi-dimensional combinations, suggesting creativity perception may be more holistic than existing theory suggests. These findings indicate that practical applications in design and advertising can leverage simpler creativity models without sacrificing predictive accuracy.

**Sina Dehghan-Toranposhtia**, Mohannad Alghamdia, Avery Smitha, and Martin Seifrida

**Graduate Program:** Materials Science and Engineering

**Advisor:** Martin Seifrid

**Poster Number:** 43

### **Robust Learning from Literature Data: Model Generalizability and Uncertainty for Predicting Conjugated Polymer Solution Conformation**

Predicting solution conformation and aggregation of conjugated polymers remains a bottleneck for translating solution processing into controlled film microstructure and for closing the loop in self-driving laboratories. We construct a cleaned, machine-readable dataset of 256 entries that links polymer chain length, polymer-solvent compatibility, formulation, and sample history to the radius of gyration,  $R_g$ . We evaluate molecular representations and common ML algorithms under both independent-and-identically-distributed (IID) and out-of-distribution (OOD) regimes, including leave-one-polymer-out and polymer-solvent interaction splits. Under IID, models that combine size, chemistry, formulation, and history achieve strong accuracy ( $RMSE \approx 0.18$ ;  $R^2 \approx 0.90$ ), while structure-only models add little beyond polymer chain length. Generalization is the central limit: OOD errors rise sharply for polar sidechain polymers and formulations with significant Hansen descriptor mismatches, and global distribution shift alone does not explain failure—alignment within key feature subspaces matters. Model uncertainty is reasonably calibrated overall, but degrades under strong distribution shift, limiting reliable experiment selection without targeted data. We identify concrete actions to improve robustness for future machine learning: standardized, machine-readable reporting of processing history (times, temperatures, stimuli); and more deliberate sampling of chemical space. Together, these results highlight dataset design, robust generalization, and uncertainty-aware modeling as the foundations for accelerating discovery and control of conjugated polymer assemblies, capabilities that directly enable autonomous, data-driven experimentation in this field.

**Joseph Deneke**

**Graduate Program:** Aerospace Engineering

**Advisor:** Darius Carter

**Poster Number:** 44

### **Unsteady Aircraft Tailplane Loads from the Wake of a Stalled Wing**

This study experimentally investigates the unsteady aerodynamic loads imposed on a horizontal tailplane immersed in the wake of a stalled, finite wing. A low aspect ratio swept wing was tested at high angles of attack (20–30 degrees) which exhibited partial or full aerodynamic stall, and its wake structure was characterized through 7-hole probe measurements, time-averaged or time-resolved PIV, and spectral analysis. The stalled wing was found to produce multiple vortex types that induce large flow angularities, high turbulence intensities, and distinct shedding frequencies in the 125–165 Hz range. By traversing the tailplane vertically through the vortical wake, this work quantifies the resulting lift, drag, and pitching-moment responses of the tailplane. Time-averaged results reveal strongly negative tailplane lift and nose-up pitching moments across all positions due to wake skew and downward momentum transfer produced by the front wing. Time-resolved PIV and load measurements showed that vortex impingement produces fluctuations in lift coefficient of 0.2 from the vortex shedding frequency bands. These findings provide new experimental insight into wing–tail aerodynamic interactions in stall, complementing prior computational studies and informing future design considerations for aircraft components operating in highly separated flow environments prone to fatigue.

**Omar Eldaly**

**Graduate Program:** Mechanical Engineering

**Advisor:** Mohammed Zikry

**Poster Number:** 48

### **Microstructurally Defect Induced Large Strain Plasticity Failure Modes in Refractory Metals and Alloys**

The major objective of this investigation is to fundamentally understand and predict how intergranular (IG) and transgranular (TG) fracture modes nucleate and propagate in niobium and tungsten polycrystalline systems due to defects, such as total and partial dislocation densities, dislocation-density junctions, grain boundary (GB) structures, and misorientations. A dislocation density crystalline plasticity (DCP) formulation based on the evolution and interaction of total and partial dislocation densities was integrated with a recently developed fracture approach to investigate the fracture nucleation and propagation of simultaneous multiple fracture events, including both IG and TG fracture events in refractory alloys subjected to high strain-rates and temperatures. The validated predictions indicate that dislocation density pileups induce IG fracture, and that TG fracture occurred due to normal stress accumulations, which exceeds the fracture stress along cleavage planes.

**Katherine Eltz<sup>1,2</sup>**, Jose-Luis Crespo<sup>3</sup>, Arian Azarang<sup>1,2</sup>, Emma Pla-González<sup>3</sup>, Daniel García-Párraga<sup>2,3</sup>, Andreas Fahlman<sup>3,4</sup>, and Virginie Papadopoulou<sup>1,2</sup>

**Graduate Programs and Institutions:** Department of Radiology, University of North Carolina at Chapel Hill<sup>1</sup> ; Lampe Joint Department of Biomedical Engineering, University of North Carolina at Chapel Hill & North Carolina State University<sup>2</sup>; Research Department, Fundació Oceanogràfic de la Comunitat Valenciana, Valencia, Spain<sup>3</sup>; Kolmården Wildlife Park, Kolmården, Sweden<sup>4</sup>

**Advisor:** Virginie Papadopoulou

**Poster Number:** 49

### **Texture Feature Analysis of B-mode Ultrasound Images for Assessment of Gas Presence in Tissues of Sea Turtles Presenting with Gas Embolic Pathology**

**Background/Introduction:** Decompression sickness remains a significant risk in diving operations, motivating development of objective tissue imaging biomarkers to quantify gas burden. Human-caused disturbances of sea turtles' diving behavior can result in gas embolic pathology, offering an opportunistic, naturally-occurring model of tissue gas presence.

**Methods:** Ultrasound imaging of the heart, kidney, and liver was performed in bycaught sea turtles during post-surfacing veterinary care on boats (n = 32) and following transport to shore (n = 49). Gas presence in each organ was graded using an ordinal scale from 0 (no gas) to 5 (complete shadowing). Post-surfacing imaging delays and gas severity were compared between groups. Brightness analyses were conducted for all organs, and four texture features extracted from liver and kidney regions of interest. Multivariable logistic regression with leave-one-out cross-validation was performed using shore versus boat as a binary outcome and ultrasound texture metrics as predictors.

**Results:** Time to first ultrasound was significantly longer in the shore group (mean delay 163 min). Median initial gas grades in the liver, kidney, and heart were higher in boat than shore turtles (3, 3, 3 vs. 0, 1, 0, respectively). Cardiac and liver brightness increased with gas grade at low to moderate levels before decreasing at the highest grades, consistent with acoustic shadowing effects. Several texture-based image features also demonstrated robust monotonic trends with grade. Using principal component analysis and logistic regression, image texture features were found to reliably distinguish between turtles from the boat and shore groups, serving as a proxy for differing post-surfacing imaging delays. Classification performance reached areas-under-the-curve of 0.92 (95% CI [0.74, 0.98])(liver) and 0.83 (95% CI [0.66, 0.93]) (kidney).

**Discussion/Conclusion:** These findings may help veterinarians identify turtles needing hyperbaric treatment, supportive care, or release. Image texture analysis has potential for applications in human decompression studies.

**Daniel Engstrom**

**Graduate Program:** Operations Research

**Advisors:** Russell E. King and Brandon M. McConnell

**Poster Number:** 50

### **Optimizing Ordering Strategies for Maximum Artillery Target Engagement**

During the initial phases of military operations, Long-Range Precision Fires (LRPF) are critical for shaping the environment to set conditions for the success of ground forces. As technological advances reduce the time between target detection and engagement, the ability to sustain the volume of fires needed becomes increasingly important. Traditional resupply methods, such as “order-up-to” policies, often result in inefficient or mismatched distribution of munitions, limiting a unit’s capacity to effectively engage targets. This research investigates alternative ordering strategies designed to maximize the number of targets that LRPF units can engage under dynamic battlefield conditions. A simulation-based framework is used to model target presentation, apply engagement decision algorithms, and implement resupply strategies based on target density and distribution. The model begins with a baseline representing current doctrinal approaches and iteratively modifies both engagement and ordering policies. A linear programming (LP) model, assuming full knowledge of future target sets, is used as an upper bound to benchmark each strategy’s performance. Findings highlight the trade-offs between different ordering and decision strategies and their effects on maximized target engagement. The results inform the development of a generalized optimization framework that can be extended to other sustainment challenges across the logistics enterprise, enhancing operational flexibility and resilience in contested environments.

**Corey E. Febo**<sup>1</sup>, Amanda C. Taylor<sup>2</sup>, Henry H. Taylor, Scott T. Magness<sup>3,4,5</sup>, Stefano Menegatti<sup>1,6</sup>, Nathan Crook<sup>1</sup>, and Carol K. Hall<sup>1</sup>

**Graduate Programs and Institutions:** Chemical Engineering<sup>1</sup>; Plant and Microbial Biology<sup>2</sup>; Center for Gastrointestinal Biology and Disease, University of North Carolina at Chapel Hill<sup>3</sup>; Cell Biology and Physiology, University of North Carolina at Chapel Hill<sup>4</sup>; School of Medicine, University of North Carolina at Chapel Hill<sup>5</sup>; Biomanufacturing Training and Education Center (BTEC)<sup>6</sup>

**Advisor:** Carol Hall

**Poster Number:** 52

### **Physics-Based Computational Design of Peptide Drugs for *Clostridioides Difficile***

*Clostridioides difficile* (C. diff) infection is a major cause of antibiotic-associated colitis and remains a significant public health concern in the United States. Current antibiotic treatments for C. diff are not always effective due to antibiotic resistance. Toxin B (TcdB) is one of the two major toxins secreted by C. diff. It contributes significantly to tissue damage and inflammation in the colon. Peptides are a promising alternative therapeutic candidate to prevent and treat C. diff infection by inhibiting the biocatalytic activity of TcdB, the primary virulence factor of C. diff. In this work, we computationally designed two types of peptide inhibitors to target TcdB: (1) 9-mer peptides for broad-spectrum activity against the TcdB1 and TcdB3 glucosyltransferase domain; (2) 30-mer  $\alpha$ -helical peptides to target the TcdB1 glucosyltransferase domain. These designs were generated using a Monte Carlo-based algorithm, Peptide Binding Design (PepBD), and evaluated via explicit-solvent molecular dynamics simulations. Thus far, preliminary in vivo assays indicate that one 9-mer peptide candidate from method (1) not only neutralizes TcdB with greater potency than previous peptide candidates but also exhibits broad-spectrum activity against both TcdB1 and TcdB3. This peptide delayed epithelial barrier collapse in transepithelial electrical resistance (TEER) measurements by ~3 hours at 2 mM, exhibited a clear dose dependence, and significantly reduced apoptotic signaling. In summary, we have applied a computational strategy that combines the PepBD algorithm and explicit-solvent atomistic molecular dynamics simulations to design novel peptide inhibitors for TcdB. The therapeutic approaches in this work may pave the way for development of new options for treating C. diff infections.

**Vasuki Garg<sup>1</sup>**, Osman Y. Özaltın<sup>1</sup>, Maria E. Mayorga<sup>2</sup>, and Sherrie Bosisto<sup>3</sup>

**Graduate Programs and Institutions:** Industrial and Systems Engineering<sup>1</sup>, Operations Research<sup>2</sup>, Global Emancipation Network<sup>3</sup>

**Advisors:** Osman Y. Özaltın and Maria E. Mayorga

**Poster Number:** 58

### **Optimizing Criminal Investigation Resource Allocation via Decision Focused Learning**

Thousands of Illicit Massage Businesses (IMBs) are estimated to be operating in the United States by disguising themselves as legitimate establishments while exploiting trafficked workers, harming both the victims and the massage industry. The increasing digital presence of these illicit businesses presents an opportunity for detection, a crucial task for law enforcement and social service agencies aiming to disrupt their operations. However, investigative agencies have limited resources and are unable to investigate every business, making it essential to allocate resources optimally. While state-of-the-art machine learning models can predict the likelihood of a business being illicit, these predictions are often decoupled from the downstream resource allocation decisions. Our research bridges this gap by leveraging user-generated business reviews from Yelp.com, enriched with contextual multi-source data from U.S. Census records, GIS data, and licensing information, while translating stakeholder interviews into operational constraints. Using decision-focused learning, we integrate predictive analytics with prescriptive decision-making, enabling data-driven and resource-aware investigation prioritization.

**Matthew Gleason**

**Graduate Program:** Operations Research

**Advisor:** Brandon McConnell

**Poster Number:** 61

### **Balanced Personnel Assignment in Airborne Operations: An Assessment of Concentration and its Relationship with Risk**

Effective personnel assignment in airborne operations is critical for creating load plans that support ground tactical objectives while minimizing risk. Current methods lack mechanisms for assessing feasibility and risk, a limitation that intensifies with larger assault forces. We propose a mixed-integer optimization framework whose output is an initial personnel load plan that balances operational needs and risk. Paired with parameterized constraints, our model enables practitioners to compare solutions using objective measures, creating an opportunity for more informed discussions about operational risk. We utilize known features for each Soldier — such as rank, equipment and team assignment — to measure their strategic importance, assigning each Paratrooper an individual importance score. We combine the scores of personnel assigned to a specific aircraft to determine an overall importance score for each aircraft. Using these values, we introduce an optimization framework that resembles a form of the Balanced Assignment Problem, which aims to minimize the difference between maximum and minimum assignment values, encouraging the model to separate important personnel. Our formulation includes the ability to specifically target a subset of personnel within the objective function. This flexible framework is adaptable to the specific risk profile of any operation. We demonstrate model utility through a case analysis with real-world data, which we treat as a baseline. We assess the robustness of both the baseline and modeled load plans by conducting a series of aircraft removal trials to evaluate the impacts on readiness. We assess differences in force availability using typical measures of central tendency, with a focus on examining tail behavior. Specifically, we utilize Conditional Value-at-Risk (CVaR) to communicate expected outcomes, given a potential worst-case scenario. Our work introduces a novel, systematic, and optimization-driven methodology for generating resilient and tactically sound load plans in airborne operations planning.

**Teresa Groton**

**Graduate Program:** Operations Research

**Advisor:** Benjamin Rachunok

**Poster Number:** 65

### **Expanding the Dimensions of Food Access: Linking Experience and Geography**

Food access has widespread implications, with 13.5% of American households food insecure in 2023 (USDA), among a high prevalence of obesity and other diet-related diseases (CDC). However, food access and the underlying drivers of food choices are challenging to measure. Food access is highly nuanced and multi-level. Traditional measures of food access serve distinct purposes but make it difficult to evaluate holistically at a large scale. GIS-based measures can be applied to large geographic areas, but they fail to capture aspatial factors that influence dietary health, such as produce quality or the accommodation of dietary needs. Surveys and store audits provide more nuanced information, but they are resource-intensive and costly to scale. This work leverages Google reviews from grocery stores to gather insights from residents. The review text is then transformed into dense vectors using a pre-trained sentence-embedding model. We apply unsupervised topic modeling to identify recurring themes and important food access considerations for residents. Next, topics are aligned with an existing conceptual food access framework through similarity-based inference. This process is zero-shot, meaning it does not require additional labeled data and instead relies on the foundational embedding model for inference. The modeling results are then mapped back to individual grocery stores to evaluate how residents' experience intersects with geographic access. This model illustrates how spatial access may juxtapose with lived experience, revealing areas of low food access that geographic measures alone may overlook. This method provides a zero-shot, large-scale lens to evaluate local food access, advancing the precision, nuance, and scalability of food access research.

**Kayla Hahn**<sup>1</sup>, Ammon Williams<sup>2</sup>, and Alexander Bataller<sup>1</sup>

**Graduate Programs and Institutions:** Nuclear Engineering<sup>1</sup>; Nuclear Nonproliferation Division, Idaho National Lab<sup>2</sup>

**Advisor:** Alexander Bataller

**Poster Number:** 68

### **Demonstration of the SPIDER Probe for Online Material Quantification of Actinide-bearing Molten Salt**

Real-time elemental quantification of molten salts for advanced nuclear applications is critical for material accountancy and processing safeguards. Plasma-based optical emission spectroscopy offers a promising pathway for in-situ material detection under such conditions. A recently developed sensor, the Submerged Plasma for Isotopic Detection and Elemental Resolution (SPIDER), employs an atmospheric pressure glow discharge to do just that. Operating below the liquid surface, the SPIDER probe utilizes constant gas flow to extend experimental on-time while providing sufficient conditions for plasma propagation. A coupled fiber optic allows for light collection near the source of the plasma, while sensitive equipment may be placed away from the harsh environment surrounding the probe. Testing in molten salts, liquid metals, and heavy water has demonstrated the SPIDER probe's ability to provide accurate real-time elemental and isotopic measurements across diverse liquid systems. However, these tests also revealed that the probe generates significant aerosols, which accumulate in the gas lines and repeatedly force shutdowns and system resets. To support closed system operation and future use with actinide-bearing salts, this research investigates strategies of aerosol mitigation including the introduction of the woven effluent baffle (WEB). Surrounding the probe tip, this stainless steel mesh enclosure markedly reduces aerosol formation, extending probe operating lifetime and preventing gas-line clogging. Subsequent tests focused on the demonstration of the SPIDER on various actinide-bearing salt compositions, including UCl<sub>3</sub> + NaCl eutectic, providing key insight as to sensor performance in real-world molten salt monitoring applications. Collectively, these studies provide a rigorous foundation for a plasma-based sensor capable of online, quantitative analysis of molten salts for the safeguards of special nuclear materials.

**Linda Hargrove**

**Graduate Program:** Biological and Agricultural Engineering

**Advisor:** Steve Hall

**Poster Number:** 70

### **Using Gamification and Aquaponics to Enhance First-Year Engineering Engagement and Sustainability Awareness**

This study investigated the impact of a gamified, aquaponics-centered STEM activity on the engagement of first-year engineering (EFY) students compared to a traditional lecture. The findings suggest that gamification, especially when paired with a hands-on learning experience like a lab tour and taste test, is an effective tool for increasing student interest and enjoyment in unfamiliar topics like Biological and Agricultural Engineering (BAE) and its connection to global sustainability challenges. While the small sample size is a limitation, the project successfully demonstrated the potential to broaden career awareness and challenge student assumptions about engineering disciplines.

**Mahmoud Hawary**

**Graduate Program:** Nuclear Engineering

**Advisor:** K.L. Murty

**Poster Number:** 73

### **Biaxial Creep Anisotropy in Nb-Modified Zirconium Alloys: Role of Texture and Microstructure**

Understanding anisotropic creep deformation in zirconium alloys is critical for improving the structural reliability of nuclear fuel cladding under reactor operating conditions. This study investigates the biaxial creep behavior of Nb-containing zirconium alloys, ZIRLO® and HANA-4, in both cold-worked stress-relieved (CWSR) and recrystallized (Rx) conditions. Thin-walled tubular specimens were tested under combined internal pressurization and axial loading, enabling control of hoop-to-axial stress ratios from 0 to 2.

Anisotropy parameters (R, P) and formability (B) were determined using the modified Hill criterion to quantify deviations from isotropic creep response. Crystallographic orientation distribution functions (CODFs), obtained via EBSD, were used to characterize texture and correlate it with measured creep anisotropy. Grain morphology, aspect ratio, and microstructural state were further analyzed to evaluate their influence on deformation behavior.

Creep loci were constructed at constant energy dissipation to assess directional dependence of creep strain rates and to identify departures from isotropic behavior. The combined effects of stress ratio, temperature, and microstructure were systematically evaluated.

Results demonstrate a strong coupling between crystallographic texture and biaxial creep anisotropy, with significant differences observed between CWSR and Rx conditions. This work provides mechanistic insight into microstructure-controlled deformation in advanced Zircalloys and supports the design of more resilient nuclear fuel cladding materials for light water reactor applications.

**Farhan Ishrak** and Bharat Gwalani  
**Graduate Program:** Materials Science and Engineering  
**Advisor:** Bharat Gwalani  
**Poster Number:** 79

### **Metal Matrix Magnetic Composites via Solid-State Routes**

Permanent magnets enable compact, high-power-density motors and actuators, but most commercial magnet materials are brittle and difficult to integrate into parts that must also carry mechanical load. Metal-matrix magnetic composites (MMMCs) expand the design space by embedding hard-magnetic phases within ductile metals, enabling concurrent magnetic function and structural reliability. The central challenge is balancing magnetic phase fraction with manufacturability and interface integrity: increasing reinforcement boosts volumetric performance yet promotes cracking, particle degradation, and adverse interfacial reactions that reduce coercivity and toughness. We present a solid-state (no-melt), low-thermal-budget processing strategy that uses intense plastic deformation to refine and uniformly disperse the permanent-magnet phase within a ductile metal matrix, while forming controlled nanoscale interphases that promote metallurgical bonding without degrading magnetic performance. Structure–property correlations show that engineered interfaces and hierarchical microstructures can raise strength while preserving deformation capacity and a robust hard-magnetic response, establishing practical design rules for scalable multifunctional components in energy, transportation, and defense.

**Nisarg Joshi**<sup>1</sup>, Orion Dollar<sup>2</sup>, Lejla Biberic<sup>1</sup>, and Jim Pfaendtner<sup>1</sup>  
**Graduate Programs and Institutions:** Chemical and Biomolecular Engineering<sup>1</sup>; Iambic Therapeutics<sup>2</sup>  
**Poster Number:** 84

### **Augmenting Large Language Models with Reasoning for Navigating Protein-binding Landscape**

Designing ligands that selectively bind to protein targets is a cornerstone of drug discovery. However, identifying suitable ligands that fit the binding site and preserve protein function remains experimentally time consuming and expensive. To accelerate de novo drug discovery, traditional inverse design methods have opened many promising avenues. Large language models (LLMs) have further transformed machine learning (ML) applications, shifting from purely predictive tasks to leveraging vast corpora for chemistry. Their generative capabilities have led to the development of text-to-molecule models, offering new approaches for molecular design and drug discovery. Yet, existing LLMs often struggle to generate chemically valid molecules and typically lack mechanisms for reasoning-based validation of their outputs. Much less work has focused on creating reasoning LLMs for scientific tasks, and relatively little has been done specifically for protein-binding tasks.

In this work we propose a reasoning LLM which is capable of designing protein-binding ligands. Through chain-of-thought (CoT) supervised fine-tuning and group relative policy optimization (GRPO) reinforcement learning methods with verifiable custom reward functions, we demonstrate how reasoning models can enable in sampling valid ligand candidates and justify their predicted binding capabilities. This reasoning driven approach helps towards an efficient and accelerated path towards drug discovery.

**Robert Kempin**

**Graduate Program:** Mechanical Engineering

**Advisor:** Tiegang Fang

**Poster Number:** 86

### **Transcritical Combustion of n-Heptane Under Diesel Conditions**

Supercritical fuel sprays exhibit diffusive mixing dissimilar to classical atomization. This change in mixing behavior opens the door for improvements in diesel combustion through more complete fuel/air mixing, without the losses in volumetric energy density associated with injecting gaseous fuel. To study the effects of these changes in mixing behavior on flame morphology, sprays of n-heptane are injected under transcritical and supercritical conditions. Chamber conditions are varied between subcritical and supercritical relative to the fuel's critical point. We observe a marked decrease in flame luminosity once within the supercritical regime. Transcritical and supercritical spray conditions do not have a significant impact on ignition delay. Flame morphology is observed to be similar between subcritical/subcritical and supercritical/supercritical flames, differing under mixed cases.

**Donghyun Ko**

**Graduate Program:** Industrial and Systems Engineering

**Advisor:** Jacob Peloquin

**Poster Number:** 90

### **Risk-Aware Parameter Optimization of Additive Manufacturing Processes via Conditional Diffusion Models**

Laser powder bed fusion (LPBF) additive manufacturing has attracted significant interest due to its ability to produce complex, high-performance components; however, build quality remains highly sensitive to process parameter settings and defect formation. Reliable estimation of defect-rate distributions is challenging because repeated physical sampling across candidate parameter configurations is cost-prohibitive, and production decisions must often be made before a build is completed. Moreover, rare but high-severity defect events can occur even when average defect rates are low, limiting the effectiveness of conventional mean-based optimization approaches.

This research proposes a unified generator–evaluator–decision framework for risk-aware process optimization under partial observability in LPBF. A conditional diffusion model is employed as a probabilistic virtual printing engine to generate multiple realizations of unobserved future layers conditioned on partial in-situ observations and selected process parameters. These generated realizations are evaluated using a pretrained machine learning–based defect predictor to estimate empirical defect-rate distributions without requiring additional physical experiments. Tail risk is explicitly quantified using Conditional Value-at-Risk (CVaR), enabling assessment of both average defect behavior and extreme outcomes.

The estimated distributions are integrated into a risk-aware optimization framework that jointly determines economically efficient observation ratios and process parameter settings, supporting real-time GO/NO-GO decisions to terminate high-risk builds early while preserving viable production runs. Using the Oak Ridge National Laboratory Peregrine co-registered digital twin dataset, which integrates multimodal layer-wise imaging, anomaly segmentation, scan-path data, and process metadata, the proposed framework is expected to demonstrate improved defect-risk estimation accuracy under data-scarce conditions. Anticipated results include substantial reductions in exposure to rare but high-severity defect events compared to conventional mean-based optimization strategies.

The key contributions of this work are threefold: (i) introducing conditional diffusion models as probabilistic virtual printing tools for distributional defect forecasting, (ii) integrating generative modeling with CVaR-based risk-aware optimization under partial observability, and (iii) providing a practical decision-support framework that bridges in-situ monitoring, probabilistic inference, and actionable process control in additive manufacturing.

**Aline C. K. Nascimento**<sup>1</sup>, Ronald Lichtenwalner Jr<sup>2</sup>, Gregory Lucier<sup>1</sup>, Amin Akhnoukh<sup>3</sup>, and Moe Pourghaz<sup>1</sup>

**Graduate Programs and Institutions:** Civil, Construction, and Environmental Engineering<sup>1</sup>; Materials and Tests Unit, North Carolina Department of Transportation<sup>2</sup>; Construction Management, East Carolina University<sup>3</sup>

**Advisors:** Moe Pourghaz and Gregory Lucier

**Poster Number:** 95

### **Modified T-FAST Test for Quantifying the Risk of Alkali Silica Reactivity in Hardened Concrete**

Alkali-silica reaction (ASR) remains a significant durability challenge for concrete infrastructure, leading to premature cracking, loss of serviceability, and costly repairs. Current standard test methods such as ASTM C1293 (Concrete Prism Test) provide reliable results but require up to two years, limiting their usefulness in timely decision-making for materials selection and quality assurance. Faster tests, such as ASTM C1260 (Mortar Bar Test), offer faster results within weeks but often lack consistency with field performance. To address this gap, recent research has focused on the Turner-Fairbank Alkali-Silica Reactivity Test (T-FAST), which assesses aggregate reactivity by quantifying ion leaching in sodium hydroxide solutions. T-FAST has demonstrated strong agreement with ASTM C1293 and field performance data, with results available in just 21 days. Building on this approach, the present study extends/modifies the T-FAST protocol to concrete mixtures, providing a more direct evaluation of ASR in field-representative samples. Concrete specimens were produced using Type I (high alkali) and Type IL (low alkali) cement with five different aggregates with different levels of reactivity. Samples were tested under varying conditions of temperature, solution composition, and test duration. Results were compared against 1-year ASTM C1393 expansion data to evaluate the applicability of the 0.45 Reactivity Index (RI) threshold, used in T-FAST, to crushed concrete samples. Findings suggest that this modified protocol, when combined with consideration of cement chemistry, offers a promising, rapid and reliable alternative for assessing ASR susceptibility in concrete mixtures, with potential to support faster materials qualification and mitigation strategies in practice.

**Jacob Leff**

**Graduate Program:** Aerospace Engineering

**Advisor:** James Braun

**Poster Number:** 98

### **Inferring 2D Computational Detonation Properties from the Latent Space of 1D Detonations**

The size of the cellular structures formed by 2D and 3D detonation is a fundamental physical property that influences the initiation, transmission, and diffraction of detonation waves. Detonation cells are the result of chemical processes on the scale of the induction length  $\Delta$ , and are difficult to reproduce in simulations, which is an obstacle for modeling of next generation combustion systems. The computational detonation cell size  $\lambda_c$  depends on the physical properties of the reactants (species, temperature, pressure) as well on the settings of the model (resolution, chemical mechanism, numerical solver). First, this study compares the results of hundreds of 2D simulations of stoichiometric ethylene-air detonation with different reactant temperatures, pressures, and model settings. Millions of measurements of  $\lambda_c$  were performed automatically using the Cellpose-SAM neural network. The results show ubiquitous underprediction of  $\lambda_c$  compared to experiments, even with a 231-reaction mechanism in 3D. There is, however, a need for a method to rapidly estimate  $\lambda_c$  for new model settings. To this end, corresponding conditions and settings were used to simulate the relaxation of 1D ZND detonations. A multichannel neural network was trained to encode  $\lambda_c / \Delta$  from the nondimensionalized 1D relaxation signals of pressure, temperature, velocity, fuel, and hydroxyl. The network performed well on in-distribution test signals, thus permitting the fidelity of future detonation simulations to be rapidly estimated.

**Nicholas Mecham**

**Graduate Program:** Nuclear Engineering

**Advisor:** Igor Bolotnov

**Poster Number:** 115

### **Interface Capturing Computational Fluid Dynamics Simulations of Experiment-Scale Nucleate Boiling**

Nucleate boiling is a complex heat transfer process that simultaneously consumes latent heat for the generation of vapor and greatly enhances convective heat transfer due to the motion of bubbles near the heated surface. This enhancement makes nucleate boiling a critically important process for a variety of industrial heat transfer processes, notably including light water nuclear reactor core cooling and steam generators. However, all attempts to quantify the effective heat transfer coefficient of nucleate boiling processes result in significant uncertainty surrounding the value. This uncertainty arises from the sensitivity of the boiling process to both microscopic and macroscopic characteristics, ranging from the heated surface characteristics to the system pressure. A promising avenue of study to clarify the relationships between microscale mechanisms and effective heat transfer is the pursuit of high-resolution, interface capturing simulations of boiling experiments to provide a detailed view of the phenomena. Ongoing developments in the selected computational fluid dynamics code have resulted in the improved ability to reproduce experimental results with simulations, providing an excellent opportunity to obtain mechanistic descriptions of heat transfer behavior across a range of conditions. The objective of this work is to demonstrate this ability with a strong experimental validation basis and critically analyze the selected problems to compute latent and sensible heat components and the resulting effective heat transfer coefficient.

**Austin L. Mituniewicz<sup>1</sup>**, Michael D. Lewek<sup>1,2</sup>, and Helen (He) Huang<sup>1</sup>

**Graduate Programs and Institutions:** Biomedical Engineering, University of North Carolina at Chapel Hill<sup>1</sup>; Physical Therapy, University of North Carolina at Chapel Hill<sup>2</sup>

**Advisor:** Helen (He) Huang

**Poster Number:** 117

### **Targeted Prevention of Intrinsically Generated Trips in People Post-Stroke**

People post-stroke (PPS) experience falls from internally generated trips (IGT), or unexpected ground contact after the foot leaves the ground, during walking at higher rates than age matched peers. Although training strength, balance, and specific reactive responses can reduce fall prevalence in otherwise healthy older adults, the presence of altered voluntary muscle control in PPS limits the potential benefit of these interventions. Instead, we contend an IGT can be prevented if it is predicted and intervened upon by an engineering system, given sufficient time. As such, we developed a real-time trip inference system that interfaces with a functional electrical stimulation (FES) unit that increases ankle dorsiflexion, and therefore foot clearance, when an ensuing IGT is predicted.

Accomplishing this task requires several steps, pun intended. First, we recorded motion capture data from PPS recorded walking on a treadmill and promoted IGTs using real-world distractors, such as asking participants converse with experiments and look at them while doing so. Of the >10,000 gait cycles collected, 58 IGTs were visually identified. We resolved this imbalance by altering our minority class definition and applying a cost sensitive data imbalance method. We then addressed notorious post-stroke inter-individual gait variability by applying a personalized scaling routine ubiquitously across potential kinematic features. We employed a constrained sequential forward selection, using a linear kernel support vector machine, to identify a minimal feature set capable of early IGT prediction. These features are sensed in real-time using internal measurement units placed on the affected side leg and delivered to a Raspberry Pi. Not only is the trip inference system deployed on this controller, but also a novel gait phase estimator, which informs the controller when in a cycle FES will be applied.

**Tristan Mullins**

**Graduate Program:** Computer Science

**Advisor:** Rudra Dutta

**Poster Number:** 119

### **Spatio-Temporal Information Fusion for Ignition Point Localization**

Mobile sensors, such as drones, provide autonomous detection and surveillance of physical phenomena. Particularly, those which are dangerous or occur in remote areas, such as wildfires. Detecting wildfires, and estimating their parameters, in the early stages is crucial for protecting lives and property, allowing for time-critical decisions to be made regarding fire fighting and evacuation strategies. This work studies multi-drone information fusion using time-series shapelets and spatial constraint satisfaction to perform agile redeployment of drones within the mission area. Shapelets are used to extract the temporal patterns within real-time thermal data to classify the stage of combustion a drone is witnessing at a specific time and place. The temporal features are then shared amongst the drones, allowing an environmental model to be computed through the spatial constraints. The resulting model is used to actively retarget and continuously redeploy the drones within the sensing field to reduce uncertainty regarding the fire's parameters. Six experiments were run to evaluate how uncertainty in the fire's parameters evolve under different surveillance conditions.

**Hiruni Niwunhella<sup>1</sup>**, MehrSadat Salami<sup>1</sup>, Leila Hajibabai<sup>1</sup>, and Faisal Alkaabneh<sup>2</sup>

**Graduate Programs and Institutions:** Industrial and Systems Engineering<sup>1</sup>; Industrial Engineering, American University of Sharjah<sup>2</sup>

**Advisor:** Leila Hajibabai

**Poster Number:** 123

### **An Integrated Optimization Framework for Volunteer Allocation and Vehicle Routing in Non-profit Food Distribution Systems**

Food banks play a critical role in coordinating the collection, storage, and distribution of food to households experiencing insecurity. To provide reliable transportation for volunteers and enable participation in service activities, some organizations coordinate travel to and from service locations. When transportation is offered, assigning volunteers while routing their travel becomes a coupled decision problem with significant operational complexity. This study addresses that challenge by developing an integrated optimization framework that simultaneously assigns volunteers to service locations while minimizing routing costs and ensuring equitable distribution of volunteers across all service locations. We formulate a mixed integer linear programming (MILP) model that introduces a novel vehicle routing problem with co-located pickup and delivery, capacity, time windows, and equity constraints (CVRPPDTW-e). To overcome the computational limitations of direct MILP solving, which becomes intractable for larger problem sizes due to exponentially growing solution times, we implement an algorithm that implements Lagrangian relaxation and column generation integrated with a branch-and-price framework. This approach dynamically generates feasible routes by solving a shortest path subproblem via a labeling algorithm, enabling scalable solutions for real-world instances. The methodology is validated using two datasets: (1) a test case from the literature and 2) a case study of the Durham food bank network. Results demonstrate that larger problem instances can be solved optimally and efficiently using the proposed framework. Extensive sensitivity analyses across four network topologies (i.e., random, clustered, combined, and complete networks) reveal that geographically clustered volunteer distributions yield faster computation times and superior solution quality. This study provides actionable insights for food bank and humanitarian logistics practitioners to support efficient resource utilization through a scalable optimization framework.

**Regan Richardson<sup>1</sup>, Laura Mora<sup>1</sup>, Maria Mayorga<sup>2</sup>, Bradley Ray<sup>3</sup>, and Osman Ozaltin<sup>2</sup>**  
**Graduate Programs and Institutions:** Operations Research<sup>1</sup>; Industrial Engineering<sup>2</sup>; RTI<sup>3</sup>  
**Advisors:** Maria Mayorga and Osman Ozaltin  
**Poster Number:** 141

### **Unintended Impacts of Disruptions to the Illicit Drug Market on Violent Crime and Overdose Death**

The use of illicit substances remains an ongoing and widespread part of society, with the illegal drug market estimated to be 1% of the total global trade. The true scale of this market is unknown because it is an illicit underground trade that is poorly understood, dynamic, and complex. While there have been trends towards decriminalization or legalization of marijuana in the United States, the overarching policy and strategy has consistently been to allocate large amounts of resources to law enforcement agencies to disrupt and dismantle illicit distribution networks. Therefore, the purpose of this project is to utilize national integrated data to develop an understanding of the impact of law enforcement disruptions to the illicit drug supply on both public health (e.g. overdoses) and public safety (e.g. violent crime) outcomes. In the present study, we utilize multivariate granger-causality to investigate the relationships between police drug seizures and violent crime rates, and between police drug seizures and overdose death rates using data from the National Incident Reporting System (NIBRS) and the National Center for Health Statistics Mortality Data from CDC WONDER.

**Fardin Saad, Liwen Du, and Munindar P. Singh**  
**Graduate Program:** Computer Science  
**Advisor:** Munindar P. Singh  
**Poster Number:** 46

### **Mind Your Manners, Cook Up Collaboration. Politeness as a Catalyst for Effective Multiagent Collaboration**

Politeness is central to human communication, enabling smoother coordination, preserving social rapport, and fostering trust. Yet its role in human-AI collaboration remains underexplored. We investigate whether large language models (LLMs) can be guided to achieve politeness in multiagent teamwork. Using Overcooked, a cooperative cooking game widely adopted as a testbed for coordination, we design an LLM agent, Plato, whose communication either follows politeness theories or omits them. Plato interacts with a surrogate human collaborator, Alice, also realized as an LLM. For the politeness framework, we combine Brown and Levinson's model of politeness with Spencer-Oatey's rapport management model, capturing both face-saving strategies and relational rapport. This setup enables us to isolate the effects of politeness on plan negotiation, trust, and affective outcomes in collaboration. We realized Plato on two LLMs, GPT-4o and DeepSeek-Chat, and find that Plato with politeness across both models outperforms their baselines, especially on competence, acknowledgment, order completion, and total turns, which shows that LLMs can be guided to achieve politeness.

**Sultanus Salehin**, Sean Kearney, and Sevgi Z. Gurbuz  
**Graduate Program:** Electrical and Computer Engineering  
**Advisor:** Sevgi Z. Gurbuz  
**Poster Number:** 146

### **Radar-Based Online Learning of Human Skeleton Keypoints Without Any Prior Real Data**

Existing radar-based human skeleton keypoint estimation methods typically depend on large volumes of real training data and often suffer from high estimation errors due to their reliance on position-based loss functions alone. In this work, we introduce a novel skeleton estimation framework that removes the need for real data prior to deployment by pretraining models exclusively on simulated data and subsequently fine-tuning them online after deployment using a new kinematic cycle consistency (KCC) principle. The proposed KCC framework incorporates a physics-informed loss derived from micro-Doppler signatures reconstructed from the estimated skeleton, enabling the model to explicitly minimize velocity-based kinematic inconsistencies. This allows the network to adapt to a new environment in an online, self-supervised manner without requiring motion capture ground truth. Experimental results demonstrate that the proposed approach achieves improved skeleton estimation accuracy compared to models trained solely on real data, with performance evaluated against ground truth provided by a VICON optical motion capture system.

**Abolfazl Shahrooei**<sup>1</sup>, L. Arthur<sup>2</sup>, O. Patel<sup>2</sup>, and D. Kamper<sup>2</sup>

**Graduate Programs and Institutions:** Electrical and Computer Engineering<sup>1</sup>; Lampe Joint Department of Biomedical Engineering, University of North Carolina at Chapel Hill<sup>2</sup>  
**Advisor:** Derek Kamper  
**Poster Number:** 152

### **Assessing Neuromorphic Computing for Fingertip Force Decoding from Electromyography**

High-density surface electromyography (HD-sEMG) provides a noninvasive neural interface for assistive and rehabilitation control, but mapping neural activity to user motor intent remains challenging. We assess a spiking neural network (SNN) as a neuromorphic architecture against a temporal convolutional network (TCN) for decoding the fingertip force from the motor unit (MU) firing derived from HD-sEMG. Data were collected from a single participant (10 trials) with two forearm electrode arrays; MU activity was obtained via FastICA-based decomposition, and models were trained on overlapping windows with causal convolutions throughout. On held-out trials, the TCN achieved 4.44% MVF RMSE (Pearson  $r = 0.974$ ) while the SNN achieved 8.25% MVF ( $r = 0.922$ ). While TCN was more accurate, the SNN remains attractive for low-power, event-driven inference and may close the gap with architectural and hyperparameter refinements.

**Yousif Shwetar**

**Graduate Program:** Biomedical Engineering

**Advisor:** Melissa Haendel

**Poster Number:** 154

### **A Simple Derivative-Based Method to Quantify ON and OFF Retinal Pathways of Vision**

Visual processing is composed of parallel ON and OFF retinal pathways that activate in response to the onset and offset of light respectively. Selective disruption of these retinal pathways produce characteristic phenotypes including complete and incomplete congenital stationary night blindness (cCSNB and iCSNB). Despite their clinical significance and emerging link between cone-driven pathway balance and myopia risk, directly isolating ON and OFF function in humans typically requires special protocols that are poorly tolerated and impractical for routine care. In this work, we present a simple, clinically deployable analysis that extracts pathway-specific information from the standard light-adapted 3.0 (LA 3.0) full-field electroretinogram (ERG) by computing the waveform's first derivative and quantifying two reproducible positive peaks representing the ON and OFF pathways of vision respectively.

We first evaluated whether these derivative-defined features reflected known pathway biology in patients with cCSNB and iCSNB. In individuals with cCSNB, the ON-linked derivative peak was nearly absent, while the OFF-linked component was relatively preserved (consistent with selective ON-pathway dysfunction). In iCSNB, both ON and OFF components were reduced, consistent with broader disruption of post-receptoral signaling.

We next examined a large adult twin cohort stratified by allelic dosage at a common myopia-associated locus near GJD2 (previously shown to be associated with OFF pathway dysfunction). Increasing risk allele dosage was associated with a progressive reduction in the OFF-linked derivative component, while the ON-linked component remained largely unchanged. Findings were reinforced with additional healthy population protocols that demonstrated selective changes in both pathways consistent with those previously noted in the literature. Together, these findings demonstrate that a simple derivative-based analysis of the routine LA 3.0 ERG that can provide specific functional analysis of both ON- and OFF-pathways, offering a practical tool for retinal phenotyping.

**Aldina Sultana**, Alan Ferris, Colton King, Seongbak Moon, and Veronica Augustyn

**Graduate Program:** Materials Science and Engineering

**Advisor:** Veronica Augustyn

**Poster Number:** 159

### **Governing Factors in Mildly Acidic Zn/MnO<sub>2</sub> Batteries: Interplay of Electrochemical Protocols, Electrolyte Composition, and Cell Configuration**

Zn–MnO<sub>2</sub> aqueous batteries are promising candidates for sustainable energy storage due to their use of cost-effective materials and inherent safety profile. In acidic aqueous electrolytes, both electrodes ideally undergo reversible electrodeposition during charge and electrodisolution during discharge. At the cathode, MnO<sub>2</sub> operates through a reversible Mn<sup>4+</sup>/Mn<sup>2+</sup> proton-coupled electron transfer reaction with the formation of solid MnO<sub>2</sub> during charge and its electrodisolution to Mn<sup>2+</sup> during discharge. In this work, we investigate the electrodeposition and electrodisolution mechanisms of the MnO<sub>2</sub> cathode under different electrochemical protocols using both an aqueous and a hybrid electrolyte. We electrodeposited MnO<sub>2</sub> onto carbon substrates under constant current and constant potential conditions, with systematic variation of the electrodeposition time and areal capacity. Ex-situ Raman spectroscopy and scanning electron microscopy (SEM) were used to characterize the local structure and morphology of the deposited films. Raman spectroscopy revealed substantial heterogeneity in electrodeposited MnO<sub>2</sub> phases across both electrolyte systems. SEM imaging demonstrated that MnO<sub>2</sub> growth, morphology, and uniformity are strongly influenced by the electrochemical protocol. Both SEM and Raman analysis show a correlation between film thickness and phase heterogeneity in electrodeposited MnO<sub>2</sub>. Operando electrochemical optical spectroscopy (EC-OM) provides real-time insights into the electrodeposition and electrodisolution of Zn and MnO<sub>2</sub>, highlighting how hydrogen evolution at the anode and deposition thickness impact the capacity of Zn–MnO<sub>2</sub> batteries. This study underscores the critical role of electrolyte composition and electrochemical parameters in governing MnO<sub>2</sub> electrodeposition/electrodisolution to further the development of Zn–MnO<sub>2</sub> batteries in mildly acidic electrolytes.

**Alireza Velayati**, Jeffrey A. Bennett, Negin Orouji, and Milad Abolhasani  
**Graduate Program:** Chemical Engineering  
**Advisor:** Milad Abolhasani  
**Poster Number:** 169

### **Flex-Cat: A Fully-Autonomous Ligand and Reaction Exploration Platform for Data-driven Catalysis**

The discovery and optimization of homogeneous catalysts remain bottlenecks in the development of efficient and selective chemical transformations. Here we report Flex-Cat, an autonomous catalysis laboratory that integrates parallel miniaturized batch reactor automation with a custom artificial intelligence framework for closed-loop, data-driven catalyst discovery. Using rhodium-catalyzed hydroformylation of propylene and a chemically diverse library of phosphorus-based ligands, Flex-Cat autonomously conducted 360 experiments across three multi-objective optimization campaigns targeting branched, linear, and tunable aldehyde regioselectivity. The system autonomously identified ligand–condition combinations that achieved over 2.5-fold improvements in turnover frequency and expanded the accessible regioselectivity range. Mechanistic trends in ligand performance emerged from autonomous exploration, and top candidates were validated through successful scale-up from 2 mL to 20 mL reactors. Flex-Cat establishes a scalable and generalizable approach for autonomous catalyst development, linking discovery-scale experiments to process-relevant outcomes.

**Cormak Weeks**, Wentao Tang, and Lilian Hsiao  
**Graduate Program:** Chemical and Biomolecular Engineering  
**Advisor:** Lilian Hsiao  
**Poster Number:** 177

### **Imaging and Flow Modeling for the Extrusion of Nanoemulsion Hydrogels**

Liquid-based soft material extrusion exhibits complex phase behavior and heterogeneous velocity fields arising from the coupled effects of pressure-driven flow and attractive colloidal interactions. Bulk rheological measurements and simple shear flow models are insufficient to describe non-Newtonian behavior under confined channel flow, limiting accurate prediction of ink printability. Here, fast line-averaging and object-tracking image analysis are combined with first-principles transport modeling to resolve phase evolution in gels flowing through a cylindrical capillary at temperatures from 39 °C to 60 °C and radially averaged shear rates between 0.21 s<sup>-1</sup> and 6.2 s<sup>-1</sup>. The material system consists of a colloidal suspension containing 20 vol% fluorescent poly(dimethylsiloxane) nanoemulsion droplets dispersed in a liquid precursor with 200 mM sodium dodecyl sulfate and 33 vol% poly(ethylene glycol) diacrylate. At elevated temperatures, the system self-assembles into gel networks with length scales spanning nanometers to microns due to interparticle attractions. Under applied pressure drops of 0.5 kPa to 30 kPa in a 1 mm diameter capillary, the material exhibits shear thinning accompanied by localized cluster migration, producing strongly heterogeneous flow profiles not predicted by bulk rheology. High-speed confocal microscopy reveals intermittent flow regimes and syneresis at specific velocities, intensified by strong droplet attractions. A finite-difference transport model is developed to describe momentum advection and species dispersion within the capillary. Coupling this model with time-resolved imaging enables extraction of local velocity fields and cluster diffusion coefficients, providing a framework for in situ monitoring and rapid control of additive manufacturing processes.

**Ory Wickizer**

**Graduate Program:** Computer Science

**Advisor:** Aditi Mallavarapu

**Poster Number:** 179

### **Engaging Decision Makers and Educators Using an Interactive Learning Environment to Understand the Complex Systems Challenges of Antimicrobial Resistance**

This project explores the design of an interactive learning environment (ILE) that engages users with the integrative, systemic One Health approach to understanding and mitigating antimicrobial resistance (AMR). The spreading and strengthening of AMR is a serious threat: if not resolved, it is estimated that AMR will claim over 8 million human lives globally in 2050.

While the intake of prescription antibiotics has been a major factor, there are additional important factors relating to the environment, food supply, water supply, and interactions with animals that we consume and cohabitate with. Potential mitigation strategies exist, but stakeholders must leverage systems thinking techniques that adopt the integrative One Health perspective in order to work towards addressing this complex challenge. We look to use ILEs, a powerful educational tool, to empower decision-makers and the general public with systems-oriented awareness on these issues.

Working towards the goal of designing such an ILE, we adopt a human-centered approach by performing a systematic review of the literature surrounding interactive learning technologies for healthcare, and conduct two participatory design sessions. One of these sessions is focused on domain experts and aims to map the different factors of the complex system surrounding AMR. Another leverages educator expertise to validate designs that best portray these concepts.

These design sessions guide us toward an ILE that can be used by decision makers and the general public to better understand the complex system that AMR and potential solutions operate in.

Our initial assessment of the literature has yielded sparse implementations of ILEs for AMR, none of which leverage the systems thinking approach. The participatory design helps us gather the domain and pedagogical expertise necessary for the design of an ILE that engages audiences to explore the integrative One Health perspectives of AMR through simulation and artificial intelligence-driven feedback for conceptual clarity.

**Xiaoran Yang, Yang Zhan, Noboru Matsuda, and Qiao Jin**

**Graduate Program:** Computer Science

**Advisor:** Qiao Jin

**Poster Number:** 186

### **From Tool to Partner: Exploring the Roles of Embodiment on AI Agent in Pair Programming**

Pair programming with AI often faces challenges in productive communication and engagement. Integrating embodiment offers a promising solution by making AI a more engaging and context-aware programming partner. To explore how embodied AI agent supports programming learning and affects user experiences, we designed a virtual reality (VR) programming environment with Wizard-of-Oz-controlled AI agents. Our study collected data from 18 participants through knowledge acquisition assessments and interviews. The results showed that embodiment improved engagement, enhanced communication efficiency, and offered emotional support. Specifically, the incorporation of embodied actions allows users to perceive the AI agent as a "programming partner" and introduces many interactions that resemble those shared with real-life partners. However, the effectiveness of embodied actions in supporting users with programming tasks depends on the timing and accuracy of those actions. This study reveals the potential of embodied AI agents in advancing programming education and provides valuable design insights for creating more intuitive and supportive AI programming partners.

## College of Humanities and Social Sciences

**Paul Agada**

**Graduate Program:** Communication

**Advisor:** David Berube

**Poster Number:** 2

### **Analysis of X Users' Perception of Crowdsourced Fact-checking as an Effective Tool for Combating Misinformation**

This study titled, Analysis of X Users' Perception of Crowdsourced Fact-checking as an Effective Tool for Combating Misinformation, aimed to find out if X users perceive the crowdsourced fact-checking feature, Community Notes, as an effective means for combating misinformation; if they are mindful of the Community Notes when they create and interact with posts; and if they trust the quality of open-sourced information offered on Community Notes. The theories guiding this study are Information Processing Theory, Source Credibility Theory, and Uses and Gratification Theory. Interviews were conducted with 20 respondents purposely sampled from the United States and Nigeria. Analysis of data collated revealed that respondents believe community notes can be an effective tool for combating misinformation, but the 14-hour time lag affects the effectiveness of the community notes as misinformed posts would have gone viral; majority of the respondents are mindful of community notes when they interact with posts, so they remove posts, reposts, and likes because they do not want to feel responsible for spreading false information; the trust in community notes also varies, and this is because users lack clarity on how contributors are vetted. Overall, the findings highlight the need for X to improve transparency, accuracy, and speed in Community Notes to enhance user trust and effectiveness in combating misinformation.

**Taibat Amoke Akinsanya-Ibrahim**

**Graduate Program:** Communication, Rhetoric, and Digital Media

**Advisor:** Helen Burgess

**Poster Number:** 5

### **Eco-Memes in Digital Discourse: Humor as Environmental Communication**

As environmental pollution has become a major public concern, eco-memes on digital media serve as popular communicative tools for representing environmental challenges through humor and multimodal elements. This research explores the multimodal discourse analysis of environmental memes on the internet, focusing on the ideological representation of the memes. Through the lens of multimodal discourse analysis, the study examines how visual and textual elements construct representations of environmental pollution. Findings from the study indicated a range of ideologies within the broad spectrum of anthropocentric to ecocentric, including environmental ethics, value-driven, ecological sensibility, and deep ecology. Humor and pop culture references are used to simplify complex environmental debates and to encourage reflection among online audiences. Also, the integration of multimodal elements, such as texts, colors, intertextuality, visual metaphor, salience, and foregrounding, frames environmental pollution as a systemic problem or the consequences of individuals' actions, which influence how audiences perceive their role in addressing the problem. This study contributes to scholarship in digital environmental discourse, demonstrating how online artifacts influence the understanding of environmental issues. Overall, the study provides insight into the ideological underpinnings of the memes, enhancing environmental reflection, engagement, and awareness in digital spaces.

**Talia Brenner**

**Graduate Program:** Public History

**Advisor:** David Zonderman

**Poster Number:** 19

### **“But Not Their Song’: The Lost Colony in Public History”**

The “lost colony” of Roanoke Island (1587) is one of America’s favorite historical mysteries, when in reality, it was just one of England’s many failed, early experiments in colonizing North America. That discrepancy compels the question: why is the “lost colony” special to so many people? And what has been the role of public historians? Through archival research, oral history, and analysis of museum interpretation, and theory in museum studies, cultural heritage, and collective memory, my research analyzes the three institutions interpreting this history on Roanoke Island. These are: The Lost Colony play, written in 1937 and performed every summer; Fort Raleigh National Historic Site; and Roanoke Island Festival Park. I argue that The Lost Colony play has serious intentions. Playwright Paul Green drew on ethnographic research and sought to present authentic sixteenth-century folk culture, although with significant biases and omissions in his presentation of Indigenous characters. Over time, the play’s renown and high visitation, stemming from its role as a heritage ritual for participants and audiences, has promoted its version of the history. Changes to the script and casting practices since 2021 have dramatically shifted the play’s narrative toward Indigenous characters and perspectives. These representations of the “lost colony” have significant bearing on present-day ideas and relationships around indigeneity and belonging. Native North Carolinians have long contested the “lost colony” narrative as a myth for settlers, stemming from their unwillingness to believe that Native Americans could ever defeat Europeans. Meanwhile, settlers and their descendants have used the “lost colony” story to justify their presence to themselves and others. This phenomenon not only has local dimensions, but also connects to national, regional, and state identity, as an accelerating tourism industry has led more people to locate part of their heritage on the North Carolina coast.

**Karina Burbank**

**Graduate Program:** Public History

**Advisor:** Nishani Frazier

**Poster Number:** 22

### **“Reading the Natural World: Histories of Science on the Page” - NC State University Special Collections Research Center Exhibit**

“Reading the Natural World: Histories of Science on the Page” is an upcoming exhibit hosted by the NC State University Special Collections Research Center (SCRC), in collaboration with Libraries Communications. The exhibit highlights aspects of the field of natural history as reflected in the NC State University Libraries’ Special Collections Research Center (SCRC) Rare Books Collection. “Reading the Natural World” uses objects from the medieval period through the 20th century, showing the development of scientific thought, use of design, and changing access to scientific knowledge. It draws on extensive primary and secondary source research and interdisciplinary collaboration with departments across the university. By pairing rare books with samples from the University’s Vascular Plant Herbarium and the Insect Museum, “Reading the Natural World” asks visitors to consider how the natural world has been preserved through different means and what is represented in different media. The exhibit links the tradition of “natural history” research with today’s scientific field by highlighting connections to scholarship at NC State University. Through its research, curation, and design “Reading the Natural World” reminds visitors of the vital importance of history, legacies, and centuries of scholarship behind the modern scientific field.

**Reyyan Can**

**Graduate Program:** Psychology

**Advisor:** Shevaun Neupert

**Poster Number:** 25

### **Daily Dynamics of Happiness Hedonic & Eudaimonic Perspectives**

Happiness is a multidimensional construct that includes both momentary/hedonic and long-term/eudaimonic experiences and impacted by cultural and contextual factors. We will present findings from a cross-cultural daily diary study examining fluctuations in happiness among middle-aged and older adults in the United States and Türkiye. Using micro-longitudinal data collected over 14 days, we investigated how daily happiness relates to affective experiences and eudaimonic well-being. Participants (N = 174, ages 50–90) completed self-reports of positive and negative affect and happiness each day, and eudaimonic well-being and demographic information at baseline. Results showed that daily increases in positive affect and decreases in negative affect were each associated with greater happiness in both countries. Participants who reported higher eudaimonic happiness also indicated higher daily happiness. These findings portray roles of hedonic and eudaimonic experiences and their impacts on daily happiness across later adulthood.

**Lily Cavanaugh** and Members of the Tuscarora Nation in Robeson County, North Carolina

**Graduate Program:** Anthropology

**Advisors:** Claudia Gastrow and John Millhauser

**Poster Number:** 27

### **Connection Over Extraction: Indigenous Storytelling and Trauma-Informed Ethnography**

The responsibility of the ethical ethnographer to hold a safe space for Indigenous Peoples who wish to recount their lived experiences as part of an anthropological research project requires a deeper understanding of the connection between structural violence and access to cultural heritage than anthropology can offer on its own. Utilizing my own interdisciplinary background and following the lead of Tuscarora community members in Robeson County, North Carolina, I explore the capacity for transdisciplinary heritage studies, particularly across the fields of psychology and anthropology, to serve as a meaningful space for decolonization and traditional knowledge preservation through trauma-informed ethnography. In prioritizing authentic relationship-building across boundaries and incorporating the strengths of both traditional Tuscarora knowledge systems and Western social science disciplines into its methodology, this project has endeavored to detail what it looks like to develop a definition of 'trauma-informed' research that is both culturally-relative and historically-specific. Over the course of a year, community members and myself have worked diligently to facilitate and transcribe semi-structured interviews with the intent of compiling a community-owned thematic quotation index which will serve as an accessible source of intergenerational, cultural knowledge for years to come.

**Mahashweta Chakraborty** and Aura Ankita Mishra  
**Graduate Program:** Lifespan Developmental Psychology  
**Advisor:** Aura Ankita Mishra  
**Poster Number:** 29

### **Exploring the Interplay between Adverse Childhood Experiences, Teen Bullying and Adult Mental Health**

Adverse Childhood Experiences (ACEs) and bullying have a cascading negative impact on people's well-being, especially on their mental health. This study aims to (1) investigate the relation of ACEs and bullying on mental health (depression and anxiety) of young adults, (2) explore the mediating role of bullying in the association between ACEs and mental health and (3) understand the role of demographics (i.e., sexual orientation, race/ethnicity, and gender) in the interplay between ACEs, bullying and mental health. The Future of Families dataset was used, where the ACEs data was collected from the families across childhood (ages 1- 15), bullying data came from adolescent self-reports of experiences of bullying at school when they were approximately age 15 and measures of anxiety and depression were assessed when respondents were 22 years old. Regression analyses showed that both ACEs and bullying showed a significant association with depression and anxiety in early adulthood. Additionally, it was also found that bullying does have a significant mediating role in the ACEs - mental health interplay. Whereas females reported a similar trend in the association between ACEs, bullying and mental health, males reported a significant association between ACEs and both depression and anxiety, whereas bullying was associated only with anxiety. Across different race/ethnic populations, ACEs had a significant association with depression while only White and Black individuals reported an association between ACEs and anxiety. Hispanic and Black individuals additionally reported the bullying-anxiety and bullying-depression associations respectively. Furthermore, heterosexual individuals reported mental health symptoms to be significantly associated with both ACEs and bullying whereas sexual minorities showed a significant association only between bullying and mental health. Thus this study highlights the independent and unique association of traumatic events such as exposure to ACEs and bullying in school on adult mental health.

**Alexa Clymer**  
**Graduate Program:** Communication  
**Advisors:** Colten Meisner, Cynthia Rosenfeld, and Steve Wiley  
**Poster Number:** 35

### **Against Ephemerality: Understanding Physical Media Audiences in the Age of Streaming**

This thesis examines contemporary engagement with physical media (VHS, DVD, and Blu-ray) in the context of a contemporary media landscape increasingly dominated by digital streaming platforms. Drawing on semi-structured interviews and ethnographic observations at Orbit DVD, a long-standing video store in Asheville, North Carolina, this study investigates why consumers and employees continue to collect, preserve, and consume physical media in 2025. The findings reveal four dimensions of contemporary media practice: (1) collector culture, in which collection and curation operate as markers of identity, expertise, and community; (2) resistance, where ownership of physical media serves as a strategy to reclaim control and autonomy from subscription-based, ephemeral streaming services; (3) the endurance of physical formats, valued for tangibility and durability; and (4) nostalgia and memory, which shape both individual and intergenerational relationships with media. Across these themes, participants' practices demonstrate that physical media is far from obsolete; it functions as an active cultural strategy that encompasses both personal and social means of resistance, preservation, and identity formation. This research contributes to understandings of contemporary media consumption, cultural preservation, and the persistence of physical formats in a digital era.

**Jaida Ellis, Jenny Elander, and April Davidson**

**Graduate Program:** Social Work

**Advisors:** Terrance Ruth and Ebony Perez

**Poster Number:** 41

### **Beyond Baby Blues: Evaluating Anchor's Perinatal IOP in Reducing Depression and Anxiety in North Carolina**

Perinatal mood and anxiety disorders (PMADs) rank among the most common complications during pregnancy and the postpartum period and are a leading contributor to maternal morbidity and mortality in the United States. Despite their prevalence, access to specialized and intensive treatment remains limited, particularly in North Carolina. This study proposes a quantitative evaluation of Anchor Perinatal Wellness's Intensive Outpatient Program (IOP), the only perinatal-focused IOP in the state. The primary objective of this study is to assess its effectiveness in reducing symptoms of perinatal depression and anxiety. Using a single-group pretest–posttest design, the evaluation will analyze existing, de-identified clinical data from the 2024 IOP cohort. Symptom change will be measured using the Edinburgh Postnatal Depression Scale (EPDS) and the Perinatal Anxiety Screening Scale (PASS), comparing intake and discharge scores (a decrease of 30% or more shows an effective decrease in PMAD symptoms). In addition to evaluating the efficacy of the program, the study will describe participant demographics, engagement patterns, and access-related factors such as referral sources and insurance coverage. Although data analysis has not yet been completed, this evaluation is expected to provide practice-based evidence on the clinical value of perinatal IOPs for social work practice and policy advocacy. Findings may assist in the creation of a comprehensive system of care that encourages social workers to gain PMH-C licensure in this area, along with the creation of more perinatal-focused IOPs in the United States.

**Syd Fryer**

**Graduate Program:** Spanish Language and Literature

**Advisor:** Greg Dawes

**Poster Number:** 55

### **Between Accusation and Ambiguity: Political Commitment and Literary Form in Rodolfo Walsh and Julio Cortázar**

This research examines how literature functions as political intervention under conditions of authoritarianism and state terror through a comparative analysis of Argentinian writers Rodolfo Walsh and Julio Cortázar. As both wrote amidst censorship, repression, violence, and revolutionary turmoil in Latin America in the mid-20th century, they used writing to engage politically, but in radically different ways. Drawing on theories of the avant-garde, political commitment, and aesthetic autonomy, this study argues that Walsh and Cortázar represent two distinct modes of politically engaged authorship. Through close readings of works including *Operación masacre*, "Esa mujer," and *Carta abierta de un escritor a la junta militar*, this research demonstrates how Walsh engages in direct accusation, documentation, and activism. Conversely, works of Cortázar, including "Reunión," "Apocalipsis de Solentiname," *Libro de Manuel*, and *Nicaragua tan violentamente dulce*, reveal how he maintains ambiguity, fragmentation, and experimentation as a means of resisting authoritarian ideology without reproducing it. By comparing these two strategies, this research shows both the strengths and limitations of both styles, as well as the changing conceptions of politically committed literature. This study argues that political literature under repression operates within a space of tension, where form itself becomes a site of resistance.

**Naomi Garcia**

**Graduate Program:** Anthropology

**Advisor:** Kathryn Grossman

**Poster Number:** 57

### **More than a Religious Act: A Social Study of Nonhuman Animal Fauna at the Church of San Ignacio**

A traditional approach to the study of zooarchaeology has often involved a uniform analysis of nonhuman animal fauna as a food resource. The ritualistic role of the nonhuman animal and its symbolic capacity within the subfield has therefore been an understudied topic. Furthermore, despite scholarly interest in the study of magic, limited research has been conducted on the use of nonhuman animals as a protective device, or apotropaia, against magic in white colonial culture. This is further compounded by the use of religion as an instrument to isolate western theology from the supernatural in earlier research. Recent studies have aimed to address these dilemmas; however, further analysis of this phenomenon is still necessary. My project intends to explore these issues through a case study of the San Ignacio Church, where nonhuman animal fauna has been documented within the burials of Spanish colonial clergymen.

**Leah Harrell and Julie K. Wesp**

**Graduate Program:** Anthropology

**Advisor:** Julie K. Wesp

**Poster Number:** 71

### **Biological Distance Analysis of the Individuals Buried at San Ignacio Church**

This study analyzes human remains from Iglesia de San Ignacio, an enduring landmark in the city of Bogotá, Colombia, as well as a sacred place of worship and burial for the Jesuits during the Colonial (17th - 18th century) and Republican (19th century) periods. Our project explores the population affinity and biological distance of the individuals once buried at this site using the Arizona State University Dental Anthropology System (ASUDAS) to analyze dental morphology for Colonial (n=29) and Republican (n=15) individuals and estimate affinity through the rASUDAS web application. A comparison of the posterior probabilities based on dental nonmetric traits show high probabilities for a multiethnic burial ground, which is reflective of historical Colonial society. Biological distance analysis then explored the intersection of population variation within the differing burial contexts. Results show individuals from burial contexts associated with the clergy and high status lay people are more biologically similar to each other than those from the locales associated with individuals of lower status. A statistically significant difference was found between these individuals of lower status and members of the clergy, though this divergence lessens when solely looking between the lower and higher status parishioners. Through exploring questions of relatedness and distance within this burial ground, this research furthers our understanding of the population history of this site and the way that biological relationships are discussed in bioarchaeology.

**Jessica F. Khan**, Serena Kim, Ph.D., and Jerrell D. Coggburn, Ph.D.

**Graduate Program:** Public Administration

**Advisor:** Jerrell Coggburn

**Poster Number:** 87

### **Who is most likely to leave? Predictors of Turnover Intention in the Federal Workforce: A Machine Learning Approach**

Retaining human resources is essential, particularly in today's labor market where public organizations face growing challenges in attracting and retaining top talent. The loss of high performing employees can significantly impact organizational performance and other key outcomes. This study examines the predictors of turnover intention among federal employees, comparing factors that influenced turnover intention before COVID-19 and after COVID-19. Drawing on the turnover intention literature, we use both personal and organizational characteristics as predictor variables using data from the Federal Employee Viewpoint Survey spanning from 2018 to 2024. By employing CART and XGBoost machine learning models, we seek to identify shifts in the predictors of turnover intention and determine which subgroups of employees are at the highest risk. This research has important implications for public managers because by understanding the most influential predictors, they can take a more targeted approach to address turnover intention. This study also contributes to the public human resources literature by applying novel methodological approaches while examining workforce dynamics in the post COVID-19 work environment.

**Austyn D. Kobs**

**Graduate Program:** English

**Advisor:** Justin Tackett

**Poster Number:** 91

### **The Emotional History of Modern War: Reading Trauma Across Veterans' Diaries**

This project examines veterans' diaries, memoirs, and autobiographies as a longitudinal archive of emotional expression, tracing how experiences of trauma, military violence, and moral injury shape mental health and are articulated across modern U.S. conflicts from the First World War to the post-9/11 era. Building on existing scholarship in American war literature and trauma studies, the project approaches veterans' life writing as a record of psychological experience in closer proximity to lived events than many retrospective literary representations.

I argue that these texts reveal a historically contingent emotional vocabulary through which veterans attempt to register the psychic consequences of contact with military violence -- an idiom shaped by evolving military technologies, medical paradigms, and cultural expectations surrounding masculinity, duty, and resilience. Early twentieth-century writings frequently encode distress through somatic complaint, euphemism, and religious idiom, whereas late twentieth- and twenty-first century veteran narratives increasingly register suffering through diagnostic, therapeutic, and bureaucratic frameworks associated with PTSD and trauma discourse. Yet across periods, authors consistently negotiate a tension between documenting psychological injury and performing functional military subjectivity.

Methodologically, the project combines close reading with selective digital humanities techniques such as keyword clustering and collocation analysis to identify recurring emotional registers and their historical inflections. By foregrounding American veterans' life writing as a coherent analytic corpus, this project reframes trauma not as a stable psychological category but as a shifting mode of expression through which the mental health consequences of military service are variously named, displaced, or managed.

Ultimately, this project demonstrates how veterans' personal narratives of conflict serve to complicate both heroic and pathologizing models of war experience, offering a more granular account of how individuals interpret, manage, and narrate prolonged exposure to violence in the name of American military service.

**Gabrielle Lopez** and Julie K. Wesp  
**Graduate Program:** Anthropology  
**Advisor:** Julie K. Wesp  
**Poster Number:** 100

### **Congregational Movement: Degenerative Joint Disease in Colonial Bogotá, Colombia**

This project analyzes the frequency and severity of degenerative joint disease (DJD) for individuals buried at San Ignacio, a colonial Jesuit church in Bogotá, Colombia. The site sits at 2639 masl and is characterized by a diverse colonial population with varied occupations, histories, and social positions. DJD is a progressive disease triggered by the degeneration of cartilage in afflicted joints and can be witnessed skeletally as bone reacts to the breakdown. The degree of wear visible on joints with DJD can be a useful indicator of daily life and activity in past populations. Our study aims to compare patterns of DJD prevalence and severity across different occupations, social identities, and lived experiences. We predict lower limb joints, especially the knee, will yield a higher frequency and severity of DJD compared to upper limb joints. We analyzed 411 joint surfaces in the shoulder, elbow, hip, and knee following the methodology developed by Zampetti and colleagues (2016) that scores marginal lipping (ML), porosity (PO), surface osteophytes (SO), eburnation (EB), and loss of morphology (LM). Overall, we found higher frequencies of degenerative change in the hip (ML 63%) and knee (ML 62%), with moderate degenerative change found in the shoulder joints (ML 63%). Elbow joints exhibited the lowest levels of degenerative change (ML 50%). Moderate or severe degenerative changes, especially eburnation, were not observed in the upper limb joints (0%), but moderate eburnation was more widespread in the lower limb joints (EB 17%). Our findings illustrate how the environment, occupation, and social identity leave physical traces on skeletal remains and ongoing research further explores variation in lived experiences and indicators of physical activity and occupational disease in colonial New Granada.

**Linnea Murthy**  
**Graduate Program:** Anthropology  
**Advisor:** Nora Haenn  
**Poster Number:** 120

### **Living with a Volatile Body: Embodiment, Attention, and Diagnosis in Dysautonomia**

Dysautonomia is an umbrella term to refer to a group of disorders involving dysfunction of the autonomic nervous system, producing multisystemic, fluctuating, and often unpredictable bodily symptoms. Conditions such as Postural Orthostatic Tachycardia Syndrome (POTS) are frequently difficult to diagnose and they lack definitive biomarkers and are commonly misrecognized or psychologized within biomedical settings. This project examines how individuals living with dysautonomia experience bodily instability prior to and following diagnosis, with particular attention to how volatility shapes embodiment and attentional labor.

Drawing on ten semi-structured interviews with individuals diagnosed with dysautonomia, this study explores how autonomic instability disrupts bodily regulation and narrative coherence, forcing sustained attention to bodily sensations in the absence of clear explanatory frameworks. Participants describe experiences of confusion, fear, and interpretive overload as they attempt to track symptoms, seek care, and make sense of fluctuating bodily states. These forms of attentional labor are frequently misread as anxiety, contributing to diagnostic delay and dismissal.

Rather than resolving bodily instability, diagnosis emerges as a partial intervention that provides language, structure, and legitimacy, allowing individuals to reorient how they attend to and interpret ongoing symptoms. By foregrounding dysautonomia as a condition of embodied volatility, this project contributes to medical anthropological discussions of contested illness, embodiment, and diagnosis, highlighting how biomedical recognition reshapes lived experience even in the absence of cure.

**Raquel Olvera**

**Graduate Program:** Spanish Linguistics and Literature

**Advisor:** Mark Darhower

**Poster Number:** 129

### **A Culture-fronted Approach to Teaching First-year University Spanish**

The purpose of this study is to examine the impact of a culture-centered approach in first-year university Spanish courses. In most Spanish textbooks, cultural content appears at the end of each chapter, usually as a short reading or note that often simplifies or stereotypes aspects of a specific country. This type of information typically focuses on geography or social facts and is rarely connected to the main instructional themes, which makes it feel secondary or disconnected from the rest of the curriculum.

In this project, four sections of WLSP 102 (Beginning Spanish II) adopted a culture-fronted approach. In this model, the cultural section, usually placed at the end of the chapter, was moved to the beginning and expanded to encourage reflection and critical thinking about cultural products, practices, and perspectives related to the target countries in each chapter. In addition, the rest of the chapter content was redesigned to include more cultural examples and activities.

At the end of the semester, a questionnaire was administered in all WLSP 102 sections (both treatment and non-treatment groups). The instrument included Likert-scale and open-ended questions to gather students' perceptions of how the course contributed to their development of cultural competence. The results showed that students enrolled in the treatment sections demonstrated significantly greater intercultural competence than the control sections.

**Nell Pietri**

**Graduate Program:** World Languages and Cultures

**Advisor:** Irina Randriamiadan

**Poster Number:** 134

### **The Coloniality of Laughter: Representing Black Women from France's Overseas Territories in Contemporary French Caricature (2020–2026)**

On Thursday, 5 February 2026, the White House published a racist video depicting former Democratic President Barack Obama and his wife Michelle as monkeys. The persistence of such a racialized visual imaginary demonstrates that the question of the representation of Black people remains a pressing issue in contemporary media cultures. France is not exempt from these representations, which illustrate the concepts of misogynoir (Moya Bailey, 2008) and “erocoloniality” (éroticolonie, Sylvie Chalaye).

Drawing on these works, as well as Françoise Vergès's analyses of the coloniality of gender, this study examines how certain graphic choices – hypersexualization, exoticization, animalization, and folklorization – reactivate stereotypes inherited from the colonial regime. The project thus lies at the intersection of postcolonial studies, gender studies, and visual studies.

It focuses on the representation of Black women originating from France's overseas territories in the French satirical press – Charlie Hebdo and Le Canard enchaîné – between 2020 and 2026. While nineteenth- and twentieth-century colonial caricature has been widely studied, the specific figure of the Black woman – at the intersection of racism and sexism – remains marginal in scholarship, as does the consideration of overseas territories in the analysis of contemporary images.

The aim of this research is therefore twofold: to demonstrate the persistence of colonial imaginaries in contemporary caricature and to examine caricature as an ambivalent space, capable not only of reproducing such representations but also of becoming a site of critique, resignification, and symbolic reconfiguration in postcolonial France.

**Luke I. Priest** and Asa Beale

**Graduate Program:** Industrial and Organizational Psychology

**Advisor:** Adam W. Meade

**Poster Number:** 136

### **Seeking Destruction: How Personality Shapes Implicit Leadership Theories and Perceptions of Destructive Leadership**

The literature on destructive leadership largely focuses on the traits and behaviors of leaders themselves, leaving out the role followers' traits play in perceiving leadership. To address this issue, we drew on the Big Five and Dark Tetrad personality frameworks to examine how individuals' personalities and Implicit Leadership Theories (ILTs) influenced their evaluations of destructive leadership. Using a sample of 500 participants from NC State and USC Upstate, we collected personality data and had participants rate supervisors in a series of four vignettes, each designed to embody a particular dark trait and its relevant destructive leadership behaviors. Participants rated them across three dimensions: observed dark traits, perceived destructiveness, and satisfaction. The results suggest that individuals higher in Dark Tetrad traits tend to endorse anti-prototypical leader traits, such as Tyranny and Masculinity. Additionally, perceived dark traits predicted higher ratings of supervisor destructiveness, which in turn predicted lower levels of satisfaction. Finally, there was a modest positive correlation between Neuroticism and Openness and perceived psychopathy in leadership. These results bring a fuller picture to the leader–subordinate relationship by underscoring the role individual differences have in shaping one's perception of destructive leadership, thus highlighting the importance of considering raters' personality in leader assessment situations.

**Jinzhe Qiao**

**Graduate Program:** Communication, Rhetoric, and Digital Media

**Advisor:** Huiling Ding

**Poster Number:** 138

### **Playful Interfaces and Invisible Facial Recognition: Examining AR Face Filters on Snapchat**

AR face filters are widely used on social media for entertainment and self-expression. During these interactions, facial recognition technologies operate continuously. However, facial recognition is rarely presented as a system for identification, classification, or data collection. Instead, it is embedded within playful visual effects and routine interface interactions. This study examines how everyday interface design may shape public understanding of facial recognition and its ethical implications.

The study focuses on AR face filters on Snapchat, where facial detection and tracking are central to everyday use. Snapchat is selected because it provides stable, platform-created materials that show how face filters are designed and explained to users. The analysis examines official product pages, app store descriptions, and standard in-app filter interfaces. User-generated content and user behavior are not included. This approach keeps the focus on how the platform presents facial recognition at the moment of interaction.

Methodologically, the study combines the walkthrough method with multimodal discourse analysis. The walkthrough documents how users are guided through interface pathways, prompts, animations, and feedback. The analysis focuses on visual representation, interface composition, and interaction cues. In addition, the study examines short texts written by the platform, such as feature descriptions and interface prompts, to understand how purpose, control, and responsibility are framed alongside interface design.

Rather than treating facial recognition as an explicit technical process, this study explores how recognition is positioned as a background condition for playful visual interaction. It also examines whether data collection and algorithmic processes are explained within interface design and platform texts. By focusing on these everyday interface forms, the study highlights the role of visual and interaction design in shaping how facial recognition may be understood, normalized, or overlooked in discussions of AI ethics and public understanding.

**Emily Robinson**

**Graduate Program:** Public Administration

**Advisor:** Tom Birkland

**Poster Number:** 142

### **Charter School Diffusion: The Role of Compatibility in Adoption Decision**

Charter schools are a popular school choice alternative to traditional public schools. Since the first charter school enabling legislation was passed in 1991, forty-six more states have adopted charter schools. I use an event history analysis to test propositions from Everett Rogers' diffusion of innovation theory. He proposed that innovation adoption decisions are made based on the innovation's attributes: relative advantage, compatibility, complexity, trialability, and observability. Compatibility occurs when an innovation aligns with a potential adopter's values, needs, and past experiences. I ask how charter school policy compatibility influences adoption in American states. I assess compatibility with state values. Since private school vouchers are another popular school choice policy, states with laws permitting school vouchers display a stronger level of value compatibility with charter school policies because of their support for school choice. I use an event history analysis to determine the probability of policy adoption. EHA is a pooled cross-sectional time series analysis that can help explain behavior, in this case, policy adoption. I expect to find that as compatibility between the policy and the state increases, the probability of adoption also increases.

**Andrea Ryan**

**Graduate Program:** History

**Advisor:** Traci Brynne Voyles

**Poster Number:** 144

### **Conceal and Conspire: Countersurveillance under Slavery near the Dismal Swamp**

Spilling over the Virginia-North Carolina border, the vast wetland of the Dismal Swamp sheltered countless people escaping slavery in the decades leading up to the Civil War. Known as the "Canada of the South," reports of the success of fugitives to live freely in the swamp spread across the nation. Some runaways lived independently, subsisting deep within its tangled interior. However, the swamp is only half the story. Many other fugitives leveraged relationships with those outside of its margins to ensure their survival. While it's widely accepted that runaways were supported by local enslaved people, few specifics on the material and methods of such aid exist. Providing aid to runaways could have deadly consequences if enslavers discovered such actions; thus, assistance efforts demanded secrecy and, consequently, remain less well archived. By analyzing legal records, newspaper ads, and oral histories, I explore the ways in which individuals and communities outside the Dismal Swamp contributed to the survival of those who took refuge there. I argue that the success of fugitivity often depended upon individual and communal efforts to evade detection, and that intimate knowledge of the natural environment frequently underpinned these tactics. Specifically, skills in concealment and conspiracy served as the foundation for fugitivity efforts in Southern communities near the Dismal Swamp. Illuminating complex, countersurveillance behaviors is particularly useful for a more multifaceted understanding of how fugitives from slavery were able to survive, both inside and outside the Dismal Swamp.

**Elle Thigpen**

**Graduate Program:** Social Work

**Advisor:** Paige Averett

**Poster Number:** 164

### **Needs Assessment of School-Based Mental Health Services in Guilford County and Alamance-Burlington County, NC**

There is a tremendous need for school social workers (SSW) to provide mental health services in school settings. However, SSWs have high caseloads with an average of 1:996 students in 2025. SSWs are also seeing a mental health crisis within the schools, with approximately 20% of students diagnosed in 2025. Yet, SSWs are facing decreased funding and support for school-based mental health (SBMH) services. As a result, the NC State School of Social Work was funded by the NC Department of Instruction to assess social determinants of health, mental health disparities, gaps, and opportunities for SBMH services that school social workers can address within K-12 public school settings in Guilford County and Alamance-Burlington County, North Carolina. This needs assessment was based on collecting existing data and involved analyzing community health needs assessments, state of the county health reports, school report cards, existing mental health resources, and school assessment data to determine the mental health, social, and behavioral health needs of students within the identified counties. Findings reveal that there is a high need for SSWs to provide trauma-informed and equitable SBMH resources, education, and services for economically disadvantaged areas, students with disabilities, students of color, and English learners. These reports seek to contribute to a better understanding of how to expand the number of SSWs to address the shortage of SBMH providers within disenfranchised and historically marginalized locations.

**Swathi Vepachedu<sup>1</sup>** and Joseph Sherlock<sup>2</sup>

**Graduate Programs and Institutions:** Psychology<sup>1</sup>; Government, Kings College London<sup>2</sup>

**Advisor:** Lori L. Foster

**Poster Number:** 170

### **When Access Isn't Enough: Engagement as the Key to Remote Worker Well-Being**

Teleworking is now a routine feature of contemporary organizations, yet concerns about employee well-being and productivity have intensified. In response, many organizations provide remote work supports such as workspace resources, planning tools, and behavioral guidance. Despite widespread adoption, evidence on whether these resources actually improve employee outcomes remains mixed. A central limitation of existing research is that it often evaluates whether supports are offered, rather than whether they are used. This study examines whether remote work well-being interventions improve outcomes through access alone or through employee engagement with those supports. Drawing on behavioral science and intervention process frameworks, I propose that many remote work initiatives underperform because of a resource-utilization gap, a disconnect between having access to resources and translating them into action. To test this proposition, I conducted a preregistered four-week field experiment with 1,024 U.S. remote and hybrid workers. Participants were randomly assigned to receive weekly home workspace redesign recommendations, the same recommendations paired with a small financial incentive, access to a digital planning tool, or no intervention. Weekly pulse surveys and mixed-effects models compared intent-to-treat effects with treatment-on-the-treated effects capturing actual engagement. Across conditions, simply providing resources did not reliably improve well-being or productivity. In contrast, participants who adopted workspace recommendations or consistently engaged with the digital planning tool reported higher well-being and fewer productivity difficulties. Financial incentives briefly increased early engagement but did not sustain use over time. Individual capacities, particularly self-control and psychological safety, were strongly associated with outcomes. Together, these findings suggest that remote work supports are effective only when employees engage with them. By distinguishing access from utilization, this study helps explain why many well-intentioned workplace interventions yield weak average effects and highlights the importance of designing supports that reduce friction, promote engagement, and bridge the intention–action gap in remote work contexts.

**Kyle Walker**

**Graduate Program:** Psychology

**Advisor:** Lori Hoggard

**Poster Number:** 174

### **Impact of Vicarious Police Violence on Black Emerging Adults**

The present study examines the mechanisms and consequences of witnessing vicarious incidents of police violence on the mental well-being of Black individuals during emerging adulthood. This population is uniquely significant due to their stage of identity exploration, high susceptibility to anxiety and depression, and their status as the largest active age group of social media users. Research indicates that Black Americans experience negative mental health impacts from viewing videos of police violence on social media, an experience that can contribute to a unique type of racial trauma. Despite the rise of citizen journalism, much of the existing literature relies on static stimuli or previous exposure. This research fills critical gaps by identifying the psychological and affective responses of minoritized individuals through dynamic stimuli, specifically third-person perspective videos, while also determining the effectiveness of content warnings on stress responses. Additionally, the study aims to understand how racial centrality impacts perceptions of police and to identify the specific coping strategies individuals employ when dealing with racial trauma. The methodology utilizes a combined approach of self-reported quantitative scales and qualitative inquiry. Participants will complete an initial demographics survey and the Positive and Negative Affect Schedule (PANAS) to establish a baseline for current mood. They will then view previously rated videos of police violence against both White and Black targets, categorized by the severity of the outcome. Participants are randomly assigned to receive or not receive a content warning before viewing. Following the video portion, participants will be asked to complete a survey about their impressions of the video, emotional responses, experiences on social media, and their general attitudes, beliefs, and identities. It is hypothesized that individuals with high racial centrality and target identity will exhibit higher self-reported stress and negative affect. Furthermore, it is predicted that Black participants will report higher levels of distress regardless of the race of the target in the video. Beyond its academic contributions, the research holds significant broader impacts. Findings could inform policy changes regarding cultural sensitivity in police training and healing community-police relations. Furthermore, the results may influence how social media platforms and traditional media outlets disseminate violent content, advocating for viewer-controlled content warnings to assist those coping with racial trauma. Ultimately, this research aims to contribute to the development of accessible, culturally sensitive care practices in the clinical space by hearing directly from the impacted community members through their qualitative responses.

**Madeline Wessels**

**Graduate Program:** English

**Advisor:** Agnes Bolonyai

**Poster Number:** 178

**“Is There Hope?”: A Discourse Analysis of Lebanese Post-Revolution Mobility Narratives and Language Ideologies**

In 2019, protests broke out in Lebanon, expanding into a revolutionary movement often discussed as a period of unprecedented mobilization of the Lebanese diaspora and transnational community. Exploring this moment of Lebanese unification across borders demonstrates shifting constructions of global communities and identities via new forms of engagement with digital platforms and communication. My research project explores post-revolution representations of Lebanese identity, addressing the following questions: (1) How do members of the Lebanese diaspora and transnational community use mobility narratives to spatially and temporally situate their identities and connections to homeland? and (2) How are these articulations of identity connected to linguistic code choices and broader Lebanese language ideologies? I analyze episodes from the Lebanese podcast *Sarde After Dinner* and oral histories provided by the Khayrallah Center, looking at narrations of movement to and from Lebanon and code-switching between English, French, and Arabic. I use discursive analytical frameworks surrounding identity construction (Bamberg et al., 2011), membership categorization analysis, and chronotope (Bakhtin, 1981), as well as the Rational Choice model (Myers-Scotton and Bolonyai, 2011) and language ideologies (Irvine and Gal, 2000) to explore code-switching patterns. Preliminary conclusions demonstrate identity categories associated with staying, leaving, or returning to Lebanon connected to a ‘revolution’ chronotope, as speakers invoke the revolution to position themselves in relation to Lebanon’s political trajectory. This works toward ideological ‘de-diasporisation,’ as speakers balance mobility outside Lebanon with a political responsibility to remain. This political alignment is mirrored in code-switching patterns, as socially marked code-switches reflect revolutionary language ideologies emphasizing Arabic usage, demonstrating a shift and re-negotiation of Lebanese multilingualism and language attitudes. This research has implications for understanding how transnational communities can utilize digital platforms and storytelling mediums to not only establish individual political identity but also narrate a revolutionary historical moment to encourage sustained collective political involvement.

**Cullen Wiggins**

**Graduate Program:** History

**Advisor:** Matthew Booker

**Poster Number:** 180

### **Eastern Conventions: How One Convention in 1911 Made a Lasting Impact on North Carolina's Fisheries**

At the turn of the twentieth century (1890-1910), heavy fish market demands with poor localized fisheries management jeopardized many of North Carolina's most profitable commercial species like shad and oysters. State fishing industry leaders led a campaign to draft legislation urging the NC General Assembly to establish a Fisheries Commission with coastwide jurisdiction over all species, but they rejected it in January 1911. After this legislative shortcoming, fishing industry leader Joseph Hyde Pratt called for a convention to meet at New Bern in December which ended up marking the turning point of the campaign. I fuse minutes from the December Convention with legal records, fisheries data, letter correspondence, and state newspapers to show first, that the event garnered an unprecedented base of support from across the state and beyond compared to any other part of this campaign; and second, that this support altered the way North Carolinians began to think about fisheries management. The Convention encouraged North Carolinians to understand these resources as a broader state asset and even embrace fisheries policy recommendations from other states. This ultimately galvanized the attendees to take more organized, collaborative steps to lobby for change. In 1915 the General Assembly did establish a Fisheries Commission, and fisheries data in conjunction with the Commission's 1924 progress report suggests this convention was successful.

In the face of contemporary debates surrounding fisheries production and management and broader phenomena like climate change which face the NC coast today, this research illuminates ways in which North Carolinians have addressed environmental vulnerability in the past. This research also encourages us to understand waterways as a rich archive for the state's cultural, political, and legal history.

**Ann Sloan Wilson**

**Graduate Program:** Sociology

**Advisor:** Andrea Leverentz

**Poster Number:** 183

### **Hearing Things: A Qualitative Interview Study of True Crime Podcast Listeners**

Public perceptions of crime are influenced by the frequency of media coverage and how these institutions portray violent victimization. The more crime-related content a person consumes, the more likely they are to believe that crime is on the rise—even if it is not. Additionally, television coverage of crime often frames violence perpetrated by strangers as a common occurrence. As a consequence, consumers of crime content are more fearful of crime and believe violence is more likely to occur at random. Existing research on this topic has focused on television news coverage; however, public consumption of crime content today extends far beyond television screens. One of the most popular types of media for this content are podcasts, which are unique in their accessibility, portability, and interactivity between hosts and fans. The current project explores how true crime podcast fans consume this content and how their perceptions of crime, victimization, and safety are informed through their consumption. Using five popular true crime podcast subreddit forums as recruitment sites, I plan to conduct 10-15 virtual interviews with true crime podcast listeners about their preferences, habits, and perceptions of crime. Based on previous research on the demographics of true crime podcast listeners, I expect that my interviews will be with female true crime podcast listeners. I expect that women, being more likely than men to fear violent victimization, consume this content to learn strategies for avoiding victimization. Female consumers may find community in true crime fandoms, and they may consider consumption as a form of activism against the pervasiveness of gender-based violence. Preliminary results suggest that female consumers are fearful of violent victimization at the hands of strangers, they believe this type of violence is likely to happen, and they learn strategies to mitigate their risk of violence from the hosts and stories in true crime podcasts.

# College of Natural Resources

**Phoebe Anderson**

**Graduate Program:** Natural Resources

**Advisor:** Ritwick Ghosh

**Poster Number:** 8

## **Biodiversity Offsets: Perspectives of Buyers in the United States' Conservation Credit Market**

With a rapidly industrialising world and its direct and indirect impacts on biodiversity, conservation is increasingly governed by market-oriented approaches that integrate environmental protection into capitalist economic systems (McAfee, 2012). This shift is reflected in the evolution of conservation policy in the United States, which has moved from predominantly command-and-control regulation toward market-based, incentive-driven mechanisms. One such instrument is conservation banking, whereby developers impacting endangered species engage in compensatory mitigation, including the purchase of conservation credits, to meet Clean Water Act and Endangered Species Act permitting requirements.

This paper examines how different categories of buyers, defined by project purpose, influence the choice of mitigation mechanism, including in-lieu fee payments, permittee-responsible mitigation, and the purchase of conservation credits, and whether buyers' broader environmental impacts should be considered when determining mitigation requirements.

The analysis draws on data extracted from the U.S. Army Corps of Engineers' Regulatory In-Lieu Fee and Bank Information Tracking System (RIBITS), including information on conservation credits, species impacted, and buyer characteristics. Buyers were categorized by sector and location to assess patterns in mitigation choice and proximity between buyers and conservation banks. California was selected as a particular focus due to its well-established conservation banking market, which contains 126 of the 194 conservation banks nationwide. The results indicate that the majority of credit purchases in California are made by property developers and energy companies, raising the question of whether credit valuation should consider the wider environmental externalities associated with these sectors. This sectoral analysis aims to inform stronger offset policies that improve implementation, monitoring, and enforcement of ecological outcomes in the United States' conservation credit market.

**Sweta Dixit<sup>1</sup>**, Lincoln Larson<sup>1</sup>, Nils Peterson<sup>2</sup>, and Leslie Burger<sup>3</sup>

**Graduate Programs and Institutions:** Parks, Recreation, and Tourism Management<sup>1</sup>; Fisheries, Wildlife, and Conservation Biology<sup>2</sup>; Wildlife Biology and Conservation Education, Mississippi State University<sup>3</sup>

**Advisor:** Lincoln Larson

**Poster Number:** 45

### **Public Tolerance of Endangered Carnivore Species: Red Wolves and Florida Panthers**

Red wolves (*Canis rufus*) and Florida panthers (*Puma concolor coryi*) represent two of the most critically endangered apex predators in the US. Historically native to the Southeastern US, they face strong opposition due to concerns over livestock depredation, perceived competition with hunters, fear of the species, and distrust in governmental agencies managing wildlife. To ensure long-term recovery success of these predators, it is crucial to identify the factors that drive or impede public tolerance across geographic scales. Therefore, this study employed a comparative approach to evaluate public tolerance toward both species. Using statewide web surveys conducted across urban-to-rural gradients in North Carolina (N=1602) and Florida (N=1600), we assessed key components of tolerance, such as knowledge, attitudes, norms, and behavioral intentions. Identical survey instruments were used in both states to allow for a direct comparison of socio-psychological drivers across regional contexts and predator species. Our findings revealed a significant “knowledge paradox” where self-rated knowledge was not correlated with factual knowledge in both states. While people’s mean attitude towards Florida panthers was generally positive (M=0.65) and higher than red wolves (M=0.49), there was a ‘not in my backyard’ effect for both species, as the public showed significantly lower support for coexistence in their own county as compared with a different county. Behavioral intentions varied by region: respondents were less likely to act in support of wolves in NC (M=0.16) compared to FL, where respondents were more likely to support panthers (M=0.66). However, the likelihood of people opposing wolves in NC was lower (M=-0.72) than the likelihood of people opposing panthers in FL (M=0.16). In both states, higher formal education was a strong predictor of tolerance. By identifying and responding to regional nuances, wildlife management agencies and organizations can more effectively tailor communication strategies to mitigate conflict and enhance long-term public tolerance of controversial carnivore species.

**Maria Gonzalez**

**Graduate Program:** Forest Biomaterials

**Advisor:** Lokendra Pal

**Poster Number:** 64

### **Bridging Cellulose–Water Interactions to Energy and Carbon Performance for Sustainable Manufacturing of Packaging and Hygiene Products**

The pulp and paper industry (P&PI), one of the largest producers of cellulose-based materials, plays a central role in the transition toward sustainable manufacturing. However, the inherent cell-wall structure of cellulose and its hydrogen-bonded fiber network make water removal a dominant contributor to energy consumption and greenhouse gas emissions during production. Consequently, improving cellulose dewatering efficiency represents a critical lever for reducing thermal energy demand and carbon intensity across bio-based manufacturing systems.

This research integrates techno-economic analysis (TEA) and life-cycle assessment (LCA) with spectroscopic characterization to quantify the energy and carbon impacts of enhanced press-section dewatering strategies. Process modeling is used to evaluate how incremental increases in press-section solids influence steam demand, total energy use, and carbon emissions across different mill configurations. To elucidate the physical limits of water removal, confocal Raman spectroscopy is employed to probe water structure and hydrogen-bonding environments within cellulose networks under varying dewatering conditions and in situ perturbations.

The findings revealed dependency on system configuration, with modest increases in press-section solids yielding up to 60% reductions in steam demand and ~40% reductions in carbon emissions. Additional benefits are realized when dewatering improvements are coupled with complementary strategies, including fuel switching and biopower self-sufficiency. Spectroscopic analysis further reveals mechanistic constraints on water removal at different dewatering stages, linking molecular-scale cellulose–water interactions to macroscale process performance. Overall, this work connects fundamental dewatering physics with quantitative energy and carbon accounting, providing a science-based framework for identifying cost-effective and scalable pathways to reduce emissions and energy intensity in the pulp and paper industry.

**Ann Morgan Hawthorne** and Carla Barbieri  
**Graduate Program:** Parks, Recreation and Tourism Management  
**Advisor:** Carla Barbieri  
**Poster Number:** 74

### **The Creative Agritourism Rubric: Research into Extension**

Creativity has historically been vital to agriculture, helping producers navigate production and consumer needs. Its importance has grown as producers diversify through agritourism (i.e., offering education and recreation to visitors) to distinguish their farms and attract visitors. While frameworks like Creative Placemaking and Creative Tourism emphasize that creativity should reflect authenticity, local environment, and co-creation, knowledge remains limited on what constitutes creativity in agritourism and how to leverage it to increase farm distinctiveness. In 2025 we conducted ‘walking interviews’ with eight agritourism providers across North Carolina to learn how they are incorporating creative elements into their agritourism components. Data garnered were analyzed using inductive and deductive coding. Participants are infusing creativity across all agritourism components (offerings, provider-visitor interactions, setting, repurposing), beyond the conventional meanings of authenticity, local embeddedness, and co-creation. Authenticity surpassed infrastructure and offerings to integrate the providers roles as farmers and family. Local embeddedness expanded beyond local tangible and intangible offerings to encompass community. Co-creation evolved from the provider-visitor relationship to include immersive connections with the community and farm animals. We translated study findings into the Creative Agritourism Rubric (CAR), a resource for agritourism providers and extension agents to enhance agritourism creativity. CAR consists of four components –Offerings, Meaningful Interactions, Setting, Repurposing and Multi-use– across 17 subcomponents. Each sub-component is assessed whether it reflects providers’ agricultural and personal experience (authenticity), uses (in)tangible displays of their self-defined community (community embeddedness), and facilitates the interaction between providers, visitors, and other farm and community actors (co-creation). Providers can utilize a three-tier scale (essential, promising development, opportunity for growth) to guide further creative development. By synthesizing the literature and providers’ experiences, CAR offers a practical framework for enhancing creativity in agritourism. Its implementation can increase farm distinctiveness, ultimately driving visitor satisfaction and supporting rural revitalization.

**Jing Hu**  
**Graduate Program:** Geospatial Analytics  
**Advisor:** Josh Gray  
**Poster Number:** 77

### **Seeing Through Clouds: Spatiotemporal SAR–Optical Neural Network for Cloud Removal**

High spatiotemporal satellite NDVI time series are indispensable for monitoring vegetation dynamics in heterogeneous landscapes, but persistent cloud cover creates large gaps in space and time that limit data quality and coverage. These gaps are not merely sporadic; they can span long periods and broad areas, leaving too little spatiotemporal structure for traditional interpolation methods to work reliably. Therefore, complementary cloud-penetrating sensors like SAR are considered to provide alternative all-weather information that helps reconstruct reliable, fine-resolution NDVI when optical observations are unavailable.

We present a spatiotemporal SAR–optical fusion network that learns a dynamic mapping from SAR backscatter sequences to cloud-free NDVI, without requiring contemporaneous optical observations or relying on static, potentially outdated auxiliary data. The model extends a U-Net with explicit temporal modeling over multi-date SAR inputs and inject embeddings from the AlphaEarth Foundations model at the bottleneck as a globally consistent and compact context prior. We train and validate on SEN12MS-CR-TS, a benchmark covering 53 regions across the globe, each providing 30 co-registered Sentinel-1/2 time-paired observations with cloud masks and cloud conditions from clear sky to full coverage. Our approach captures dynamic SAR–NDVI relationships and generalizes across biomes and seasons to produce spatially detailed, temporally consistent, gap-free NDVI suitable for large-scale ecosystem and carbon–water applications.

**Molly Irvin**<sup>1</sup>, Kimberly McKeever<sup>1</sup>, Ralph Dean<sup>2</sup>, Peter Balint-Kurti<sup>3</sup>, Amanda Hulse-Kemp<sup>3</sup>, and Fikret Isik<sup>4</sup>

**Graduate Programs and Institutions:** Forestry and Environmental Resources/Genetics and Genomics<sup>1</sup>; Entomology and Plant Pathology<sup>2</sup>; USDA-AR<sup>3</sup>; Forestry and Environmental Resources<sup>4</sup>

**Advisors:** Fikret Isik and Amanda Hulse-Kemp

**Poster Number:** 78

### **Virulence Variation in Fusiform Rust Fungus and Interactions with Loblolly Pine Resistance QTL**

Fusiform rust disease, caused by the fungus *Cronartium quercuum* f. sp. *fusiforme* (Cqf), is the most significant threat to pine plantations in the southern U.S. Our group previously discovered evidence for race-non-specific resistance in a mapping population of loblolly pine. The goals of this research are to characterize virulence variation in single-spore isolates of the pathogen and understand how they interact with two known host QTL. A population of 6,000 half-sib seedlings was developed from a maternal parent heterozygous at both QTL. The population was inoculated with a mixed basidiospore inoculum (112,333 spores/mL) of the pathogen. Seedlings with galls were kept and the rest were discarded. One year after inoculation, seedlings were subjected to cold treatment to induce pycniospore production. More than 5,000 pycnial droplets were collected from 336 seedlings and genotyped using the Pita50K SNP array to determine host resistance haplotypes. Single pycnial droplets were screened using SSR markers to classify fungal diversity within and among galls and identify distinct fungal strains. Illumina sequencing of ~400 unique strains will be used to identify SNPs in the fungal genome and to identify genomic regions exhibiting signatures of selection (selective sweeps) for virulence. Genes within these regions will be examined to determine whether recognition of fungal effectors is responsible for the broad-spectrum resistance conferred by host resistance alleles. Long-read PacBio sequences will be generated from three fungal isolates capable of overcoming each host resistance haplotype. Finally, we will integrate Illumina short-read and PacBio long-read data to generate a pangenome for Cqf and evaluate potential structural variants.

**Courtney L. Johnson**<sup>1</sup>, Abby R. Ratcliff<sup>1</sup>, Jean Turgeon<sup>2</sup>, Bill Panagakos<sup>3</sup>, and Kelly L.F. Oten<sup>1</sup>

**Graduate Programs and Institutions:** Forestry and Environmental Resources<sup>1</sup>; Great Lakes Forestry Centre, Canadian Forest Service<sup>2</sup>; Forest Pest Methods Lab, USDA-APHIS<sup>3</sup>

**Advisor:** Kelly L.F. Oten

**Poster Number:** 82

### **Pencils down! Asian longhorned beetle adult and body sizes vary by location.**

The Asian longhorned beetle (ALB), *Anoplophora glabripennis*, is a highly destructive and invasive wood-boring beetle which attacks and kills hardwood trees. While it can feed on about 23 genera, it has a strong preference for maple (*Acer* spp.). As the pest feeds and grows beneath the bark of its hosts, it bores beyond the cambial layer and into the wood, sometimes reaching the heartwood. Trees suffer structural weakness from this feeding and often die from breakage following high wind, threatening people and property near the urban trees ALB often infests. Within North America, ALB populations have occurred in Ontario, Canada as well as several northeastern states and South Carolina. Eradication of the pest has been achieved in Canada and some northeastern states, largely through host removal. However, outreach is a critical component of ALB eradication as it raises awareness about the pest. Over 2/3 of ALB infestations were first detected by a member of the general public. Typically, outreach messaging states that the perfectly round exit hole ALB produces within its hosts is about the size of a standard number two pencil eraser. Still, anecdotal evidence has suggested that beetles and their exit holes may be larger in the newest and most southern infestation within South Carolina. To inform outreach messaging and our understanding of ALB's invasion biology, we measured 349 beetles and 1838 exit holes from infestations in Ontario, New York, Ohio, and South Carolina. Results suggest that not only are both adult beetles and their exit holes significantly larger in SC, but almost all exit holes from any infestation are larger than a standard number two pencil, necessitating an updated outreach message. As larger adult females are more fecund, this finding may also suggest that beetles in SC are able to reproduce at a higher rate.

**Taylor Kanipe<sup>1</sup>, Luz Meza<sup>1</sup>, Dr. Sunkyu Park<sup>1</sup>, Dr. Hou-Min Chang<sup>1</sup>, Dr. Matthew Farrell<sup>2</sup>, and Dr. Richard Venditti<sup>1</sup>**  
**Graduate Program and Institutions:** Forest Biomaterials<sup>1</sup>; Cotton Incorporated, Cary, NC<sup>2</sup>  
**Advisors:** Richard Venditti and Sunkyu Park  
**Poster Number:** 85

### **Formaldehyde-free Cotton Finishing: Utilizing Epoxidized Cottonseed Oil as a Sustainable Alternative**

The textile industry is moving away from formaldehyde-based durable press finishes due to regulatory and environmental concerns, creating a need for sustainable alternatives. Cotton fabric, widely used in apparel and home textiles, benefits from treatments that enhance durability, wrinkle resistance, and hydrophobicity. However, conventional finishing agents often rely on synthetic chemicals, which pose potential health and environmental risks. This study explores the use of epoxidized cottonseed oil (ECSO) as a bio-based alternative for modifying cotton fabric and cellulose-based materials. Cotton fabric and filter paper were grafted with ECSO using a solvent-based system, varying catalyst concentrations, reaction times, and ECSO loadings. ATR-FTIR analysis confirmed successful modification through the presence of carbonyl peaks (1740 cm<sup>-1</sup>), while water contact angle (WCA) measurements increased from 0° to 125°, demonstrating significant hydrophobicity enhancement. Additionally, stable ECSO oil-in-water emulsions were developed using green emulsifiers and applied to cotton fabric via a pad-dry-cure process to assess their performance as fabric softeners and wrinkle-resistant finishes. These results highlight the potential of ECSO as a sustainable textile treatment, offering improved fabric performance without the use of formaldehyde-based chemistry. Continued refinement of curing conditions, including time, temperature, and catalyst loading, seeks to improve treatment effectiveness. Future research will assess additional performance factors, such as tear strength, smoothness, wrinkle resistance, and durability, to validate the feasibility of ECSO-based finishes for industrial use.

**Lokesh Kumar<sup>1</sup> and Lokendra Pal<sup>1,2,3</sup>**

**Graduate Programs and Institutions:** Forest Biomaterials<sup>1</sup>; Mechanical and Aerospace Engineering<sup>2</sup>; Global One Health Academy<sup>3</sup>  
**Advisor:** Lokendra Pal  
**Poster Number:** 93

### **Exploring Multifunctional Bio-Based Edible Coatings for Sustainable Food Preservation**

This research explores new pathways for extending the shelf life of fresh produce by developing edible composite coatings utilizing chitosan (CH) and microfibrillated cellulose (MFC) with enhanced functional properties. Edible films were prepared by dissolving CH in acetic acid and incorporating glycerol as a plasticizer to improve flexibility. MFC, derived from bleached hardwood kraft pulp, was added at varying concentrations to reinforce the composite films.

The incorporation of MFC improved the films' thermal stability, crystallinity, mechanical strength, and water and oxygen barrier properties, while reducing solids content, pH, and contact angle. Films containing an optimized amount of MFC exhibited significant reductions in water vapor permeability and oxygen transmission rate, along with enhanced tensile strength, compared to control films. Colloidal stability analysis revealed that the dispersion and suspension behavior of MFC particles was influenced by surface charge. FTIR and XPS analyses confirmed enhanced hydrogen bonding between CH and MFC, contributing to improved film stability. SEM and EDX analyses confirmed uniform coating coverage over the strawberry's surface.

The optimized coating was highly effective in preserving the quality of strawberries during storage, significantly reducing weight loss and maintaining firmness relative to uncoated control fruits. Overall, this study demonstrates the potential of CH–MFC composite coatings to extend the shelf life of fresh produce by preserving key quality attributes.

**Sierra McMurry<sup>1</sup>, Dr. Roland Kays<sup>1</sup>, and Dr. Jim Clark<sup>2</sup>**

**Graduate Programs and Institutions:** Forestry and Environmental Resources<sup>2</sup>; Forestry, Duke University<sup>2</sup>

**Advisor:** Roland Kays

**Poster Number:** 112

### **Not All Mast is Equal: Regional Decoupling and Carryover Effects in Mast–Black Bear Relationships**

Seed mast is a foundational resource for many forest mammals, yet mast–consumer relationships often vary across space and time, suggesting that food availability alone may not fully explain wildlife responses. Using over 18,000 camera trap records spanning forests in the eastern and western United States, this study examined when, where, and why mast–bear relationships strengthen or break down for American black bears (*Ursus americanus*). We evaluated bear detections in relation to mast availability, food composition, habitat context, and temporal carryover effects. Bear responses to mast differed markedly by region: mast availability was positively associated with detections in the Northeast and West, but weak or negative in the Southeast, indicating regional decoupling. Models incorporating mast composition, particularly high-value mast such as oaks, hickories, and high-energy conifers outperformed those using total mast alone, revealing that food quality and type are critical drivers of bear responses. Habitat context further modified these relationships, with forest cover strengthening mast effects and urbanization weakening them. To assess temporal dynamics, we distinguished mast failure, normal, and bumper years at the regional scale. Including previous-year mast category improved model performance beyond current mast alone, demonstrating threshold-based carryover effects consistent with delayed behavioral or demographic responses. Visualization of oak mast dynamics showed that failure and bumper events are often synchronous across oak groups, supporting the ecological relevance of composition-based failure definitions. Together, these results show that mast–bear relationships are shaped by food composition, regional context, and temporal thresholds, highlighting the importance of moving beyond total mast production to understand consumer responses in heterogeneous landscapes.

**Pratikshya Regmi<sup>1</sup>, Corey T White<sup>1</sup>, and Helena Mitsova<sup>1,2</sup>**

**Graduate Programs:** Center for Geospatial Analytics<sup>1</sup>; Marine, Earth, and Atmospheric Sciences<sup>2</sup>

**Advisor:** Helena Mitsova

**Poster Number:** 140

### **Geomorphic Impacts of Hurricane Helene: A Multi-Sensor Geospatial Analysis in Western North Carolina**

Catastrophic storms can rapidly reorganize mountain landscapes through extreme rainfall, flooding, landslides, and debris transport, producing spatially complex elevation changes that are difficult to quantify under the forest canopy. This study evaluates storm-driven geomorphic change after Hurricane Helene in western North Carolina using multi-temporal elevation and optical datasets, including pre-event lidar (2017, 2020), immediate post-event Structure-from-Motion (SfM) products derived from Civil Air Patrol imagery, and post-storm lidar (2024), complemented by multi-source optical imagery (NAIP, PlanetScope, and Sentinel-based products). We use NDVI differencing to delineate disturbance patterns and guide the selection of a landslide-prone watershed for detailed analysis. Topographic change is quantified using the DEM of Difference (DoD) after DEM co-registration. We compare lidar–lidar and lidar–SfM differencing to evaluate the reliability of rapid post-event SfM surfaces for geomorphic assessment, and we assess drainage-path modification in the watershed using process-based overland-flow simulation and flow accumulation. In a downstream Lake Lure reach, where debris and shoreline impacts were pronounced, and a 2020 lidar baseline was unavailable, we compute DoD relative to 2017 lidar and summarize erosion and deposition on land surfaces. Together, these analyses demonstrate how dataset timing, sensor characteristics, and uncertainty control govern the detectability and interpretation of storm-driven terrain change in steep, forested mountain settings.

**Mariangeles Salas<sup>1</sup>, Raman Rao<sup>1</sup>, Simran Singh<sup>1,3</sup>, Aditya Sarker<sup>1</sup>, Rakshit Kumar<sup>1</sup>, Anand Singh<sup>2,4</sup>, Ashutosh Mittal<sup>5</sup>, John Yarbrough<sup>5</sup>, and Lokendra Pal<sup>1,3</sup>**

**Graduate Programs and Institutions:** Forest Biomaterials<sup>1</sup>; Electrical and Computer Engineering<sup>2</sup>; Mechanical and Aerospace Engineering<sup>3</sup>; IBM<sup>4</sup>; National Laboratory of The Rockies<sup>5</sup>

**Advisor:** Lokendra Pal

**Poster Number:** 145

### **Integrating Hyperspectral Imaging and Computer Vision for Chemically Informed Material Recovery Systems**

In material recovery and recycling systems, conventional computer vision datasets and RGB-based approaches often fail to capture chemical heterogeneity and surface contamination that directly affect downstream process performance. This work presents an integrated framework that combines computer vision with hyperspectral imaging (HSI) to enable non-destructive, real-time characterization of complex material streams. Hyperspectral data provide chemically relevant spectral signatures linked to material composition, coatings, and contamination, complementing spatial features extracted from RGB imagery. In parallel, a domain-specific dataset was developed to reflect realistic operational conditions, including mixed materials, variable degradation states, and conveyor-based environments.

Models trained on this dataset were systematically evaluated against commonly used benchmark datasets, demonstrating that chemically informed sensing and dataset design significantly improve classification robustness and process-relevant decision accuracy. By explicitly linking spectral chemistry, data quality, and engineering performance, this work highlights how advanced imaging and dataset-centered design can reduce misclassification-driven waste, improve material circularity, and support scalable green chemistry-enabled infrastructure.

**John H. Sanders, Phoenix Tiller, Richard Venditti, and Sunkyu Park**

**Graduate Program:** Forest Biomaterials

**Advisors:** Sunkyu Park and Richard Venditti

**Poster Number:** 147

### **Pressurized Deep Eutectic Solvent Pulping of Aspen Wood Chips and Totally-Chlorine-Free Bleaching Toward Synthesis of Sustainable Cellulose Acetate**

Deep eutectic solvents (DESs) present an eco-friendly method to pulp woody biomass to separate cellulose from hemicellulose and lignin. DES pulping has been shown to perform well with wood powder feedstocks, however the potential upgrading of DES pulps to value-added biomaterials has not been explored. In this work, aspen wood chips are upgraded to cellulose acetate (CA), a functionalized cellulose derivative that requires high cellulosic purity. Novel high-pressure DES pulping paired with totally-chlorine-free (TCF) bleaching was utilized to prepare a high-purity feedstock (>90% mass cellulose) for CA production. Pressurized DES pulping significantly reduced lignin and hemicellulose content of the wood chips with minimal undercooked wood chip content. TCF bleaching resulted in a pulp with 94.6% cellulose content, which was similar to that of the commercial hardwood dissolving pulp control (95.2% cellulose). The upgraded pulp was then acetylated to a degree of substitution (DS) of 2.7, confirmed by FTIR measurements to be in the range of high-quality cellulose triacetate. Insoluble gel particle (IGP) content, a measure of CA processability, was determined to be 5.9% by mass. The results show the potential of a DES-based biorefinery, as dissolving grade pulp was successfully produced and further valorized to cellulose acetate.

**Titilayo Tajudeen<sup>1</sup>**, Marcelo Ardon<sup>1,2</sup>, Mirela Tulbure<sup>1,2</sup>, Jeff Doser<sup>2</sup>, and Katie Martin<sup>1,2</sup>

**Graduate Programs:** Center for Geospatial Analytics<sup>1</sup>; Forestry and Environmental Resources<sup>2</sup>

**Poster Number:** 161

### **Accessing Coastal Forest Retreat Rate Under Current and Projected Sea Level Rise and Climate Change**

Coastal forests are increasingly threatened by saturated soil and elevated salinity levels caused by sea level rise, saltwater intrusion, and storm surges. In response to rising salinization and flooding, healthy coastal forests that depend on freshwater are transforming into landscapes dominated by dead or dying trees, surrounded by salt-tolerant shrubs and grasses, eventually converting into marshes or open water. Quantifying the rate and pathway of these landscape changes is crucial for understanding how coastal ecosystems degrade and for predicting future transformations. The speed and direction of forested wetland shifts will depend on the rate of saltwater intrusion, sea level rise, and factors such as soil type, geomorphology, and hydrologic connectivity. Although studies have shown the conversion of these areas, limited research has examined the lateral and vertical retreat rates of forests, and our knowledge about the future progression of forest-marsh loss remains limited. To improve our understanding of these impacts, this research aims to analyze long-term trends from remote sensing datasets to determine how quickly the ecosystem is shifting both inland and vertically, thereby helping us better comprehend these processes. Climate drivers, including temperature, precipitation, water levels, salinity, and groundwater levels, as well as the relative sea level rise rate (RSLRR), will be incorporated into the analysis. A statistical model that considers both temporal and spatial dependencies of forest loss will be developed to predict and forecast future changes, guiding decisions on which areas to prioritize for conservation. Additionally, we will also explore how resilient these coastal ecosystems are to these drivers by comparing a managed forest vs a natural, mature forested wetland.

**Aakash Upadhyay<sup>1</sup>**, Lucian Lucia<sup>1,2</sup>, Lokendra Pal<sup>1,3,4</sup>

**Graduate Program:** Forest Biomaterials<sup>1</sup>; Chemistry<sup>2</sup>; Mechanical and Aerospace Engineering<sup>3</sup>; Global One Health Academy<sup>4</sup>

**Advisor:** Lokendra Pal

**Poster Number:** 166

### **Biobased Functional Coatings for High-Barrier and Safe End-of-Life Food Packaging**

Global food packaging systems rely heavily on single-use plastics and fluorochemical-based barrier coatings, raising persistent environmental and human health concerns. Sustainable alternatives must deliver high barrier performance while remaining recyclable and environmentally benign. Fiber-based materials, particularly microfibrillated cellulose (MFC), offer strong gas and oil barrier properties but are limited by moisture resistance due to their intrinsic hydrophilicity. To address this limitation, this work develops a novel bilayer composite coating (BCC) for PFAS-free, high-performance food packaging. The engineered structure consists of an MFC interlayer that provides gas and oil < grease barrier functionality while also preserving recyclability, combined with a hydrophobic top layer composed of styrene-butadiene copolymer and nanoclay. The top layer system enhances moisture resistance by increasing surface hydrophobicity and diffusion tortuosity. BCC achieved a 56% reduction in water vapor transmission rate, a ~630-fold decrease in air permeability, kit rating 12 oil resistance, and < weight gain under hot oil exposure. SEM confirmed interfacial stability, while XPS and ToF-SIMS revealed minimal interlayer mixing, supporting improved repulpability. Accelerated UV photo-oxidative aging further demonstrated controlled early-stage degradation, validating environmental compatibility. Overall, this research integrates barrier enhancement, recyclability, and end-of-life validation to advance circular, PFAS-free cellulose-based packaging systems.

**Emma M. Wilson**<sup>1</sup>, Nathan J. Hostetter<sup>2</sup>, Donald J. Brown<sup>3</sup>, and Ivana Mali<sup>1</sup>

**Graduate Programs and Institutions:** Fisheries, Wildlife and Conservation Biology<sup>1</sup>; U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology<sup>2</sup>; United States Department of Agriculture Forest Service, Pacific Northwest Research Station<sup>3</sup>

**Advisor:** Ivana Mali

**Poster Number:** 182

### **Fine-Scale Shifts in Occupancy of an At-Risk Turtle in Response to a Potential Competitor**

The maintenance of community assemblages reflects a combination of landscape and local processes. Interspecific competition may be especially influential in urban environments, where system degradation can increase species interactions, shift the strength of competition, and result in species displacement. In this study, we implemented a multi-species occupancy modeling approach to assess whether the presence of painted turtles (*Chrysemys picta*) influences occupancy of spotted turtles (*Clemmys gutatta*), a species of greatest conservation need. We evaluated three hypotheses: (1) occupancy is independent between species; (2) painted turtle occupancy has a constant effect on spotted turtle occupancy; and (3) the effect of painted turtle presence on spotted turtle occupancy is mediated by environmental and landscape covariates. In 2024 and 2025, we surveyed freshwater turtles across 34 wetlands in Wake County, North Carolina, one of the fastest-growing regions in the United States, using baited hoop-net traps. Treating each trap as a survey site ( $n = 741$ ), we detected spotted turtles and painted turtles at 43 and 45 sites, respectively. Based on the penalized likelihood estimation with k-fold cross-validation, the top model corresponded to our third hypothesis. Specifically, spotted turtle occupancy declined in the presence of painted turtles across all wetland types, but this effect was the greatest in vernal pools, where occupancy probability decreased from 0.26 [85% CI: 0.20–0.33] when painted turtles were absent to 0.16 [85% CI: 0.12–0.21] when present. This decline in occupancy provides evidence that painted turtles may represent a native competitor through the compression of the spotted turtle spatial niche in a resource-limited landscape. Our results emphasize the importance of biotic interactions when assessing habitat suitability, while future work exploring conditional spotted turtle occupancy across regions and landscape gradients can improve our understanding of the precise mechanisms underlying competitive dynamics and species coexistence.

## College of Sciences

**Md Arifuzzaman**, Mansoor A Haider, and Mette S. Olufsen

**Graduate Program:** Mathematics

**Advisors:** Mansoor A Haider and Mette S. Olufsen

**Poster Number:** 9

### **Effects of Pressure Loss Coefficients on Arterial Pressure and Flow Wave Dynamics in 1-D Aortic Hemodynamics**

Assessment of blood pressure drop due to stenosis resulting from an aortic coarctation (CoA) is important for determining disease severity and evaluation of treatment efficacy. Magnetic resonance images (MRI) can provide insight into changes in flow, but provide limited insight into how vessel geometry, tapering, and flow redistribution contribute to pressure gradients. In this study, we develop a one-dimensional (1D) hemodynamic model calibrated to experimental porcine data to quantify pressure loss, flow distribution, and parameter sensitivities in CoA. The model incorporates anatomically informed vessel geometry extracted from MRI images from a sham and CoA swine. Using our model calibrated to the data, we study the influence of geometric characteristics, including stenosis shape, length, and percent lumen area reduction, on pressure loss. Sensitivity analyses quantify the relative contributions of geometry, arterial stiffness, and loss coefficients, reducing a set of 27 model parameters to a smaller subset governing pressure gradients and flow distribution. Our results show that the CoA swine has stiffer arteries and elevated pressure losses, with factors, especially viscous and turbulent loss parameters, playing a dominant role in shaping pressure gradients. This framework provides mechanistic insight into the hemodynamic consequences of CoA and demonstrates the utility of reduced-order modeling for interpreting experimental data.

**Azka Arshad**<sup>1</sup>, Richard B. Canty<sup>2</sup>, Evgeny O. Danilov<sup>1</sup>, Jonathan P. Wheeler<sup>1</sup>, Kritika Sharma<sup>1</sup>, Tehshik P. Yoon<sup>3</sup>, Milad Abolhasani<sup>2</sup>, and Felix N. Castellano<sup>1</sup>

**Graduate Programs and Institutions:** Chemistry<sup>1</sup>; Chemical and Biomedical Engineering<sup>2</sup>; Department of Chemistry, University of Wisconsin-Madison<sup>3</sup>

**Poster Number:** 11

### **Roblonski: A Material-Efficient Robo-Fluidic Toolbox for Rapid Photochemical Characterization**

Reliable photochemical and photophysical characterization is essential for understanding and optimizing photocatalytic processes; however, traditional, manual spectroscopic methods for determining bimolecular photoreaction quenching constants, molar extinction coefficients, and photoluminescence quantum yields (PLQYs) are time-, cost-, material-, and labor-intensive and generate considerable chemical waste. Herein, we report Roblonski, a compact, material-efficient microfluidic robotic platform that automates these three foundational photochemical assays with high precision, reproducibility, and accuracy. Using Ru(bpy)<sub>3</sub>(PF<sub>6</sub>)<sub>2</sub> as a model photosensitizer and photocatalyst, we performed Stern–Volmer analyses with eleven excited state electron and triplet energy transfer quenchers, Beer–Lambert studies of five compounds spanning three orders of magnitude in their molar extinction coefficients across multiple solvents, and relative PLQY determinations for fluorophores/luminophores with PLQYs ranging over three orders of magnitude in efficiency. The machine-generated results matched manual experimental measurements and literature benchmarks across diverse spectral features, solvent environments, and signal intensity regimes. Roblonski reduces sample consumption (20-fold by solution volume, 1000-fold by reagent moles) and accelerates data collection (4-fold) compared to traditional, manual approaches. By integrating these photochemically relevant assays into a single, compact automated platform, Roblonski has the potential to lower experimental barriers, enable data-rich evaluation of photocatalysts and substrates, and augment autonomous photochemical discovery and characterization.

**Mehdi Ashrafjanjoe**<sup>1</sup>, Kelvin Dsouza<sup>2</sup>, Prithu Bhatnagar<sup>2</sup>, Khalid Hossain<sup>3</sup>, Mangal Dhoubhadel<sup>3</sup>, Preston Webster<sup>4</sup>, Simone Assali<sup>5</sup>, Patrick Daoust<sup>5</sup>, Oussama Moutanabbir<sup>5</sup>, Daryoosh Vashae<sup>2</sup>, and Demitry Farfurnik<sup>1,2</sup>

**Graduate Program and Institutions:** Physics and Astronomy<sup>1</sup>; Electrical and Computer Engineering<sup>2</sup>; JP Analytical, LLC<sup>3</sup>; Air Force Research Lab<sup>4</sup>; Polytechnique Montreal<sup>5</sup>

**Poster Number:** 13

### **Magneto-optical Characterization of GeSn Heterostructures Using Rapid-scan FTIR-based Photoluminescence Spectroscopy**

Hole spin qubits in germanium heterostructures have demonstrated their potential for scalable quantum information processing using all-electrical gate operations. Furthermore, the emerging material platform of GeSn can feature a direct bandgap, which makes it promising for establishing spin-photon interfaces for quantum networking while enabling the characterization of the material via photoluminescence. Here, we perform the first photoluminescence measurements of GeSn/SiGeSn double quantum wells using a Fourier transform infrared spectrometer. While common methods for performing such spectroscopy rely on the operation of the spectrometer in a “step-scan” mode, this operation mode is unavailable in many research groups. Here, our approach that involves the modulation of a high-power above-band laser and a wise choice of integration times enables photoluminescence measurements from quantum wells using the commonly available “rapid scan” spectroscopy mode. After benchmarking our method on a previously characterized bulk GeSn sample, we use it for performing the first photoluminescence measurements from a Ge<sub>0.88</sub>Sn<sub>0.12</sub>/Si<sub>0.02</sub>Ge<sub>0.89</sub>Sn<sub>0.09</sub> double quantum well. First, the descending trend of photoluminescence versus temperature reveals a direct-bandgap behavior and phonon-independent spectral broadening. Second, magneto-photoluminescence measurements exhibit expected diamagnetic shift, Landau behavior, and Zeeman splitting. Finally, polarization-resolved magneto-photoluminescence measurements allow us to extract an effective hole g-factor of  $\sim 4$ , which indicates the potential of the material platform for robust all-electrical coherent control. Our spectroscopy method can be further utilized to study the potential of group IV semiconductors as hosts for hole spin qubits for scalable quantum information processing.

**Harshit Bhatt**

**Graduate Program:** Applied Mathematics

**Advisor:** Chao Chen

**Poster Number:** 17

### **Adaptive Randomized Framework For Matrix Approximation**

Large-scale matrices arising in PDE-constrained inverse problems, Gaussian processes, and deep learning are often too expensive to assemble or store explicitly. We propose an adaptive randomized framework that constructs hierarchical low-rank (HODLR-type) approximations using only matrix–vector products. By combining randomized range finding with automatic rank detection, the method adaptively balances accuracy and computational cost without prior rank tuning. Numerical experiments on PDE Hessians and kernel matrices demonstrate significant reductions in storage and runtime while maintaining controlled approximation error.

**John Britt**<sup>1</sup>, Mahe Jabeen<sup>2</sup>, and Balaji Rao<sup>2,3</sup>

**Graduate Programs and Institutions:** Biological Sciences<sup>1</sup>; Chemical and Biomolecular Engineering<sup>2</sup>; Golden LEAF Biomanufacturing Training and Education Center<sup>3</sup>

**Advisor:** Balaji Rao

**Poster Number:** 20

### **Development of Chemically Defined Culture Conditions for Macaque Trophoblast Stem Cells**

**Background:** Nonhuman primates (NHPs) are well-suited as models for human trophoblast development due to the high genetic similarity between humans and NHPs. However, high cost and complexity limit NHP studies. In vitro models for NHP trophoblast development can complement in vivo animal studies. Further, they can enable comparative studies with human in vitro models and facilitate studies on genetic knockouts that are difficult to conduct with monkey embryos, and not possible with human embryos due to ethical and legal constraints. Towards this end, macaque trophoblast stem cells (TSCs) have been derived from early gestation placental samples using trophoblast stem cell medium (TSCM) that was originally used for derivation of human TSCs from first trimester placental samples and blastocyst stage embryos. However, macaque TSCs cultured in TSCM show poor differentiation to syncytiotrophoblast (STB) and extravillous trophoblast (EVT) lineages relative to human TSCs, limiting their usefulness.

**Objectives:** We hypothesized that defective differentiation of macaque TSCs is due to the sub-optimal nature of TSCM for their culture in the undifferentiated state. To address this limitation, we sought to develop a chemically defined medium that allows for long-term cultivation of macaque-derived TSCs and improves their differentiation potential to both EVT and STB lineages.

**Methods:** Macaque TSCs from first trimester (TSrho20119, and TSrho12919) were used for this study. Additionally, we also derived a macaque TSC line from term cytotrophoblasts using similar protocols as that used for deriving TSC from human placentas at birth. We investigated the culture of macaque TSCs in a chemically defined basal medium (LG BM) containing physiological glucose concentrations. Unlike TSCM, this medium does not contain valproic acid or any albumin. Additionally, we also evaluated the effect of including lipids in LG BM on culture of macaque TSCs.

**Results:** Macaque TSCs have been cultured for 5+ passages in LG BM, as well as variations of LG BM supplemented with lipids. All cells showed expression of core TSC markers (TEAD4, p63, and GATA3) similar to TSCs cultured in TSCM. Notably, upon differentiation cells cultured in the defined conditions showed improved EVT morphology and expressed the EVT markers Mamu-AG and NCAM1. Similarly, cells in defined media also showed substantially improved differentiation to STB, characterized by significantly higher fusion index and expression of the STB marker SDC-1. Interestingly, introduction of lipids caused changes in histone acetylation and methylation patterns as well as quantifiable changes in STB and EVT differentiation.

**Conclusions:** Macaque TSCs can be cultured in a chemically defined medium, and show improved differentiation to STB and EVT lineages, relative to cells cultured in TSCM. This culture system will enable development of improved in vitro models of macaque trophoblast development and therefore accelerate research into human placental biology.

**Adira Cohen**<sup>1</sup>, Roland Kays<sup>2,3</sup>, Mohammad Alyetama<sup>2,4</sup>, Matthew Snider<sup>2</sup>, and Erin Schliep<sup>1</sup>

**Graduate Programs and Institutions:** Statistics<sup>1</sup>; Forestry and Environmental Resources<sup>2</sup>; North Carolina Museum of Natural Sciences<sup>3</sup>; Department of Psychology, Neuroscience and Behavior, University of Nebraska<sup>4</sup>

**Advisor:** Erin Schliep

**Poster Number:** 36

### **Don't Throw Away Uncertainty: Using All AI Confidence Scores to Model Deer Body Condition**

Camera traps have become a core tool in ecological research, enabling large-scale, noninvasive monitoring of wildlife populations and behavior. By automatically recording animals as they pass within view, these devices generate massive image datasets with minimal field effort. Yet this data richness introduces a new bottleneck when translating the images into usable information due to time and effort required for human annotation. Recently, artificial intelligence (AI) has been integrated into the workflow to improve this efficiency. However, the data procured from AI approaches are of a different nature, necessitating new statistical methods in order to obtain inference, make predictions, and quantify uncertainty. We propose a new Bayesian hierarchical data-fusion model that combines the strengths of human annotations and AI predictions. The benefits of our approach are the ability to provide uncertainty quantification as well as improved inference and prediction power, which we demonstrate using a simulation study. We apply our model to an AI analysis of the body condition of white-tailed deer (*Odocoileus virginianus*) from camera trap images from North Carolina to study the relationship between health and their environment. We find that bucks in rut have higher body condition than other deer and that green, open habitats are correlated with high body condition. Our new model derived novel ecological inference compared to a traditional approach using the same data.

**Natalie Davis**

**Graduate Program:** Marine, Earth, and Atmospheric Science

**Advisor:** Jay Levine

**Poster Number:** 42

### **Evaluating Freshwater Mussel Responses to Algal Food Sources Using Bivalve-Based Living Sensor Systems**

Freshwater mussels are one of the most imperiled freshwater species on Earth. Understanding their diets, physiology, and behaviors is imperative to planning effective conservation efforts. Progress in understanding their diets has been made in other studies. However, their physiological and behavioral reactions to the diets are not well known. This study aims to capture baseline heart rate, gaping, and burrowing data of the common North Carolina freshwater mussel, *Elliptio complanata*, in response to two different types of algae diets using miniature “backpack biosensors” adhered to the mussel shell. The sensors include heart rate monitors, pressure sensors, and accelerometers. To capture this data, mussels were placed in groups in tanks and consistently fed a source of eukaryotic phytoplankton (*Chlorella vulgaris*, *Nanochloropsis oculata*, and *Phaedactylum tricornutum*) and cyanobacteria (*Microcystis* sp., *Dolichospermum* sp., and *Aphanizomenon* sp.), and compared to a control group that was not fed. Hemolymph was harvested from the mussels before and after feeding trials and was sent to be evaluated for metabolomic data that can indicate the health of the mussel. Data will be evaluated for changes in heart rate, behavior, and metabolomics once experimental trials have been completed.

**Shuvrarghya Ghosh**

**Graduate Program:** Statistics

**Advisor:** Subhasgis Ghoshal

**Poster Number:** 60

### **Bayesian Tensor Completion with Smooth Tucker Decomposition**

Tensor data analysis has emerged as a problem of interest due to advances in multilinear algebra and computing power that allow the extension of traditional statistical models to fit these multidimensional data. The tensor completion problem is defined as the prediction of missing entries in a large tensor using a limited number of observed values in the same tensor, and its wide range of applications includes recommender systems, image analytics, and more. In this article, we study this problem within a nonparametric Bayesian framework. We assume that the true tensor admits a Tucker-type decomposition structure. Each column of a latent factor matrix in the decomposition is expressed as an unknown smooth function of a set of univariate latent variables. These smooth functions and latent variables differ across the factor matrices. A prior of random series of B-spline functions is used for each unknown function and a uniform prior is put on the latent variables. We study the posterior consistency of our model and establish minimax optimal contraction rates, up to a logarithmic factor. Finally, we assess the predictive performance of the proposed method using simulation studies and real data analyses.

**Carter Hall<sup>1</sup>, Sujit Ghosh<sup>1</sup>, and Mette Olufsen<sup>2</sup>**

**Graduate Programs:** Statistics<sup>1</sup>; Mathematics<sup>2</sup>

**Advisor:** Sujit Ghosh

**Poster Number:** 69

### **Quantifying Uncertainty in a Mathematical Model of Autonomic Dysfunction**

Autonomic dysfunction involves impaired control of involuntary physiological processes such as heart rate, blood pressure, and respiration, contributing to conditions like diabetes, Parkinson's disease, and chronic pain. Yet, no automated or quantitative diagnostic tools currently exist. We propose a novel mathematical model of the Valsalva Maneuver—a noninvasive test that elicits autonomic responses—integrating blood pressure and ECG-derived measures of heart rate and respiration. The model parameters capture key physiological mechanisms. Instead of traditional Fisher Information–based sensitivity analysis, which can be unreliable for nonlinear or correlated parameters, we use Hamiltonian Monte Carlo to obtain the full joint posterior distribution of parameters. This approach is extended across multiple patients to yield individualized posterior estimates, which are further analyzed through regression on covariates such as age and gender. This two-stage hierarchical analysis aims to explain additional variability and guide refinement of the underlying physiological model.

**Thao “Tina” Luu, Anh-Thu “Julia” Nguyen Tran, and Jonathan S. Lindsey**

**Graduate Program:** Chemistry

**Advisor:** Jonathan S. Lindsey

**Poster Number:** 104

### **Harnessing the Ingredients of Plants for Medical Applications**

Plants contain numerous substances that are believed to be beneficial for human health. A recently discovered (~1990s) class of chlorophyll derivatives – known as phyllobilins – has been found to have anti-bacterial, anti-inflammatory, anti-cancer, and anti-oxidant properties. It is now known that there are many members of this family of compounds, and the difficulties in purification have stymied research to understand how molecular structure affects biological activity. My project is to develop a method for the laboratory synthesis of pure phyllobilins. Among the various compounds, perhaps the most intriguing members are those that are shaped like a giant ring. The resulting structure is hypothesized to bind to various biomacromolecules (e.g., proteins) and thereby exert biological activity. As a first step, I am working on the synthesis of a model compound (a simplified structure) that contains the giant ring but lacks some adornments. The model phyllobilin, once obtained in pure form and sufficient quantity, will be tested in biological and medicinal chemistry studies. An immediate goal is to compare experimental data (in vitro and in vivo) with computational predictions (in silico). The computational work has been done by collaborators in Austria. Follow-on research is planned to create a family of synthetic phyllobilins. In short, the development of an efficient synthetic route to ample quantities of this class of hitherto unexplored natural products – giant ring derivatives of chlorophylls – should provide a platform for exploring studies in biological, medicinal, and potentially therapeutic realms.

**Javier I. Madariaga and Patrick L. Combettes**

**Graduate Program:** Mathematics

**Advisor:** Patrick L. Combettes

**Poster Number:** 106

### **A Geometric Framework for Stochastic Iterations**

We present a geometric framework for stochastic algorithms arising in nonlinear analysis and optimization. Within this framework, existing solution methods are unified and new ones are designed, establishing almost sure and linear convergence results. These results apply specifically to stochastic fixed point iterations, the stochastic gradient descent method, and stochastic extrapolated parallel algorithms for feasibility problems. The proposed algorithms exceed the features and convergence guarantees of the state of the art.

**Julie Matheny**

**Graduate Program:** Chemistry

**Advisor:** Tatyana I. Smirnova

**Poster Number:** 108

### **Beyond Lubrication: The Role of Metal-Oxide Nanoparticle Additives in Radical Formation in Oil**

Nanoparticle additives have recently attracted considerable attention for their ability to enhance the tribological and thermophysical properties of petroleum-based lubricants. However, relatively little research has explored their potential to generate free radicals in oils through photochemical or mechanical activation mechanisms.

In this work, spin-trapping Electron Paramagnetic Resonance (EPR) spectroscopy was used to quantify and characterize short-lived free radical intermediates formed in light mineral oil containing nanoparticle additives. Under 365nm UV light irradiation, samples containing  $\text{TiO}_2$ ,  $\text{CeO}_2$ , or  $\text{ZnO}$  nanoparticles initiated significantly higher radical formation as compared to oil-only samples, particularly in the presence of molecular oxygen.  $\text{TiO}_2$  and  $\text{CeO}_2$  primarily promoted the formation of alkoxyl radicals, while  $\text{ZnO}$  favored peroxy radical generation in air-equilibrated samples. In contrast, in the absence of oxygen, the presence of nanoparticles had a negligible impact, or even a suppressive effect, on radical formation, primarily due to reduced generation of carbon-centered radicals.

Additionally, mechanical activation of nanoparticles by ball milling initiated free radical formation in air-equilibrated oil. Mechanoactivated  $\text{Al}_2\text{O}_3$ ,  $\text{ZnO}$  or  $\text{TiO}_2$  each induced significantly increased radical formation in oil as compared to their non-activated counterparts. Mechanoactivated  $\text{TiO}_2$  induced a mixture of alkoxyl and peroxy radicals, whereas additions of mechanoactivated  $\text{ZnO}$  or  $\text{Al}_2\text{O}_3$  induced primarily alkoxyl radicals in the oil. Remarkably, mechanoactivated particles retain significant radical-generating activity even after 48 hours of rest maintaining 54% ( $\text{TiO}_2$ ), 76% ( $\text{ZnO}$ ), and 77% ( $\text{Al}_2\text{O}_3$ ) of their initial EPR signal intensities.

Our findings bridge the gap between tribology and chemistry, clarifying the effect metal oxide nanoparticles have on chemical aging pathways in lubricating oil.

This work was supported by ACS PRF 65503-ND4 grant to TIS.

**Matthew Nuyten**<sup>1</sup>, Boris Tselikhovskiy<sup>2</sup>, and Bojko N. Bakalov<sup>1</sup>

**Graduate Programs and Institutions:** Mathematics<sup>1</sup>; Mathematics, UC Riverside<sup>2</sup>

**Advisor:** Bojko N. Bakalov

**Poster Number:** 125

### **Provable Absence of Barren Plateaus for the QAOA with Grover Mixers**

We analyze the dynamical Lie algebras (DLAs) associated with the Grover-mixer variant of the Quantum Approximate Optimization Algorithm (GM-QAOA). When the initial state is the uniform superposition of computational basis states, we show that the corresponding DLA is isomorphic to  $\text{su}(d) \oplus \text{u}(1) \oplus \text{u}(1)$ , where  $d$  denotes the number of distinct values of the objective function. We also establish an analogous result for other choices of initial states and Grover-type mixers. Furthermore, we prove that the DLA of GM-QAOA has the largest possible commutant among all QAOA variants initialized with the same state, corresponding physically to the maximal set of conserved quantities. We derive an explicit formula for the variance of the GM-QAOA loss function in terms of the objective function values, and we show that for a broad class of optimization problems, GM-QAOA with sufficiently many layers avoids barren plateaus.

**Jisu Oh** and Subhashis Ghoshal  
**Graduate Program:** Statistics  
**Advisor:** Subhashis Ghoshal  
**Poster Number:** 127

### **Testing Multivariate Normality Using Angular Skewness and Kurtosis Processes**

Let  $X_1, \dots, X_n$  be a sample from a distribution  $P$  on  $\mathbb{R}^d$ , with  $d \geq 2$ . In this paper, we develop a multivariate normality test based on two random processes  $S_n$  and  $K_n$ , indexed by the unit sphere  $S^{d-1}$ , which represent, respectively, the sample skewness and kurtosis of the inner products  $\langle \lambda, X_i \rangle$  for  $\lambda$  in  $S^{d-1}$ . We show that the limiting processes of  $S_n$  and  $K_n$  are Gaussian under the null hypothesis. We also show that, under local alternatives, the limiting processes remain Gaussian and have the same covariance kernels as under the null, with only their mean functions shifted. Using this fact, a Bayesian testing procedure based on reproducing kernel Hilbert spaces is proposed. We construct a test statistic from the Radon-Nikodym derivatives of the limiting processes, and derive its expression in terms of spherical harmonics. The unbiasedness and consistency of the proposed test are also considered. Through simulation studies under various settings, we demonstrate that our method performs well compared to existing multivariate normality tests.

**Daniel Piasecki**  
**Graduate Program:** Physics  
**Advisor:** Chueng Ji  
**Poster Number:** 133

### **Koopman-von Neumann Field Theory for Classical Point Particles**

We present a field-theoretic framework for the relativistic classical mechanics of point particles that is mathematically parallel to quantum field theory (QFT), while preserving an underlying classical phase-space structure. Our construction is based on the Koopman–von Neumann–Sudarshan (KvNS) formulation of classical statistical mechanics, which realizes classical dynamics on a complex Hilbert space satisfying the Dirac–von Neumann axioms traditionally associated with nonrelativistic quantum mechanics.

Within this framework, we distinguish between quantum Dirac spinors and their Koopman counterparts, and show that the Koopman spinor naturally captures the classical limit as an isomorphism to the on-shell fermionic Wigner operator, while correctly encoding relativistic classical dynamics. We further extend the single-particle theory to a Fock phase space, defined in direct analogy with the construction of quantum Fock space, thereby providing a classical field-theoretic description of multiparticle systems.

This work extends Koopman–Schönberg methods to relativistic fluid dynamics, plasma physics, and relativistic classical statistical mechanics, with potential applications to condensed matter and novel computationally efficient algorithms.

**Ananya Roy**

**Graduate Program:** Statistics

**Advisor:** Jonathan Williams

**Poster Number:** 143

### **E-values for Measurement Error Models**

Measurement error in covariates fundamentally distorts the geometry of likelihood-based inference, leading to attenuation bias, loss of identifiability, and unstable statistical conclusions. This work investigates two foundational strategies for handling latent covariates in measurement error models---profiling and marginalization---within a unified likelihood framework. In particular, within the context of multiple testing, we construct an e-value for each approach, pertaining to hypotheses about covariate effects in regression. Using the growth-rate optimality (GRO) criterion from safe testing theory, we derive analytical expressions for the expected evidence growth under each approach and establish their relative efficiency. Priors on the latent covariates emerge as a key ingredient for restoring identifiability and stabilizing inference, connecting classical regularization ideas with modern sequential optimality principles. Through both theoretical analysis and simulation, we demonstrate that profiling achieves systematically higher GRO values, indicating faster evidence accumulation. The results delineate clear regimes where one strategy dominates the other, clarifying the statistical and computational trade-offs inherent in inference under measurement error.

**Prajima Sapkota**

**Graduate Program:** Physics and Astronomy

**Advisors:** Karen Daniels (NC State University), Silke Henkes (Leiden University), Jen Schwarz (Syracuse University)

**Poster Number:** 148

### **How Rigidity Shapes Vibrational Modes in Disordered Granular Packings**

Rigidity in disordered materials emerges from the topology of their underlying networks, the geometric arrangement of constituents, and the forces transmitted through their interactions. Maxwell's counting criterion provides a global necessary condition for rigidity, however it does not capture the local distribution or independence of constraints. In two dimensions, a structure-based approach called the Pebble Game offers a rigorous framework to identify rigid and floppy regions by analyzing constraint networks at the mesoscale. Granular materials provide a natural experimental realization of these ideas. As packing density increases, granular systems undergo a jamming transition from a fluid-like to a solid-like state, where mechanical stability is governed by a heterogeneous network of interparticle contacts and force chains. Near this transition, theoretical and numerical studies of disordered systems predict an excess of low-frequency vibrational modes associated with structurally weak or floppy regions, yet direct experimental verification of this spatial correspondence remains limited.

We test the hypothesis that a direct spatial correspondence exists between mesoscale rigid and floppy structures and their emergent vibrational dynamics. Using an experiment with frictional photoelastic disks, we reconstruct interparticle forces and contact networks with PhotoElastic Grain Solver (PEGS). These networks are analyzed using the Pebble Game algorithm to identify rigid and floppy regions. Independently, particle-scale vibrational dynamics are measured using a Scanning Laser Doppler Vibrometer (SLDV). By directly comparing rigidity-based structural maps with measured vibrational modes, we provide experimental insight into how structural heterogeneity controls acoustic response in disordered granular systems.

**Irene Silvernail** and Xingcheng Lin  
**Graduate Program:** Physics  
**Advisor:** Xingcheng Lin  
**Poster Number:** 156

### **Utilizing Coarse-Grained Models in Simulations to Study Chromatin Organization**

DNA is the coded instruction manual for all life, and protein is what decodes and carries out the orders. Characterizing the DNA-protein interactions is essential for understanding the underlying molecular mechanisms of many DNA processes, including chromatin formation and DNA replication. One such process is liquid-liquid phase separation (LLPS), which enables organization and compartmentalization of biomolecules into biomolecular condensates in cells without the need for a membrane. Within the nucleus, LLPS of chromatin regulates the accessibility of DNA and therefore controls gene expression. We utilized a coarse-grained model with residue resolution to simulate nucleosomes at different salt concentrations to explore the molecular mechanisms driving LLPS of chromatin. This model allows us to accurately and efficiently simulate chromatin interactions with sequence and epigenetic specificity. The simulation revealed a non-monotonic nucleosome condensate phase change at different salt concentrations that agrees with prior experimental results. By altering the variables of the model, we can explore the biophysical properties of condensates, viscoelasticity, and hydrophobicity.

**Abdul-Rahman Sweilam**, Erica Curran, and Megan Pike  
**Graduate Program:** Chemistry  
**Advisor:** Thomas Theis  
**Poster Number:** 160

### **Rapid, Low-Cost Hyperpolarization of 1,2-<sup>13</sup>C<sub>2</sub> Pyruvate for Real-Time Metabolic Tracking by NMR/MRI**

Metabolism—the chemical network that powers cells—often changes early in disease and can reveal how tissues respond to stress or treatment. However, it remains difficult to monitor metabolic reactions non-invasively and in real time. Magnetic resonance techniques (NMR and MRI) are, in principle, non-invasive and allow real-time tracking. However, at tracer concentrations, conventional NMR and MRI signals from metabolic tracers are too weak. Hyperpolarization can temporarily boost the signal of <sup>13</sup>C-labeled molecules enough to track metabolism, but today's dominant technology (dynamic nuclear polarization) is typically slow, expensive, and operationally complex, limiting access to specialized centers. My research develops a faster, lower-cost hyperpolarization workflow that can plug directly into time-resolved <sup>13</sup>C NMR experiments and, ultimately, metabolic imaging pipelines. The approach targets 1,2-<sup>13</sup>C<sub>2</sub> sodium pyruvate, a central metabolic substrate, and uses parahydrogen (hydrogen gas prepared in a special spin-ordered state) together with an iridium-IMes catalyst platform to transfer spin order to the 1,2-<sup>13</sup>C<sub>2</sub> sodium pyruvate probe, producing a strong <sup>13</sup>C signal for immediate detection. A key focus is establishing a practical optimization strategy to improve reproducibility and polarization yield by tuning solution formulation (including co-ligands such as DMSO), temperature, and magnetic-field conditions during parahydrogen bubbling. With robust hyperpolarization in hand, this platform enables quantitative tracking of pyruvate conversion in controlled in vitro biological systems (e.g., yeast and bacterial cultures, with extension to mammalian cells) and supports translation toward in vivo workflows by measuring biodistribution and uptake using MRI methods. Compared with singly labeled pyruvate, the doubly <sup>13</sup>C-labeled probe increases the metabolic information available by providing access to additional downstream transformations linked to cellular energy metabolism. Overall, this work aims to broaden access to metabolic NMR/MRI measurements that can help detect disease-associated metabolic phenotypes and monitor treatment response.

**Puja Thapa**<sup>1,2</sup>, Zixu Wang<sup>3</sup>, Cong Yang<sup>4</sup>, Md Zaibul Anam<sup>5</sup>, Ziqi Wang<sup>4</sup>, Ming Hu<sup>5</sup>, Jun Liu<sup>4</sup>, Jian Shi<sup>3</sup>, Yoji Nabei<sup>1,2</sup>, and Dali Sun<sup>1,2</sup>

**Graduate Programs and Institutions:** Physics<sup>1</sup>; Organic and Carbon Electronics Laboratories (ORaCEL)<sup>2</sup>; Rensselaer Polytechnic Institute<sup>3</sup>; Mechanical and Aerospace Engineering<sup>4</sup>; Mechanical Engineering, University of South Carolina<sup>5</sup>

**Advisor:** Dali Sun

**Poster Number:** 163

### **Self-Detection of Intrinsic Chiral-Phonon-Activated Spin Seebeck Effect in Elemental Tellurium at Room Temperature**

Chiral phonons are quanta of lattice vibration having non-zero angular momentum, offering a new route for coupling spin and heat in chiral solids, such as  $\alpha$ -HgS, tellurium, and  $\alpha$ -quartz. At thermally equilibrium conditions, the net angular momentum of the chiral phonon vanishes unless the chiral material is subject to a nonequilibrium thermal gradient. Previous studies have shown that upon thermal gradient, the non-zero finite angular momentum of chiral phonons can inject pure spin currents in an adjacent nonmagnetic metallic layer through electron–phonon interactions at chiral material/metal interfaces. Here, we report the intrinsic chiral phonon-activated spin Seebeck effect (CPASS) in elemental tellurium, in which thermally excited chiral phonons create spin polarization within the crystal itself in the absence of an adjacent metallic layer. Unlike prior work, the spin polarization originates inside the chiral lattice rather than in an adjacent metal. This intrinsic CPASS is confirmed through self-detection via the inverse Rashba–Edelstein effect at the Te surface. The observed chirality- and heat-current-dependent responses, supported by chiral phonon calculations, firmly establish the intrinsic nature of the effect.

**Cristhian Valladares**

**Graduate Program:** Animal Sciences

**Advisor:** Eduardo Beltranena

**Poster Number:** 168

### **Feeding Peanut Skins to Lactating Sows on Sow and Litter Performance**

Dietary fiber in sow diets can enhance satiety, reduce stereotypic behaviors, improve gut health, alleviate constipation, and potentially improve reproductive performance. The southeastern United States produces most of the nation's 2.5 to 2.9 million metric tonnes of peanuts, over half destined for the food industry. Peanut skins, a local, low-cost co-product rich in total dietary fiber (40%) and fat (23%) offer a potential alternative source of fiber and energy at about one-fifth the cost of corn grain. The objective of this study was to evaluate the effects of feeding peanut skins, alone or combined with soyhulls, on sow and litter performance. In a randomized complete block design, 75 multiparous Landrace  $\times$  Large White sows (parity 2-5;  $245 \pm 4.7$  kg BW) were assigned by parity and BW to one of three lactation diets: a corn–soybean meal control K+MgSO<sub>4</sub> added, 12% peanut skins, or 8% peanut skins + 4% soyhulls. Sows were fed their assigned diets (10.5 MJ NE, 1.0 g SID Lys/MJ NE) from entry into farrowing until return to estrus after weaning. Sows fed peanut skins lost more body weight, backfat, and caliper units during lactation, peanut skin-soy hulls were intermediate, and control lost the least ( $P < 0.05$ ). Feed disappearance during lactation was highest ( $P < 0.05$ ) in sows fed the control diet, intermediate in sows fed peanut skins–soyhulls, and lowest when fed peanut skins alone. There were not significant differences on total born, liveborn, stillborn, weaned piglets, birth or weaning weights, litter wean weight, litter gain, or creep feed disappearance. Feeding high-fiber peanut skins, alone or combined with soyhulls, reduced feed intake and increased body tissue mobilization in lactating sows without impairing litter performance. These findings indicate that peanut skins are a viable fibrous ingredient for sow diets, though their energy value requires further evaluation.

**Anqi Zhao**<sup>1</sup>, Jungeum Kim<sup>1</sup>, Ke Zhu<sup>1,2</sup>, Yichi Zhang<sup>3</sup>, and Shu Yang<sup>1</sup>

**Graduate Programs and Institutions:** Statistics<sup>1</sup>; Biostatistics and Bioinformatics, Duke University<sup>2</sup>; Statistics, Indiana University<sup>3</sup>

**Advisor:** Jungeum Kim

**Poster Number:** 192

### **Rethinking Conformal Prediction for Binary Classification: From Impossibility to Groupwise Local Singleton-Accuracy Maximization**

In binary classification, standard Conformal prediction (CP) often collapses to the uninformative set  $\{0,1\}$ . We identify a structural cause: for any conformity score monotone in  $\hat{p}(y|x)$ , a nontrivial fraction of test points can receive two-label prediction sets. We also show that pointwise level shrinkage  $\alpha(x)$  under the standard split CP formulation may not achieve conditional validity, yielding a second impossibility result. Motivated by these limits, we propose GLoSaM, a groupwise CP method with data-driven grouping and adaptive calibration that tightens prediction sets while retaining finite-sample distribution-free guarantees. Across synthetic benchmarks and binary LLM and vision classification settings, GLoSaM achieves valid groupwise coverage, substantially higher singleton rates, and robustness to score choice, outperforming e-value and multi-level conformal baselines.

**Zihao Yu**

**Graduate Program:** Applied Mathematics

**Advisor:** Hangjie Ji

**Poster Number:** 188

### **Electro-hydrodynamics Modeling of Liquid-metal Droplets with Electrochemical Oxidation**

Eutectic Gallium-Indium (EGaIn) is a room-temperature liquid metal with tunable surface tension and complex interfacial dynamics under applied electric fields. Due to its high electrical conductivity, fluidity, and low toxicity, EGaIn has gained significant interest for applications in robotics, electronics, and biomedical devices. In this work, we consider the dynamics of an EGaIn droplet immersed in a NaOH electrolyte on a flat substrate. A one-dimensional lubrication model is developed for the film thickness of the liquid metal and the oxide concentration at the EGaIn/NaOH interface. This model incorporates Marangoni effects, bulk surface tension, modified intermolecular forces, and an electrochemical oxidation flux determined by a two-dimensional multiphase electric field model. Using the coupled model, we numerically study the spatiotemporal evolution of the droplet shape and the surface oxide concentration under various electric potential boundary conditions. We demonstrate fundamental droplet behaviors such as wetting, dewetting, and directional transport. Furthermore, the simulations reveal that complex dynamics, including droplet coalescence and splitting, can be achieved by altering boundary voltages over time, offering a potential framework for programmable liquid metal manipulation.

## College of Veterinary Medicine

**Emma Atwood**<sup>1,3</sup>, Ruth Parsons<sup>2,3</sup>, Katarzyna Janowska<sup>3</sup>, Xiao Huang<sup>3</sup>, Bhisem Thakur<sup>3</sup>, Esther Beaudoin<sup>3</sup>, Priyamvada Acharya<sup>2,3</sup>, and Amit Sharma<sup>1,3</sup>

**Graduate Programs and Institutions:** Comparative Biomedical Sciences<sup>1</sup>; Biochemistry, Duke University<sup>2</sup>; Duke Center for HIV Structural Biology<sup>3</sup>

**Advisor:** Amit Sharma

**Poster Number:** 14

### **Determination of the First High-Resolution Structure of HIV-1 Envelope in Complex with Macaque CD4**

Macaque models that utilize Simian-Human Immunodeficiency Virus (SHIV) are critical for preclinical evaluation of HIV-1 therapies and vaccines. SHIVs are chimeric viruses that encode the HIV-1 Envelope (Env) and SIV accessory genes. However, the HIV-1 Env is unable to cause persistent infection in macaques. Therefore, SHIVs require engineering or adaptation of the HIV-1 Env to efficiently utilize macaque CD4 for viral entry and SHIV replication. These engineered changes can often be determined based on predictive modeling and functional/structural assays to test the ability of mutations to overcome the macaque entry barrier. However, the field is lacking a soluble recombinant macaque CD4 protein for structural assays and a high-resolution structure of the HIV-1 envelope in complex with macaque CD4. Here, I provide the design of the macaque CD4 plasmid and the subsequent protein purification. The protein was then verified utilizing SDS-Page to confirm mass and Differential Scanning Fluorometry (DSF) to confirm protein stability. Binding assays were also conducted to confirm binding capabilities and to compare macaque and human CD4 binding with HIV-1 Envelope. Lastly, cryo-electron microscopy and further analysis were performed to obtain a 5.01 Å resolution structure of the HIV-1 envelope with macaque CD4. This structure will allow the field to better predict and design SHIVs. Additionally, the soluble macaque CD4 protein will allow for rapid and efficient testing of further engineered changes.

**Ashley E. Cave**<sup>1,2</sup>, Isabella G. Livingston<sup>1</sup>, Taylor M. Gregory<sup>3</sup>, Eleanor C. Hawkins<sup>2</sup>, Shelly Vaden<sup>2</sup>, Marjorie Riofrío-Lazo<sup>4</sup>, Diane Deresienski<sup>2,4</sup>, Gregory A. Lewbart<sup>2,4</sup>, Anthony J. Orr<sup>5</sup>, Emily Griffith<sup>6</sup>, Christopher Fuller<sup>7</sup>, Mark J. Strynar<sup>7</sup>, James McCord<sup>8</sup>, Jacqueline Bangma<sup>7</sup>, Alissa C. Deming<sup>9</sup>, Diego Páez-Rosas<sup>4,10,11</sup>, and Matthew Breen<sup>1,12,13</sup>

**Graduate Programs and Institutions:** Molecular Biomedical Sciences<sup>1</sup>; Clinical Sciences<sup>2</sup>; Greensboro Science Center<sup>3</sup>; Galapagos Science Center<sup>4</sup>; Marine Mammal Laboratory, Alaska Fisheries Science Center<sup>5</sup>; Statistics<sup>6</sup>; U.S. Environmental Protection Agency<sup>7</sup>; U.S. Environmental Protection Agency, Office of Water<sup>8</sup>; The Pacific Marine Mammal Center<sup>9</sup>; Fundación Conservando Galapagos<sup>10</sup>; Dirección del Parque Nacional Galapagos<sup>11</sup>; Comparative Medicine Institute<sup>12</sup>; Center for Human Health and the Environment<sup>13</sup>

**Poster Number:** 28

### **Differences in PFAS Exposure Between Pacific Pinnipeds: the Galapagos (*Zalophus wollebaeki*) and California (*Zalophus californianus*) Sea Lions**

Per- and polyfluoroalkyl substances (PFAS) are a class of man-made persistent chemicals that have been detected in both terrestrial and aquatic environments and thus impact humans, household pets, agricultural species, and wildlife. PFAS exposure is linked to a variety of adverse health consequences, including cancer and immune disruption. This study investigates differences in PFAS exposure between California (CSL, n=69) and Galapagos (GSL, n=65) sea lion pups and juveniles across various sampling locations within each species' habitat range. Whereas the GSL were all considered healthy, 17 of the 69 CSL were classified as malnourished. Comparing the two species, significantly higher serum concentrations of summed PFAS, perfluorooctanesulfonic acid (PFOS), perfluorononanoic acid (PFNA), and perfluorodecanoic acid (PFDA) were detected in CSL than in GSL. This elevated PFAS exposure in CSL is likely related to historic pollution in their environment and close proximity to the urbanized coastline of Southern California. Within species, malnourished CSL had significantly higher PFNA than healthy CSL pups. GSL pups also tended to have higher PFAS levels than GSL juveniles. Within the Galapagos archipelago, PFAS exposure differed between rookeries, with PFOS exceeding its method reporting limit (0.5 ng/mL) in every sample, including GSL from islands uninhabited by humans. Summed PFAS, PFNA, PFDA, and perfluoroundecanoic acid (PFUnA) were all significantly higher in sea lions sampled on uninhabited than inhabited islands in the Galapagos archipelago. This study is the first comprehensive report of PFAS in CSL and the first archipelago-wide assessment of PFAS in GSL.

**Rahul Kumar**<sup>1</sup>, Jian Chen<sup>2</sup>, Sonika Patial<sup>3</sup>, and Yogesh Saini<sup>1</sup>

**Graduate Programs and Institutions:** Population Health and Pathobiology<sup>1</sup>; Comparative Biomedical Sciences, School of Veterinary Medicine, Louisiana State University<sup>2</sup>; Division of Translational Toxicology, National Institute of Environmental Health Sciences<sup>3</sup>

**Advisor:** Yogesh Saini

**Poster Number:** 94

### **Combined Liver-Specific Deletions of RNA-binding Proteins, ZFP36L1 and ZFP36L2, Promote Hepatocarcinogenesis**

Environmental carcinogens promote endogenous mutagenic processes in human liver cancer. While transcriptional regulation have been studied in this process, the role of post-transcriptional gene regulation mediated by RNA-binding proteins (RBPs) remains poorly understood. We previously showed that combined liver-specific deficiency of two RBPs, Zinc Finger Protein 36 Like 1 (ZFP36L1) and Zinc Finger Protein 36 Like 2 (ZFP36L2), cause spontaneous hepatic inflammation and activation of oncogenic pathways. Since inflammation drives liver cancer, we tested the hypothesis that ZFP36L1 and ZFP36L2 regulate diethylnitrosamine (DEN)-induced hepatocarcinogenesis in mice. Liver-specific ZFP36L1 and ZFP36L2 double knockout (L1/L2dKO; AlbCre+/Zfp36l1flox/flox/Zfp36l2flox/flox) and flox-only control (L1/L2FLX; AlbCre-/Zfp36l1flox/flox/Zfp36l2flox/flox) mice of both sexes were administered DEN (25mg/Kg BW) intraperitoneally at postnatal day 14 and euthanized at 24 h and 6 months post-injection to assess DEN-induced DNA damage and hepatocarcinogenesis, respectively. Additionally, we assessed the expression of these RBPs in hepatocellular carcinoma cohorts from the TCGA database. The expression of  $\gamma$ H2AX, a DNA damage marker, was comparable between groups at 24 h post-DEN administration, suggesting no difference in the initiation of DEN-induced carcinogenesis. Interestingly, a higher percentage of DEN-treated L1/L2dKO mice (~85%) developed high-grade liver tumors (HCC) compared to few low-grade preneoplastic foci in DEN-treated L1/L2FLX mice (~16.6%) at 6 months post-exposure. Additionally, L1/L2dKO livers had higher immune cell infiltration and collagen deposition compared to L1/L2FLX livers. Furthermore, the expression of HCC-promoting target genes, including Bcl2, Cybb, Fgf21, Igfbp1, Mmp13, Plau, and Zeb2, was significantly upregulated in the livers of DEN-treated L1/L2dKO mice compared with those of DEN-treated L1/L2FLX mice. Finally, ZFP36L1 and ZFP36L2 were significantly downregulated in the human liver cancer cohort (n=374) compared to controls (n=50). Overall, the combined liver-specific deletions of ZFP36L1 and ZFP36L2 promoted hepatocarcinogenesis by augmenting inflammation, fibrosis, and stabilizing HCC-associated target genes. This study provides a mechanistic association between post-transcriptional gene regulation and environmental carcinogenesis.

**Juan Pesantez-Valdivieso**<sup>1</sup>, Elizabeth Goya-Jorge<sup>1</sup>, Caroline A. McKinney-Aguirre<sup>1</sup>, Carla Lopez-Cruz<sup>1</sup>, Lydia Poisson<sup>1</sup>, John M. Freund<sup>1</sup>, Debra L. Sudan<sup>2</sup>, and Liara M. Gonzalez<sup>1</sup>

**Graduate Programs and Institutions:** Comparative Biomedical Sciences<sup>1</sup>; Department of Surgery, Duke University<sup>2</sup>

**Advisor:** Liara Gonzalez

**Poster Number:** 132

### **Prolonged Normothermic Machine Perfusion Preserves Intestinal Barrier Function in a Porcine Model for Intestinal Transplantation**

Intestinal transplantation (ITx) remains the only curative treatment for intestinal failure; however, outcomes are limited by early allograft dysfunction. Current static cold storage induces ischemic injury, leading to epithelial barrier breakdown and restricting preservation time to approximately 9 hours. We have previously shown that normothermic machine perfusion (NMP) preserves intestinal epithelial integrity for 6 hours, additionally, has successfully extended preservation times in other organs. Given that long-term graft success depends on maintaining mucosal integrity, we hypothesized that NMP preserves intestinal barrier function and epithelial architecture for at least 12 hours, extending viable preservation time for ITx. Porcine small intestines were preserved using NMP for 12 hours. Graft integrity was assessed through mucosal biopsies evaluated histologically using the Chiu–Park grading scale (0–5), alongside a blinded, semi-quantitative assessment by a board-certified pathologist across multiple parameters (0–3). Tight junction protein localization and relative expression were analyzed by immunofluorescence. Functional barrier permeability was assessed using the lactulose–mannitol (L/M) test, with serial perfusate sampling to calculate the L/M ratio as a marker of paracellular permeability. NMP effectively preserved the intestine for 12 hours. Chiu–Park scores increased slightly to grade 1 by 6 hours, likely reflecting procurement-related reperfusion injury, but remained stable through 12 hours. Pathological analysis demonstrated preservation of mucosal architecture without significant villus or epithelial loss, although increased villus contraction was observed as a physiological adaptation. Immunofluorescence confirmed preserved apical localization and stable expression of tight junction proteins. Functionally, the L/M ratio decreased during the first 8–10 hours, indicating barrier stabilization, followed by increased variability at 12 hours, suggesting emerging epithelial stress. These findings demonstrate that NMP preserves the structural, molecular, and functional integrity of the intestinal barrier for 12 hours, representing a promising strategy to extend preservation time, expand the donor pool, and improve outcomes in ITx.

**Aditi Vigneshwar**<sup>1,2,6</sup>, Ankita Gupta<sup>1,2</sup>, Uma Nair<sup>2</sup>, Connor Thonen-Fleck<sup>2</sup>, David Knazovicky<sup>3</sup>, Daniel Duffy<sup>3</sup>, Simon Roe<sup>3</sup>, B Duncan X Lascelles<sup>1,3,4,5,6,7</sup>, and Santosh Mishra<sup>2,4,7</sup>^

**Graduate Programs and Institutions:** Comparative Biomedical Sciences<sup>1</sup>; Translational Research in Pain Program<sup>2</sup>; Pain and Itch Neuroscience Laboratory<sup>3</sup>; Department of Clinical Sciences<sup>4</sup>; Comparative Pain Research and Education Centre<sup>5</sup>; Thurston Arthritis Center, University of North Carolina at Chapel Hill<sup>6</sup>; Center for Translational Pain Medicine, Duke University<sup>7</sup>; Comparative Medicine Institute (^co-mentors)

**Advisors:** Santosh Mishra and B. Duncan X. Lascelles

**Poster Number:** 171

### **Subchondral Bone–Derived Artemin Causes Chronic Pain Hypersensitivity in Osteoarthritis Models**

Osteoarthritis (OA) is a leading cause of chronic pain and disability, yet the mechanisms driving persistent pain remain poorly understood. We recently identified artemin (ARTN), a glial-derived neurotrophic growth factor, to be increased in dog, cat, and human serum with naturally occurring OA-pain. In dogs, ARTN levels positively correlated with pain severity and increased expression of its receptor, GFR $\alpha$ 3, in sensory neurons. Importantly, sequestering ARTN reduced pain hypersensitivity and improved limb-use in rodent OA models. Building on these observations, we sought to identify its joint-level source in OA and investigated whether systemic ARTN is sufficient to drive pain hypersensitivity.

To localize the source of ARTN in OA, we quantified Artn expression across multiple disease models. artn was significantly upregulated in tibial subchondral bone (~5-fold) in both chemical (monoiodoacetate) and surgical (destabilization of the medial meniscus) murine OA models. Similarly, Artn was significantly upregulated (~17-fold) in femoral subchondral bone from dogs with hip OA.

To successfully recapitulate the ARTN serum levels observed in OA models, naïve mice received systemic ARTN (600ng, intraperitoneal). ARTN administration produced rapid thermal hypersensitivity to heat and cold within 4 hours that persisted for up to 42 days (41% and 38% reductions in heat and cold latency, respectively). Mechanical hypersensitivity developed by 24 hours and was sustained through day 42 (65% reduction in withdrawal threshold). To determine receptor dependence, ARTN or saline was locally administered into the hind paw of wild-type and GFR $\alpha$ 3 mutant mice. ARTN induced dose-dependent thermal (48–68% heat; 35–39% cold) and mechanical (39%) hypersensitivity in wild-type mice, but not in GFR $\alpha$ 3 mutant mice.

Our work suggests that systemic ARTN is sufficient to drive long-term pain hypersensitivity and implicates subchondral bone as a major source of ARTN in OA-pain. Future studies will assess joint-level protein expression of ARTN and the mechanisms underlying ARTN-induced chronic sensitization.

**Elyse Wood<sup>1</sup>**, Jason Frye<sup>1</sup>, Shreya Dey<sup>1</sup>, Hong Jin Kim<sup>2</sup>, and Laurianne Van Landeghem<sup>1</sup>

**Graduate Programs and Institutions:** Molecular Biomedical Sciences<sup>1</sup>; Department of Surgery, University of North Carolina at Chapel Hill<sup>2</sup>

**Advisor:** Laurianne Van Landeghem

**Poster Number:** 184

### **Uncovering Cellular and Molecular Mechanisms Driving Enteric Glial Cell Infiltration Within Colon Adenocarcinomas**

Enteric glial cells (EGC), a cell type of the enteric nervous system (ENS), promote colon cancer development and progression. Our lab has shown that human colon adenocarcinomas contain dense networks of EGC cell bodies and projections. While the tumor-promoting effect of EGC in colon cancer is known, the cellular origin of EGC in these tumors and the molecular signaling that drives tumor invasion by EGC remains unknown. My work aimed to address two fundamental questions: (1) are EGC within colon tumors originating from resident, normal EGC networks adjacent to the tumor, and (2) what is the molecular signaling that drives EGC growth and/or proliferation towards and into colon tumors. We isolated colon tumors from an AOM-susceptible mouse model and visualized the EGC network within tumors in 3D using immunostaining, tissue clearing, and light sheet microscopy. Using this method, we were able to discern whether or not the EGC network within colon tumors were emanating from healthy ENS structures. Additionally, we obtained patient-matched healthy and tumor tissue and collected samples containing the secreted factors of either tissue type and applied these to primary cultures of murine colonic EGC to mimic activation in the tumor microenvironment. We performed RNA-sequencing using these samples in order to determine which molecular signaling pathways drive EGC infiltration into colon tumors. These results lay the foundation for our ultimate goal, which is to modulate EGC invasive behaviors in an in vitro coculture microdevice and in vivo in our AOM-susceptible mouse model.

## **Poole College of Management**

**Rui Chang**

**Graduate Program:** Agriculture and Resource Economics

**Advisor:** Roderick Rejesus

**Poster Number:** 30

### **Cover Crop Adoption and Corn Yields: Evidence of State-Level Heterogeneity in the United States**

Climate change has intensified production risks in agriculture, particularly for corn, which is highly sensitive to weather variability and extreme events. Cover crop adoption has been widely promoted as a strategy to enhance soil resilience and mitigate climate-related yield losses; However, most prior studies focus on specific regions, especially the U.S. Midwest, or rely on localized case studies, providing limited insight into broader spatial patterns.

This study examines how the effects of cover crop adoption on corn yields vary across U.S. states and evaluates the extent to which long-run soil characteristics explain observed spatial heterogeneity. Using a county-level panel dataset covering 2015–2023, we combine cover crop adoption data from the Operational Tillage Information System with county-level corn yields from USDA Quick Stats, weather variables from PRISM, and soil properties from the POLARIS database. We estimate baseline and state-interacted linear panel fixed effects models as baseline models. To validate the spatial heterogeneity results, we further employ a conceptually distinct Double Machine Learning approach and conduct additional robustness checks, including alternative fixed effects structures, a Lewbel instrumental variable strategy, and balanced-panel specifications. Across all empirical approaches, significantly positive yield effects of cover crop adoption are concentrated in the Plains region and the adjacent western Midwest, while estimated effects in the southeastern United States are predominantly negative or statistically insignificant. Results for other regions are mixed. Mechanism analyses indicate that soil pH and calcium carbonate content play a central role in shaping these spatial patterns, with positive yield responses observed primarily in areas where these soil attributes exceed critical thresholds. These findings provide policy-relevant evidence on where cover crop programs are most likely to enhance corn productivity and where yield benefits may be limited.

# Wilson College of Textiles

**Avishek Das Gupta**<sup>1</sup>, Yihan Huang<sup>1</sup>, Md Zahangir Alom<sup>2</sup>, and Md Abdul Quddus<sup>1</sup>

**Graduate Programs and Institutions:** Textile Engineering, Chemistry and Science<sup>1</sup>; St. Jude Children's Research Hospital<sup>2</sup>

**Advisor:** Md Abdul Quddus

**Poster Number:** 40

## **An Improved Yolov5 Model for Knit Fabric Fault Detection**

Knitted fabric is among the most widely produced textile types globally. This research is an approach for detecting fabric faults using AI to reduce the eye fatigue of the manual fabric inspection system and provide a bias-free, consistent result. However, applying any object detection model requires a large dataset and high computational power. Available fault detection systems deployed in manufacturing machines require high computational power and cost. In this approach, we propose a system that can be deployed in the inspection stage, enabling implementation of object detection models at a lower cost while improving computational efficiency and accuracy. The general sequence of producing a knit fabric starts with the knitting machines. After the production of a fixed amount of fabric, it is sent to the inspection section, where it is inspected with all other fabric from different machines. This section is responsible for grading the fabric for the next step and providing the appropriate feedback to the previous step to reduce the fault occurrence. Our proposed system is trained with our collected dataset and can be applied to the conventional inspection machine to detect fabric faults without bias. In this research, we modified the anchor-based YOLOv5 model with the Dilation-Wise Residual module and changed the default loss function to Scylla-IoU. Our proposed modified model YOLO-DWRNet shows 2.23% higher mAP@0.5 and 5.18% higher mAP@0.5:95 than the anchor-based YOLOv5 model in the validation dataset. For the test dataset, 2.9% higher mAP@0.5 and 5.37% higher mAP@0.5:0.95 are achieved by YOLO-DWRNet, maintaining the same inference speed with minimal increase of GFLOPs.

**Jessica Guadalupe Estrada** and Marguerite Moore

**Graduate Program:** Textile Technology Management

**Advisor:** Marguerite Moore

**Poster Number:** 51

## **Heat Protective Behaviors, Unmet Needs, and Knowledge Among Hispanic Latino (HL) Agricultural Workers Exposed to Excessive Heat**

Hispanic-Latino (HL) agricultural workers comprise a significant and growing segment of the U.S. workforce, yet are particularly vulnerable to extreme heat exposure due to limited access to information and protective resources. Despite increasingly severe heat conditions during agricultural seasons, particularly in states like North Carolina, no federal heat protection standards exist for farmworkers. This exploratory qualitative study establishes a baseline understanding of workwear needs among HL agricultural workers regularly exposed to extreme heat. Through in-depth interviews with agricultural workers (n=14; 7 female, 7 male), the study examined current workwear choices, identified workers' beliefs and behaviors regarding heat protective workwear, assessed unmet needs, and determined resources that inform workwear decisions. By uncovering their unique workwear needs and barriers, this research provides critical insights to inform community outreach partners, product developers, and consumer educators, ultimately supporting efforts to prevent heat-related health outcomes and promote awareness of textile-based protection strategies within HL agricultural communities.

**Kaleah Gaddy**

**Graduate Program:** Fiber and Polymer Science

**Advisor:** Jessica M. Gluck

**Poster Number:** 56

### **Exploring Various Fabrication Techniques of Hemp as Sustainable Alternatives in Biomaterials**

Many people suffer from chronic skin damage, such as diabetic ulcers and detrimental burns. Skin grafts can be the only available treatment in some of those cases. Obtaining skin from other areas of the body is difficult and costly. Skin tissue engineering aims at reconstructing the structural and functional components of skin, reducing scar formation, and improving the quality of wound healing. A vast majority of products used in tissue-engineered applications use synthetic materials derived from fossil fuel/petroleum-based materials/processing. This study investigates the potential use of various natural biotextile scaffolds as sustainable alternatives to commonly used synthetic polymers for future use in skin tissue engineering. Hemp is a biodegradable material compatible with Human dermal fibroblasts (HDFs) and a potential sustainable alternative. The material used for analysis is 100% hemp fabrics woven and knitted in multiple fabrication designs. Characterization of the samples included assessments of pore size, fiber diameter, tensile strength, and water contact angle, in addition to biological testing involving HDFs. For biological analysis, HDFs were seeded on the samples and observed over a span of 28 days. Live/Dead assays were performed at specific time points to determine sufficient cell viability and toxicity. Immunocytochemistry staining was conducted to observe if the markers indicating healthy integrated HDFs were present. Of these markers are Vimentin, Fibronectin, and Collagen 1, which are important components of the extracellular matrix to provide tissue structure and integrity. An alamarBlue assay was conducted to calculate the quantitative measurement of cell viability and proliferation. Ongoing biocompatibility studies will provide preliminary data necessary to demonstrate the effectiveness of hemp for skin graft-based tissue engineering applications. The samples have shown biocompatibility once seeded with cells.

**Xiaorui Guo**

**Graduate Program:** Fiber and Polymer Science

**Advisor:** Januka Budhathoki Uprety

**Poster Number:** 67

### **Engineering the Molecular Ladder: Designing Stronger, Sustainable Carbon Fiber for Global Innovation**

Carbon fiber, an ultra-light material with exceptional mechanical strength and chemical resilience, is a cornerstone of modern innovation, driving advancements in fuel-efficient aerospace, high-speed automotive engineering, and renewable energy infrastructure. However, the production of these high-performance materials hinges on a delicate chemical transformation known as thermal stabilization. During this phase, the precursor material—polyacrylonitrile (PAN)—must be converted into a rigid, heat-resistant "molecular ladder." The challenge lies in the intensity of this reaction. In homopolymer PAN, the transition is intensely exothermic. This rapid release of heat can trigger polymer chain scission, molecular defects, and structural failure, undermining the integrity of the final fiber. This research engineers a solution by integrating itaconic acid (IA) as a catalytic comonomer. By strategically varying IA concentrations in precursor polymers, we can "tune" the thermal stabilization process to initiate at lower temperatures and distribute energy release more uniformly. Using Differential Scanning Calorimetry (DSC) to map these thermal profiles, our study demonstrates a controlled pathway to optimize precursor chemistry. These findings not only provide a blueprint for manufacturing stronger, more reliable carbon fibers but also support the global shift toward utilizing sustainable chemical feedstocks in advanced manufacturing.

**Fatema Tuj Jahura**

**Graduate Program:** Fiber and Polymer Science

**Advisors:** R. Bryan Ormond and Jessica M. Gluck

**Poster Number:** 80

### **Comparing Toxicity of Fluorinated and Fluorine-Free Firefighting Foams Using a Liver Cell Model**

This study investigated the cytotoxicity of different firefighting foam formulations using the human liver cell line HepG2. The foam formulations tested include a soy-based foam, two fluorinated aqueous film-forming foams (AFFF) (one C6-based AFFF and one C6-based alcohol resistant AFFF), and four fluorine-free foams (F3). The cells were exposed to different concentrations of foam samples (0.009%, 0.019%, 0.038%, 0.075%, and 0.15%) for up to 144 hours. After the exposure, cytotoxicity was assessed using LIVE/DEAD® and alamarBlue® assays. Later, the relative toxicity of these foam samples was determined by comparing the half-maximal inhibitory concentration (IC50) values. The oxidative stress induced by foam formulation was measured by 2',7'-Dichlorodihydrofluorescein diacetate (DCFH-DA) assay. The expression of six antioxidant-related genes (GPX1, SOD2, CAT, HMOX1, NQO1, and GCLC) was evaluated to assess oxidative stress responses. Both AFFF and F3 induced toxicity through cell membrane disruption and oxidative stress. The initial toxicity of some F3 was higher than that of AFFF. However, AFFF became more toxic over time. While all foam samples triggered oxidative stress, F3 showed better antioxidant defense than AFFF. Oxidative stress observed by AFFF indicates potential for chronic toxicity. A moderate correlation between observed foam toxicity and surface tension suggests that the chemical composition of the foam formulation may influence its toxic effects. Furthermore, nontargeted analysis (NTA) of foam formulations identified several compounds with known toxic effects in both in vitro and in vivo models.

**Mahtab Khodadadi**

**Graduate Program:** Fiber and Polymer Science

**Advisors:** Martin King and Jessica Gluck

**Poster Number:** 88

### **Injectable GelMA-dECM Hydrogels Reinforced with Dispersed PLA Nanofibers for In Situ Cardiac Patch Formation and Cardiomyocyte Maturation**

Cardiovascular diseases remain the leading cause of global mortality, with myocardial infarction resulting in irreversible cardiomyocyte loss and fibrotic remodeling that progresses toward heart failure. Because adult cardiomyocytes exhibit minimal proliferative capacity, restoration of functional myocardium requires engineered strategies that combine biologically relevant cells with biomimetic scaffolds. Cardiac tissue engineering seeks to address this challenge by providing three-dimensional microenvironments that recapitulate the mechanical, structural, and biochemical features of native myocardium. However, existing hydrogel-based systems often fail to simultaneously achieve physiological compliance, long-term mechanical stability, and tissue-specific bioactivity. This project develops an injectable, photocrosslinkable tri-component hydrogel composed of gelatin methacrylate (GelMA), cardiac decellularized extracellular matrix (dECM), and dispersed poly(lactic acid) (PLA) nanofiber fragments for in situ cardiac patch formation. GelMA provides a cell-adhesive and tunable hydrogel matrix, while cardiac dECM supplies native extracellular cues that regulate cardiomyocyte adhesion, organization, and signaling. Because GelMA-dECM hydrogels alone are mechanically weak and prone to rapid degradation, short, fragmented PLA nanofibers are incorporated to provide isotropic mechanical reinforcement without obstructing diffusion, injectability, or cell infiltration. This composite design aims to replicate the passive mechanical compliance of adult ventricular myocardium while maintaining high hydration and structural integrity. Aim 1 focuses on characterizing the physical and mechanical properties of the GelMA-dECM-PLA nanofiber composite. The effects of nanofiber content and dECM fraction on elastic modulus, compressive strength, swelling behavior, and degradation stability are systematically evaluated, with target mechanical properties aligned to physiological myocardial stiffness. Aim 2 investigates whether the optimized scaffold supports human induced pluripotent stem cell–derived cardiomyocyte survival, structural organization, gap-junction formation, and calcium handling in three-dimensional culture. Aim 3 integrates bioreactor-based electrical stimulation to examine how controlled pacing interacts with scaffold mechanics to guide functional maturation. Together, these aims establish a unified framework linking scaffold composition, mechanical environment, and biophysical stimulation to cardiomyocyte structure and function, advancing injectable cardiac constructs with translational relevance.

**Dengyu Luo**

**Graduate Program:** Textile Technology Management

**Advisor:** Minyoung Suh

**Poster Number:** 103

### **A 3D-Printed Geometry-Customized Soft Inductive Sensor Using Liquid Metal for Interactive Stage Garments**

Interactive stage garments require sensors that are soft, unobtrusive, and aesthetically integrated, yet capable of providing stable electrical outputs under rigorous choreography. Existing approaches often rely on rigid components that disrupt wearability and movement. This study addresses this challenge by investigating geometry-customized soft inductive sensors fabricated via additive manufacturing and filled with liquid metal.

Grounding the work in practice-based design research, sensing is positioned as a garment-integrated element where geometry and material behavior align with mobility and visual storytelling. The sensors were fabricated using 3D-printed flexible resin to form structural bodies with internal channels for injected liquid metal. To examine geometry as a design variable, coils with varying turn numbers were fabricated, with theoretical inductance estimated using Wheeler's approximation.

Electrical characterization focused on impedance magnitude  $|Z|$  and phase  $\Phi$  across frequencies relevant to inductive sensing. Multiple trials involving joint bending and extension—representative of moderate to deep stage movements—were conducted to evaluate signal clarity, repeatability, and stability. In parallel, garment integration decisions were refined based on placement feasibility, comfort, and secure positioning during movement.

Results demonstrate that the sensor produces systematic, motion-correlated impedance responses. Repeated trials confirmed consistent response patterns and stability under cyclic loading, with prototype iterations indicating that coil geometry and placement significantly influence signal expressiveness. This research validates a sensing approach bridging additive manufacturing and soft conductive materials, framing the sensor as a designed costume element rather than an external add-on. The study establishes the empirical foundation required for future motion-to-visual mapping and real-time performance expression, ensuring that comfort, mobility, and aesthetic coherence remain uncompromised in interactive performance wear.

**Mahsa Nazem**

**Graduate Program:** Fiber and Polymer Science

**Advisors:** Behnam Pourdeyhimi and Benoit Maze

**Poster Number:** 122

### **Fiber Degradation Evaluation and Sustainable Alternatives in Wet Wipes**

Wipes are broadly categorized into consumer and industrial types and are used extensively across various sectors in both wet and dry forms. Wet wipes are available in two forms: pre-wetted and wet-on-demand. Pre-wetted wipes consist of an absorbent delivery substrate saturated with a formulation. The substrate, often made of nonwoven fabric, serves as the medium for delivering the cleaning formulation. This formulation typically includes purified water as a solvent, along with preservatives, surfactants, pH adjusters, skin-benefiting agents, and other additives, depending on the intended application.

Pre-wetted wipes face challenges due to interactions between the formulation and the substrate. These interactions may result in fiber degradation, reducing fiber strength and shelf life. Additionally, the growing consumption of wet wipes has raised global environmental concerns, prompting bans and regulations on the use of synthetic (“plastic”) polymers in such applications (European Commission, n.d.; UK Government, 2024), and has led to the use of cellulose, and bio-based materials.

The objective of this research is to evaluate the impact of key formulation ingredients on the properties of the fibers used in absorbent substrates, to develop a method to predict product shelf life, and to develop a protocol that can be applied to test materials of interest. This includes evaluating both current materials and more sustainable alternatives, such as rayon and biopolymers.

A thorough understanding will support the substitution of materials and chemicals with environmentally friendly options that maintain product performance during storage and promote biodegradability after disposal.

While numerous studies have investigated polymer hydrolysis, this research will specifically focus on the cleaning formulations used in wet wipes by monitoring morphological and mechanical changes to establish a baseline for evaluating the degradation behavior of polymers.

**Mohammed Kayes Patoary**

**Graduate Program:** Fiber and Polymer Science

**Advisor:** Thomas Schroeder

**Poster Number:** 131

### **A Control Mineral Deposition Through Complementary Polyelectrolyte Complexation**

Polymer-induced liquid precursors (PILPs) represent a transient, metastable, amorphous mineral phase—spanning nano- to macroscopic scales—stabilized by charged polymers. These precursors play a fundamental role in the morphogenesis of non-equilibrium mineral structures found in nature. Due to their unique ability to facilitate nonclassical mineral growth through amorphous-to-crystalline phase transformations, PILPs are extensively investigated within the field of biomineralization and hold significant potential for the biomimetic fabrication of advanced materials. Despite this potential, the underlying mechanisms governing mineral deposition from the PILP phase remain a subject of intense debate. Our study addresses this gap by testing the hypothesis that PILPs function as coacervates. Specifically, we propose that PILP stabilization is driven by associative charge interactions between a polyelectrolyte and the multivalent ions of an insoluble salt. Through a systematic investigation of polymer and spectator salt concentrations, we mapped the phase boundaries and stability of these mineral precursors. By exploiting the characteristic stimuli-responsive behavior of coacervates, we successfully demonstrated the ability to stabilize and destabilize the PILP phase in an on-demand and site-selective manner. Ultimately, this study provides a robust mechanistic framework for understanding the PILP transition, enabling the development of novel engineering fabrication and processing schemes based on the controlled assembly of mineral precursors.

**Md Abul Shahid<sup>1</sup>**, Kripa Patel<sup>1,2</sup>, and Yang Zhanga<sup>3</sup>

**Graduate Program and Institutions:** Molecular Analytics and Photonics (MAP) Lab<sup>1</sup>; Chemistry and Science Genetics Program<sup>2</sup>; College of Science, Joint Department of Biomedical Engineering, University of North Carolina at Chapel Hill<sup>3</sup>

**Advisor:** Yang Zhang

**Poster Number:** 151

### **Integrating Spectroscopic Single-Molecule Localization Microscopy with DNA-PAINT for Simultaneous Multiplexing Super-Resolution Microscopy**

Spectroscopic single-molecule localization microscopy (sSMLM) provides simultaneous spatial and spectral information from individual emitters, but its broader application is constrained by two key factors: the limited photon budget of single fluorophores and the presence of single-molecule fluorescence spectral heterogeneity (smFLUSH). DNA-PAINT offers a unique solution by continuously replenishing fluorophores through transient binding, ensuring a sustainable photon supply for both localization and spectral readout. To enable reliable multiplexing, however, smFLUSH of the dyes must be statistically quantified. Here, we present a two-color spectroscopic DNA-PAINT framework that incorporates smFLUSH characterization of red-channel dyes to guide dye selection and spectral separation. We show that smFLUSH restricts the number of distinguishable probes within a given spectral channel, and we quantify these variations across different environments, including nanorulers and cellular targets. Finally, we demonstrate two-color spectroscopic DNA-PAINT imaging in cells, achieving improved spectral precision and multiplexing performance compared to conventional sequential acquisition. Our results highlight DNA-PAINT as a robust approach to overcome photon budget limitations in sSMLM, while smFLUSH characterization provides a pathway toward photon-efficient, multiplexed super-resolution imaging of complex biological systems.

**Yiming Yuan** and Thomas B.H. Schroeder

**Graduate Program:** Textile Engineering, Chemistry and Science

**Advisor:** Thomas B.H. Schroeder

**Poster Number:** 189

### **Phase-Change Solvents for Thermally Switchable Ion Conduction in Organogels**

Ionic conductors in which ions carry charge through a solution are foundationally important to batteries, supercapacitors, and ionotronic devices. Shifts in ion mobility imposed by physical changes in the solution can dynamically impact the conductivity of the medium. This paper reports a class of temperature-responsive phase-change organogels in which a polymer network is formed within salt solutions in organic solvents with melting points between room temperature and 100 °C. The conductivity in the molten state (up to  $10^{-4}$  to  $10^{-3}$  S/cm) exceeded that in the frozen state by over 10 000-fold and remained stable after holding at 90 °C for 3 h or over 100 freezing/melting cycles. A diverse range of salts can be used, and the conductivity/temperature relationship can be tuned by selecting or mixing solvents with different melting points. Depending on the solvent composition, these phase-change organogels can either produce approximately digital (binary) thermal responses to function as switches or respond continuously as analog temperature sensors or other transducers. An advantage of this strategy over prior literature is that the identity of the charge carrier and the phase behavior of the solvent can be tuned independently, presenting a wide design space for electrolyte materials whose conductivity responds to temperature.

**Lumana Shakya**

**Graduate Program:** Economics

**Advisor:** Raymond Guiteras

**Poster Number:** 153

### **Temperature Extremes, Electricity Access, and All-Cause Mortality**

Warming trends and changing temperature variability pose a pressing threat to human well-being, contributing significantly to premature mortality worldwide. Addressing this challenge is essential, and evidence from studies on high-income countries suggests that adaptation through the use of technologies can dramatically reduce temperature-related deaths. This paper contributes to the emerging literature on climate adaptation and health in a resource-constrained setting. First, I examine all-cause mortality patterns in Bangladesh by using data from the Bangladesh Maternal Mortality and Health Care Survey (BMMS) and the Bangladesh Demographic and Health Survey (BDHS). For temperature and precipitation data, I rely on the ERA5 re-analysis dataset from the European Centre for Medium-Range Weather Forecasts. The findings suggest an increased probability of death during exposure to extreme heat. The findings indicate that, in response to extreme heat, urban populations in Bangladesh are significantly more vulnerable than their rural counterparts. Second, I examine the moderating role of electricity and cooling appliances using both household-level data and aggregate regional datasets. While access to electricity and cooling appliances offers some protection, this benefit is largely confined to urban areas and appears to fail during severe heat. The study also finds that children under five are disproportionately affected. This research demonstrates that building resilience to extreme heat requires a multi-faceted approach that goes beyond simple electrification to include robust urban planning and improved grid reliability.

Name	Poster Number	Abstract Page Number
<b>A</b>		
Acuña, Paul .....	1 .....	43
Agada, Paul .....	2 .....	66
Ahmad Ebrahim, Muhammed Ziauddin .....	3 .....	44
Akbari, Ali.....	4 .....	45
Akinsanya-Ibrahim, Taibat Amoke .....	5 .....	66
Alsaeed, Omar.....	6 .....	46
Amaral, Thaciane .....	7 .....	20
Anderson, Phoebe.....	8 .....	82
Arifuzzaman, Md.....	9 .....	92
Arline, Jarin R. ....	10 .....	6
Arshad, Azka .....	11 .....	92
Ashraf, Talha.....	12 .....	7
Ashrafganjoie, Mehdi.....	13 .....	93
Atwood, Emma .....	14 .....	104
<b>B</b>		
Balachandran, Hari Kiran .....	15 .....	46
Bandari, Raja Manikam .....	16 .....	33
Bhatt, Harshit.....	17 .....	93
Brady, Amelia.....	18 .....	8
Brenner, Talia.....	19 .....	67
Britt, John .....	20 .....	94
Brown, Rebekah .....	21 .....	8
Burbank, Karina.....	22 .....	67
Burugula, Vasishta.....	23 .....	47
<b>C</b>		
Campos, Eugenia .....	24 .....	No Abstract
Can, Reyyan.....	25 .....	68
Carter, Michael .....	26 .....	47
Cavanaugh, Lily.....	27 .....	68
Cave, Ashley E. ....	28 .....	105
Chakraborty, Mahashweta .....	29 .....	69
Chang, Rui.....	30 .....	109
Cheadle, John .....	31 .....	48
Chen, Peng.....	32 .....	48
Chhetri, Nisan.....	33 .....	49
Chougule, Kimaya .....	34 .....	34
Clymer, Alexa.....	35 .....	69
Cohen, Adira.....	36 .....	95
Coogan, Emma.....	37 .....	9
Cooper, Jackson.....	38 .....	10
Credle, Kara .....	39 .....	10

# INDEX

Name	Poster Number	Abstract Page Number
<b>D</b>		
Das Gupta, Avishek .....	40 .....	110
Davidson, April.....	41 .....	70
Davis, Natalie .....	42 .....	95
Dehghan-Toranposhtia, Sina .....	43 .....	50
Deneke, Joseph.....	44 .....	50
Dixit, Sweta.....	45 .....	83
Du, Liwen.....	46 .....	61
Dykes, Rachel .....	47 .....	11
<b>E</b>		
Elander, Jenny.....	41 .....	70
Eldaly, Omar .....	48 .....	51
Ellis, Jaida .....	41 .....	70
Eltz, Katherine .....	49 .....	51
Engstrom, Daniel.....	50 .....	52
Estrada, Jessica Guadalupe.....	51 .....	110
<b>F</b>		
Febo, Corey E. ....	52 .....	52
Ferraro, Greg.....	53 .....	11
Fluharty, Jade .....	54 .....	12
Fryer, Syd .....	55 .....	70
<b>G</b>		
Gaddy, Kaleah .....	56 .....	111
Garcia, Naomi.....	57 .....	71
Garg, Vasuki .....	58 .....	53
George, Ashlee.....	59 .....	12
Ghosh, Shuvrarghya.....	60 .....	96
Gleason, Matthew.....	61 .....	53
Goble, Kai J. ....	62 .....	13
Godwin, Kendall .....	63 .....	14
Gonzalez, Maria .....	64 .....	84
Groton, Teresa.....	65 .....	54
Grover, Kashish.....	66 .....	15
Guo, Xiaorui.....	67 .....	111
<b>H</b>		
Hahn, Kayla.....	68 .....	54

# INDEX

Name	Poster Number	Abstract Page Number
Hall, Carter .....	69 .....	96
Hargrove, Linda .....	70 .....	55
Harrell, Leah .....	71 .....	71
Haskell, Ajah .....	72 .....	15
Hawary, Mahmoud .....	73 .....	55
Hawthorne, Ann Morgan .....	74 .....	85
Hennessey, Heather .....	75 .....	34
Hensley, John .....	76 .....	41
Hu, Jing .....	77 .....	85
 <b>I</b>		
Irvin, Molly .....	78 .....	86
Ishrak, Farhan .....	79 .....	56
 <b>J</b>		
Jahura, Fatema Tuj .....	80 .....	112
Jauregui, Sofia .....	81 .....	16
Johnson, Courtney L. ....	82 .....	86
Jones, Alena P. ....	83 .....	16
Joshi, Nisarg .....	84 .....	56
 <b>K</b>		
Kanipe, Taylor .....	85 .....	87
Kempin, Robert .....	86 .....	57
Khan, Jessica F. ....	87 .....	72
Khodadadi, Mahtab .....	88 .....	113
Kisthardt, Samantha C. ....	89 .....	17
Ko, Donghyun .....	90 .....	57
Kobs, Austyn D. ....	91 .....	72
Kraemer, Jenna .....	92 .....	18
Kumar, Lokesh .....	93 .....	87
Kumar, Rahul .....	94 .....	106
Kuzniar, Teagan .....	96 .....	18
 <b>L</b>		
Lee, Seungmin .....	97 .....	35
Leff, Jacob .....	98 .....	58
Londoño, Jane .....	99 .....	19
Lopez, Gabrielle .....	100 .....	73
Lower, Lillian .....	101 .....	20
Lundquist, Ryan .....	102 .....	21

# INDEX

Name	Poster Number	Abstract Page Number
Luo, Dengyu .....	103 .....	114
Luu, Thao "Tina" .....	104 .....	97
Lyons, Jade .....	105 .....	21
 <b>M</b>		
Madariaga, Javier I. ....	106 .....	97
Matheney, Jordan .....	107 .....	No Abstract
Matheny, Julie.....	108 .....	98
Mathur, Dhruva .....	109 .....	42
McDonald, Rosa .....	110 .....	35
McInnes, Holly A.....	111 .....	22
McMurry, Sierra .....	112 .....	88
McNabb, Grace .....	113 .....	36
Mcneill, Colin .....	114 .....	36
Mecham, Nicholas .....	115 .....	59
Mismash, Christopher E. ....	116 .....	37
Mituniewicz, Austin L. ....	117 .....	59
Moazzam, Farimah.....	118 .....	No Abstract
Mullins, Tristan.....	119 .....	60
Murthy, Linnea .....	120 .....	73
 <b>N</b>		
Nascimento, Aline C. K.....	95 .....	58
Nazem, Mahsa .....	122 .....	115
Niwunhella, Hiruni.....	123 .....	60
Njaka, Ijeoma.....	124 .....	37
Nooshzadi Motlagh, Mohammad.....	121 .....	22
Nuyten, Matthew.....	125 .....	98
 <b>O</b>		
Oates, Christopher C.....	126 .....	23
Oh, Jisu .....	127 .....	99
Ojo, Cornelius.....	128 .....	38
Olvera Diaz, Raquel .....	129 .....	74
 <b>P</b>		
Pandey, Rekha .....	130 .....	24
Patoary, Mohammed Kayes .....	131 .....	115
Pesantez-Valdivieso, Juan .....	132 .....	107
Piasecki, Daniel.....	133 .....	99
Pietri, Nell .....	134 .....	75

# INDEX

Name	Poster Number	Abstract Page Number
Pretto, Tsedey.....	135	No Abstract
Priest, Luke I.....	136	75
Próspero, Laura.....	137	38
 <b>Q</b>		
Qiao, Jinzhe.....	138	76
 <b>R</b>		
Raja, Aisha .....	139	39
Regmi, Pratikshya .....	140	88
Richardson, Regan.....	141	61
Robinson, Emily.....	142	76
Roy, Ananya .....	143	100
Ryan, Andrea.....	144	77
 <b>S</b>		
Saad, Fardin.....	46	61
Salas, Mariangeles.....	145	89
Salehin, Sultanus.....	146	62
Sanders, John H.....	147	89
Sapkota, Prajima .....	148	100
Sears, Alden .....	149	24
Sgouridis, Skye.....	150	25
Shahid, Md Abul .....	151	116
Shahrooei, Abolfazl.....	152	62
Shakya, Lumana.....	153	117
Shwetar, Yousif.....	154	63
Sidhwa, Kaira .....	155	26
Silvernail, Irene.....	156	101
Stogner, Tess.....	157	39
Sullivan, Madison Lawson .....	158	27
Sultana, Aldina.....	159	63
Sweilam, Abdul-Rahman .....	160	101
 <b>T</b>		
Tajudeen, Titilayo.....	161	90
Tanaka, Kairi.....	162	28
Thapa, Puja .....	163	102
Thigpen, Elle.....	164	77
Totsline, Noah.....	165	29

# INDEX

Name	Poster Number	Abstract Page Number
<b>U</b>		
Upadhyay, Aakash.....	166.....	90
Utz, Asher.....	167.....	29
<b>V</b>		
Valladares, Cristhian.....	168.....	102
Velayati, Alireza.....	169.....	64
Vepachedu, Swathi.....	170.....	78
Vigneshwar, Aditi.....	171.....	108
Vollen, Katie.....	172.....	30
<b>W</b>		
Wajeeh UI Hassan, Muhammad.....	173.....	30
Walker, Kyle.....	174.....	79
Waltz, Rachel.....	175.....	42
Wang, Qionglan.....	176.....	40
Weeks, Cormak.....	177.....	64
Wessels, Madeline.....	178.....	80
Wickizer, Ory.....	179.....	65
Wiggins, Cullen.....	180.....	81
Williams, M.C.....	181.....	31
Wilson, Ann Sloan.....	183.....	81
Wilson, Emma M.....	182.....	91
Wood, Elyse.....	184.....	109
<b>X</b>		
Xu, Xinyu.....	185.....	No Abstract
<b>Y</b>		
Yang, Xiaoran.....	186.....	65
Yoo, Seung Hyun.....	187.....	32
Yu, Zihao.....	188.....	103
Yuan, Yiming.....	189.....	116
<b>Z</b>		
Zander, Caleb.....	190.....	40
Zhang, Chengchen.....	191.....	41
Zhao, Anqi.....	192.....	103









